Int J Public Health (2012) 57:837–847
DOI 10.1007/s00038-012-0340-6

ORIGINAL ARTICLE

Prevalence of self-reported cardiovascular risk factors in Portuguese women: a survey after delivery

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Received: 6 July 2011 / Revised: 12 December 2011 / Accepted: 19 January 2012 / Published online: 8 February 2012
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Abstract
Objectives To estimate the pre-pregnancy prevalence of overweight/obesity, smoking, hypertension, dyslipidemia and diabetes mellitus, in women who delivered a live born.
Methods In a birth cohort study, puerperae were consecutively recruited at five public maternities of Porto, Portugal (2005–2006). We included 7,381 women with complete data for the current analysis. Socioeconomic characteristics, smoking habits, pre-pregnancy weight and chronic diseases diagnosis were self-reported and height was measured.
Results Before pregnancy, 21.3% of women were overweight and 8.8% were obese, 26.6% smoked and 11.2% were former smokers. The prevalence of hypertension, dyslipidemia and diabetes mellitus was 1.7, 1.7 and 0.6%, respectively, with an evident tendency to cluster. The prevalence of all cardiovascular risk factors, except smoking, increased with age and body mass index. Education and income were inversely associated with excessive weight. Current smokers were younger, thinner and in a lower socioeconomic position, whereas former smokers were older and in a higher socioeconomic position.
Conclusion Despite the low prevalence of hypertension, dyslipidemia and diabetes, their tendency to cluster and the increased prevalence among overweight/obese women highlight the high level of risk of this young female population.

Keywords Cardiovascular risk factors · Cohort studies · Pregnancy · Prevalence

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Introduction

Pregnancy is often regarded as a good opportunity for health promotion and disease prevention (McBride et al. 2003). In healthy pregnancies, adaptive changes take place in women's physiology to meet demands of the rapidly developing foetus, including insulin resistance and hyperlipidemia (Catalano 2010). In addition, the hyperdynamic circulatory character of pregnancy may be regarded as a stress test for maternal cardiovascular function.

In Portugal, diseases of the circulatory system accounted for 32.2% of all deaths in 2006 (INE 2009). The clustering of cardiovascular risk factors, such as hypertension, dyslipidemia, diabetes mellitus, obesity and smoking is well documented (Daviglus et al. 2004; Lloyd-Jones et al. 2006; Wilson et al. 1999) and the modification of these risk factors can result in substantial reduction in mortality (Ford et al. 2007).

Despite the similar prevalence of cardiovascular risk factors in women and men, the lack of awareness of risk may be a barrier to prevention of CVD in women. In a survey conducted in the USA, only 16% of women recognized heart disease as the greatest health problem facing women today, and only half identified it as the leading cause of death (Mosca et al. 2010). Recently, a stronger emphasis on women's health status and risk behavior patterns before pregnancy is advocated

(Moos 2004) to increase the awareness and the potential for prevention at younger ages.

In the last 30 years, Portugal experienced a significant development regarding economic modernization and social structure (Costa et al. 2000), which resulted in lifestyle changes that may have an impact on cardiovascular risk. Therefore, it is important to descriptively quantify the distribution of cardiovascular risk factors to monitor trends over time and guide preventive strategies to reduce the future burden of disease.

In this study, our objective was to estimate the pre-pregnancy prevalence of five major cardiovascular risk factors (overweight/obesity, smoking, hypertension, dyslipidemia and diabetes mellitus), in mothers of a Portuguese birth cohort, and to describe their distribution by age, gravidity and indicators of socioeconomic position (SEP).

Methods

This study is based on the birth cohort Geração XXI. A total of 8,495 mothers, who gave birth to 8,647 live born infants, were enrolled into the cohort. The present study is based on the 8,182 mothers consecutively invited after delivery. We excluded 313 who were recruited and evaluated during pregnancy, since pre-pregnancy characteristics were self-reported in the first trimester and their report is expected to change over time during pregnancy. The recruitment took place between April 2005 and September 2006 at all five public maternity units covering six municipalities of the metropolitan area of Porto, Portugal. All the maternities, except one, are included in a general hospital, with a variety of medical and surgical specialties, and all correspond to level III maternity units, with differentiated perinatal support. At birth, 91.4% of the invited mothers accepted to participate.

Data on demographic and socioeconomic characteristics, lifestyles, obstetric history, anthropometrics and personal history of disease were collected within 72 h after delivery, during the hospital stay, in a face-to-face interview conducted by trained interviewers using structured questionnaires. Educational level of the mother, household income, working condition, social class and marital status were used as indicators of SEP. Social class, at the individual level, was defined according to the ACM (Almeida, Costa and Machado) social class typology (Almeida et al. 2006; Costa et al. 2000), based on two main socio-professional indicators: occupation and employment status (employer, self-employed/family workers or employee). Self-reported occupations were classified by major professional groups, according to the National Classification of Occupations (version 1994) (IEFP 2001). Working condition was defined as employed, unemployed, housewife and others (student or retired). Gravidity was recorded as the number of pregnancies for each participant, including the current one. Personal history of hypertension, dyslipidemia and diabetes mellitus was considered present when participants recalled a medical diagnosis of these conditions previously to the current pregnancy. Pre-pregnancy weight was obtained through recall information to the nearest 0.1 kg. At baseline, height was measured (without shoes) by the interviewers to the nearest 0.1 cm. When measurement was not possible, height was reported by the mother as registered in the identity card (30.8% of women with data on height). The participants' body mass index (BMI) was categorized according to the standard World Health Organization definition as underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2) and obese (≥ 30 kg/m^2) (Expert Panel 1998). Smoking habits included information on the daily number of smoked cigarettes before and during pregnancy, and age at smoking initiation. Current smokers included both daily (at least one cigarette per day in the 3 months previous to pregnancy) and occasional smokers (less than a cigarette per day). Women were considered former smokers when they had previously smoked but not in the last 3 months before pregnancy.

Missing data on the questionnaires were recovered through the review of delivery medical records. The agreement between data collected by questionnaire and abstracted from medical records was good for personal history of hypertension, weight and height and very good for personal history of diabetes mellitus, and there was very low inter-rater variability between two independent abstractors (Alves et al. 2010).

After exclusion of the participants who presented at least one missing value on personal history of hypertension, dyslipidemia, diabetes mellitus, BMI and smoking status, 7,381 women were included in our analysis. There were no significant differences between participants with complete and missing data regarding age [mean (standard deviation (SD)): 29.0 (5.6) vs. 28.9 (5.7) years, $p = 0.793$], gravidity (first pregnancy: 48.3 vs. 45.8%, $p = 0.413$), marital status (married/living with a partner: 94.0 vs. 92.9%, $p = 0.245$) and education (education >9 years: 48.9 vs. 50.1%, $p = 0.671$).

Statistical analysis was performed using Stata 9.0 (College Station, TX, 2005). Sample characteristics are presented as counts and proportions for categorical variables, mean and standard deviation (SD) for normally distributed continuous variables, and median and interquartile range (IQR) for non-normally distributed continuous variables. The prevalence of the outcomes is presented with 95% confidence intervals (95% CI). Unconditional binary logistic regression models were fitted to compute age-adjusted odds ratios (OR) and 95% confidence intervals for hypertension, dyslipidemia and diabetes

mellitus, and multinomial logistic regression models for BMI and smoking status, taking BMI < 25 kg/m^2 and never smokers as reference classes, respectively.

The study protocol was approved by the Ethics Committee of Hospital de S. João. Written informed consent was obtained from all participants.

Results

The socio-demographic characteristics of the study participants are summarized in Table 1. The mothers' mean age at birth was 29.0 years (range 14–47 years) and the index pregnancy was the first for 48.3%. Most women were married or living with a partner (94.0%) and the median (IQR) educational level was 10 (7–12) years. Approximately 72% were employed and 6.4% of the participants had a household monthly income bellow 500€, while 28.5% had a monthly income above 1,500€ (Table 1).

Table 1 Socio-demographic characteristics of the participants (Porto, Portugal, 2005–2006)

	n (%)[a]
Age (years)	
<25	1,586 (21.5)
25–29	2,236 (30.3)
30-34	2,345 (31.8)
≥35	1,209 (16.4)
Mean (SD)	29.0 (5.6)
Gravidity	
1	3,563 (48.3)
2	2,493 (33.8)
≥3	1,324 (17.9)
Marital status	
Married/cohabiting	6,911 (94.0)
Single/divorced/widow	445 (6.0)
Education	
≤4	541 (7.4)
5–9	3,055 (41.5)
10–12	1,972 (26.8)
>12	1,790 (24.3)
Median (IQR)	10 (7–12)
Working condition	
Employed	5,274 (71.7)
Unemployed	1,457 (19.8)
Housewife	412 (5.6)
Other	217 (3.0)
Income (€/month)	
<500	460 (6.4)
500–1,000	2,107 (29.5)
1,001–1,500	1,821 (25.5)
>1,500	2,034 (28.5)
Does not know/prefers not to answer	716 (10.0)

In each variable, the total may not add to 7,381 due to missing data

SD standard deviation, *IQR* interquartile range

[a] Except if otherwise specified

In this sample of Portuguese women who delivered a live born, 21.3% (95% CI 20.3–22.2) were overweight and 8.8% (95% CI 8.2–9.5) were obese before pregnancy, 26.6% (95% CI 25.6–27.6) reported to have smoked in the 3 months prior to pregnancy and 11.2% (95% CI 10.5–12.0) to be former smokers (Table 2). The prevalence of self-reported pre-pregnancy hypertension, dyslipidemia and diabetes mellitus was 1.7% (95% CI 1.4–2.0), 1.7% (95% CI 1.4–2.0) and 0.6% (95% CI 0.4–0.8), respectively (Table 3). Overall, 3.7% (95% CI 3.3–4.2) of participants had at least one of these cardiometabolic risk factors and in 0.2% (95% CI 0.1–0.4) two or three were simultaneously present, a fourfold higher prevalence than that expected under independence.

Overall, body mass index was associated with age, gravidity and SEP, with stronger effects on obesity than overweight. Age was progressively and significantly associated with overweight and obesity (≥35 vs. <25 years: OR 1.85; 95% CI 1.54–2.23 and OR 2.49; 95% CI 1.90–3.28, respectively) and a similar association was observed with gravidity independently of age (age-adjusted OR 1.43; 95% CI 1.21–1.68 and OR 2.44; 95% CI 1.96–3.05 for overweight and obesity, respectively, in women with more than 1 previous pregnancy in comparison with primigestae). Married women or those living with a partner were more likely to be overweight, as well as housewives and unemployed, when compared with employed women, independently of age. A significant inverse association was observed for education and household monthly income, while self-employed women and those in lower individual social class were more likely to be overweight or obese (Table 2).

Participants aged above 25 years were approximately half as likely to have smoked before pregnancy as younger ones. Participants with more than 1 previous pregnancy (age-adjusted OR 1.46; 95% CI 1.25–1.70), not living with a partner (age-adjusted OR 2.22; 95% CI 1.80–2.73), unemployed (age-adjusted OR 1.77; 95% CI 1.55–2.03) and no paid jobs (age-adjusted OR 1.56; 95% CI 1.15–2.13) were more frequently smokers in the 3 months prior to pregnancy. Household monthly income (age-adjusted OR 0.49; 95% CI 0.39–0.62, for income ≥1,500€ when compared with income <500€) and BMI (age-adjusted OR 0.41; 95% CI 0.30–0.56, for BMI ≥30 kg/m^2, when compared with BMI < 18.5 kg/m^2) were inversely associated with smoking. The prevalence of former smokers increased with age (≥35 years vs. <25 years: OR 1.34; 95% CI 1.05–1.72) and educational level (≥13 years

Table 2 Prevalence of overweight, obesity and smoking status before pregnancy, and age-adjusted odds ratios estimated by multinomial logistic regression for the association with gravidity, socio-economic characteristics and BMI before pregnancy, in mothers of a Portuguese birth cohort (Porto, 2005–2006)

	BMI (Kg/m^2)[a]				Smoking status[b]			
	Overweight		Obesity		Current		Former	
	n (%)	Age-adjusted OR (95% CI)[c]	*n* (%)	Age-adjusted OR (95% CI)[c]	*n* (%)	Age-adjusted OR (95% CI)[c]	*n* (%)	Age-adjusted OR (95% CI)[c]
Age (years)								
<25	273 (17.2)	1[d]	95 (6.0)	1[d]	621 (39.2)	1[d]	134 (8.5)	1[d]
25–29	457 (20.4)	1.29 (1.09–1.52)	197 (8.8)	1.60 (1.24–2.06)	511 (22.9)	0.47 (0.40–0.54)	261 (11.7)	1.11 (0.88–1.38)
30–34	527 (22.5)	1.47 (1.24–1.73)	214 (9.1)	1.71 (1.33–2.20)	549 (23.4)	0.48 (0.42–0.55)	269 (11.5)	1.09 (0.87–1.37)
≥35	312 (25.8)	1.85 (1.54–2.23)	146 (12.1)	2.49 (1.90–3.28)	282 (23.3)	0.50 (0.42–0.59)	165 (13.7)	1.34 (1.05–1.72)
Gravidity								
1	666 (18.7)	1[d]	233 (6.5)	1[d]	957 (26.9)	1[d]	388 (10.9)	1[d]
2	579 (23.2)	1.27 (1.12–1.45)	225 (9.0)	1.42 (1.17–1.73)	612 (24.6)	1.02 (0.90–1.16)	287 (11.5)	0.99 (0.83–1.18)
≥3	325 (24.6)	1.43 (1.21–1.68)	194 (14.7)	2.44 (1.96–3.05)	393 (29.7)	1.46 (1.25–1.70)	155 (11.7)	1.06 (0.85–1.32)
Marital status								
Married/living with a partner	1,498 (21.7)	1[d]	632 (9.1)	1[d]	1,737 (25.1)	1[d]	799 (11.6)	1[d]
Single/divorced/widow	67 (15.1)	0.69 (0.52–0.90)	18 (4.0)	0.47 (0.29–0.76)	220 (49.4)	2.22 (1.80–2.73)	30 (6.7)	0.89 (0.60–1.32)
Education (years)								
≤4	174 (32.2)	1[d]	100 (18.5)	1[d]	131 (24.2)	1[d]	36 (6.7)	1[d]
5–9	710 (23.2)	0.66 (0.53–0.81)	330 (10.8)	0.56 (0.43–0.73)	954 (31.2)	1.32 (1.06–1.65)	294 (9.6)	1.82 (1.26–2.63)
10–12	419 (21.3)	0.51 (0.41–0.64)	139 (7.1)	0.30 (0.23–0.41)	547 (27.7)	1.27 (1.01–1.60)	240 (12.2)	2.25 (1.55–3.27)
>12	263 (14.7)	0.27 (0.22–0.35)	82 (4.6)	0.15 (0.11–0.20)	322 (18.0)	0.81 (0.64–1.03)	256 (14.3)	2.30 (1.59–3.34)
Social class (individual)								
Entrepreneurs and executives	110 (19.8)	1[d]	41 (7.4)	1[d]	139 (25.0)	1[d]	81 (14.5)	1[d]
Professionals and managers	210 (15.4)	0.69 (0.54–0.90)	57 (4.2)	0.50 (0.33–0.76)	238 (17.5)	0.63 (0.49–0.80)	187 (13.7)	0.83 (0.62–1.11)
Self-employed	40 (26.9)	1.68 (1.10–2.58)	16 (10.7)	1.86 (1.00–3.48)	38 (25.5)	0.90 (0.59–1.38)	17 (11.4)	0.77 (0.43–1.36)
Routine employees	751 (22.7)	1.36 (1.08–1.71)	292 (8.8)	1.49 (1.05–2.11)	1,016 (30.7)	1.14 (0.92–1.41)	356 (10.8)	0.79 (0.61–1.04)
Industrial workers	219 (26.4)	1.80 (1.38–2.34)	118 (14.2)	2.74 (1.87–4.01)	170 (20.5)	0.62 (0.48–0.81)	65 (7.8)	0.47 (0.33–0.68)
Working condition								
Employed	1,116 (21.2)	1[d]	425 (8.1)	1[d]	1220 (23.1)	1[d]	608 (11.5)	1[d]
Unemployed	327 (22.4)	1.24 (1.07–1.44)	153 (10.5)	1.62 (1.32–1.98)	544 (37.3)	1.77 (1.55–2.03)	158 (10.8)	1.25 (1.02–1.52)
Housewife	97 (23.5)	1.35 (1.05–1.72)	63 (15.3)	2.36 (1.76–3.19)	111 (26.9)	1.05 (0.83–1.33)	30 (7.3)	0.64 (0.43–0.94)
Others	26 (12.0)	0.62 (0.40–0.95)	11 (5.1)	0.82 (0.43–1.54)	82 (37.8)	1.56 (1.15–2.13)	31 (14.3)	1.95 (1.27–2.99)

Table 2 continued

	BMI (Kg/m^2)[a]				Smoking status[b]			
	Overweight		Obesity		Current		Former	
	n (%)	Age-adjusted OR (95% CI)[c]	*n* (%)	Age-adjusted OR (95% CI)[c]	*n* (%)	Age-adjusted OR (95% CI)[c]	*n* (%)	Age-adjusted OR (95% CI)[c]
Household monthly income (€)								
<500	111 (24.1)	1[d]	53 (11.5)	1[d]	189 (41.1)	1[d]	40 (8.7)	1[d]
500–1,000	491 (23.3)	0.88 (0.69–1.12)	241 (11.4)	0.87 (0.63–1.21)	604 (28.7)	0.63 (0.50–0.78)	203 (9.6)	0.89 (0.62–1.28)
1,001–1,500	406 (22.3)	0.76 (0.59–0.98)	179 (9.8)	0.67 (0.47–0.94)	461 (25.3)	0.58 (0.46–0.73)	201 (11.0)	0.98 (0.68–1.43)
>1,500	367 (18.0)	0.50 (0.39–0.65)	117 (5.8)	0.31 (0.22–0.44)	425 (20.9)	0.49 (0.39–0.62)	277 (13.6)	1.16 (0.80–1.67)
Does not know/prefers not to answer	151 (21.1)	0.73 (0.55–0.98)	45 (6.3)	0.45 (0.29–0.69)	238 (33.2)	0.75 (0.58–0.97)	81 (11.3)	1.17 (0.77–1.76)
BMI before pregnancy (kg/m^2)								
<18.5	–	–	–	–	122 (38.9)	1[d]	37 (11.8)	1[d]
18.5–24.9	–	–	–	–	1,342 (27.7)	0.63 (0.49–0.80)	540 (11.2)	0.74 (0.51–1.07)
25.0–29.9	–	–	–	–	371 (23.6)	0.52 (0.40–0.68)	184 (11.7)	0.72 (0.49–1.07)
≥30	–	–	–	–	128 (19.6)	0.41 (0.30–0.56)	69 (10.6)	0.60 (0.39–0.93)

95% CI 95% confidence interval, *BMI* body mass index, *OR* odds ratio

[a] Reference class: BMI < 25 kg/m^2

[b] Reference class: never smokers

[c] Except for age

[d] Reference class

Table 3 Prevalence of hypertension, dyslipidemia, diabetes mellitus and the aggregation of the three before pregnancy, and age-adjusted odds ratios estimated by unconditional logistic regression for the association with gravidity, socio-economic characteristics and BMI before pregnancy, in mothers of a Portuguese birth cohort (Porto, 2005–2006)

	Hypertension		Dyslipidemia		Diabetes mellitus		≥1 cardiometabolic comorbidities	
	n (%)	Age-adjusted OR (95% CI)[a]	*n* (%)	Age-adjusted OR (95% CI)[a]	*n* (%)	Age-adjusted OR (95% CI)[a]	*n* (%)	Age-adjusted OR (95% CI)[a]
Age (years)								
<25	18 (1.1)	1[b]	12 (0.8)	1[b]	5 (0.3)	1[b]	32 (2.0)	1[b]
25–29	24 (1.1)	0.95 (0.51–1.75)	38 (1.7)	2.27 (1.18–4.35)	11 (0.5)	1.56 (0.54–4.51)	72 (3.2)	1.62 (1.06–2.46)
30–34	38 (1.6)	1.43 (0.82–2.52)	48 (2.1)	2.74 (1.45–5.18)	16 (0.7)	2.17 (0.79–5.94)	95 (4.1)	2.05 (1.37–3.08)
≥35	46 (3.8)	3.45 (1.99–5.97)	28 (2.3)	3.11 (1.57–6.14)	10 (0.8)	2.64 (0.90–7.74)	76 (6.3)	3.26 (2.14–4.96)
Gravidity								
1	56 (1.6)	1[b]	71 (2.0)	1[b]	22 (0.6)	1[b]	141 (4.0)	1[b]
2	37 (1.5)	0.70 (0.45–1.09)	34 (1.4)	0.55 (0.36–0.84)	15 (0.6)	0.78 (0.40–1.55)	79 (3.2)	0.62 (0.46–0.83)
≥3	34 (2.6)	1.00 (0.62–1.61)	21 (1.6)	0.57 (0.34–0.96)	5 (0.4)	0.42 (0.15–1.18)	56 (4.2)	0.72 (0.51–1.01)
Marital status								
Married/living with a partner	121 (1.8)	1[b]	119 (1.7)	1[b]	39 (0.6)	1[b]	262 (3.8)	1[b]
Single/divorced/widow	4 (0.9)	0.62 (0.22–1.71)	7 (1.6)	1.35 (0.61–2.99)	2 (0.5)	1.07 (0.25–4.63)	11 (2.5)	0.87 (0.46–1.62)
Education (years)								
≤4	17 (3.1)	1[b]	8 (1.5)	1[b]	6 (1.1)	1[b]	25 (4.6)	1[b]
5–9	65 (2.1)	1.02 (0.58–1.79)	61 (2.0)	1.76 (0.83–3.75)	17 (0.6)	0.62 (0.24–1.63)	134 (4.4)	1.31 (0.84–2.05)
10–12	29 (1.5)	0.66 (0.35–1.23)	25 (1.3)	1.00 (0.44–2.25)	7 (0.4)	0.37 (0.12–1.13)	59 (3.0)	0.80 (0.49–1.31)
>12	16 (0.9)	0.33 (0.16–0.66)	31 (1.7)	1.15 (0.52–2.53)	12 (0.7)	0.60 (0.22–1.64)	57 (3.2)	0.72 (0.44–1.17)
Social class (individual)								
Entrepreneurs and executives	8 (1.4)	1[b]	14 (2.5)	1[b]	5 (0.9)	1[b]	23 (4.1)	1[b]
Professionals and managers	13 (1.0)	0.66 (0.27–1.60)	21 (1.5)	0.59 (0.30–1.18)	9 (0.7)	0.72 (0.24–2.16)	41 (3.0)	0.71 (0.42–1.19)
Self-employed	3 (2.0)	1.49 (0.39–5.73)	3 (2.0)	0.85 (0.24–3.01)	0 (0.0)	–	6 (4.0)	1.03 (0.41–2.59)
Routine employees	59 (1.8)	1.45 (0.69–3.08)	46 (1.4)	0.62 (0.34–1.14)	11 (0.3)	0.40 (0.14–1.16)	113 (3.4)	0.93 (0.59–1.48)
Industrial workers	21 (2.5)	2.07 (0.90–4.73)	18 (2.2)	0.96 (0.47–1.95)	8 (1.0)	1.14 (0.37–3.55)	42 (5.1)	1.39 (0.83–2.35)
Working condition								
Employed	82 (1.6)	1[b]	87 (1.7)	1[b]	27 (0.5)	1[b]	185 (3.5)	1[b]
Unemployed	29 (2.0)	1.53 (0.98–2.37)	24 (1.7)	1.23 (0.77–1.95)	11 (0.8)	1.79 (0.87–3.66)	59 (4.1)	1.41 (1.04–1.92)
Housewife	13 (3.2)	2.04 (1.12–3.72)	11 (2.7)	1.80 (0.95–3.41)	3 (0.7)	1.52 (0.46–5.07)	24 (5.8)	1.80 (1.16–2.80)
Others	3 (1.4)	1.35 (0.41–4.50)	3 (1.4)	1.54 (0.46–5.10)	1 (0.5)	1.53 (0.19–12.1)	7 (3.2)	1.57 (0.71–3.48)
Household monthly income (€)								
<500	8 (1.7)	1[b]	3 (0.7)	1[b]	6 (1.3)	1[b]	16 (3.5)	1[b]
500–1,000	49 (2.3)	1.28 (0.60–2.74)	41 (1.9)	2.66 (0.82–8.64)	14 (0.7)	0.44 (0.17–1.16)	95 (4.5)	1.19 (0.69–2.05)

Table 3 continued

	Hypertension		Dyslipidemia		Diabetes mellitus		≥1 cardiometabolic comorbidities	
	n (%)	Age-adjusted OR (95% CI)[a]	*n* (%)	Age-adjusted OR (95% CI)[a]	*n* (%)	Age-adjusted OR (95% CI)[a]	*n* (%)	Age-adjusted OR (95% CI)[a]
1,001–1,500	33 (1.8)	0.97 (0.44–2.14)	31 (1.7)	2.13 (0.64–7.03)	8 (0.4)	0.26 (0.09–0.77)	67 (3.7)	0.90 (0.51–1.58)
>1,500	28 (1.4)	0.60 (0.27–1.36)	35 (1.7)	1.92 (0.58–6.33)	9 (0.4)	0.23 (0.08–0.67)	71 (3.5)	0.74 (0.42–1.30)
Does not know/prefers not to answer	5 (0.7)	0.37 (0.12–1.14)	9 (1.3)	1.81 (0.49–6.74)	2 (0.3)	0.19 (0.04–0.97)	14 (2.0)	0.52 (0.25–1.07)
BMI before pregnancy (kg/m^2)								
<25.0	49 (1.0)	1[b]	75 (1.5)	1[b]	22 (0.4)	1[b]	140 (2.7)	1[b]
25.0–29.9	44 (2.8)	2.86 (1.89–4.33)	30 (1.9)	1.25 (0.81–1.92)	10 (0.6)	1.42 (0.67–3.02)	79 (5.0)	1.80 (1.36–2.39)
≥30	34 (5.2)	5.33 (3.39–8.37)	21 (3.2)	2.09 (1.28–3.42)	10 (1.5)	3.40 (1.59–7.23)	57 (8.7)	3.18 (2.31–4.40)

95% CI 95% confidence interval, *BMI* body mass index, *OR* odds ratio

[a] Except for age

[b] Reference class

vs. ≤4 years: age-adjusted OR 2.30; 95% CI 1.59–3.34). Women in the lowest social class were less frequently former smokers than women in the highest. When compared with employed puerperae, unemployed and student or retired were more likely to be former smokers, while housewives were less likely to had stopped smoking before pregnancy, independently of age. Obese women were less frequently former smokers than underweight women (age-adjusted OR 0.60; 95% CI 0.39–0.93) (Table 2).

The prevalence of the three cardiometabolic comorbidities—hypertension, dyslipidemia and diabetes mellitus—considered individually or in aggregation, increased significantly with age (≥35 years vs. <25 years: OR for the presence of at least one of the factors = 3.26; 95% CI 2.14–4.96) and BMI (≥30 vs. <25.0 kg/m^2: age-adjusted OR 3.18; 95% CI 2.31–4.40). An inverse association was observed with gravidity, independently of age, with a more relevant individual effect for dyslipidemia (>1 previous pregnancies vs. primigestae: age-adjusted OR 0.57; 95% CI 0.34–0.96). Overall, unemployed women and housewives were more frequently hypertensive, dyslipidemic or diabetic, when compared with employed women. There was a non-significant trend for an inverse association of these cardiometabolic comorbidities with education and income (Table 3).

When restricting our analysis to primigestae, the prevalence of smoking, hypertension, dyslipidemia and diabetes mellitus remained unchanged. Although we observed a lower prevalence of overweight and obesity in primigestae (18.7%; 95% CI 17.4–20.0%, and 6.5%; 95% CI 5.7–7.4%, respectively), the direction and strength of the associations with age, socio-economic characteristics and BMI before pregnancy were essentially unchanged in comparison with those observed for the entire cohort.

Discussion

In this study of Portuguese puerperae, the prevalence of hypertension, dyslipidemia and diabetes mellitus before pregnancy was lower than 2% and although the prevalence of multiple cardiometabolic comorbidities was very low, their tendency to cluster was evident. Approximately a third of the women were overweight or obese and more than a quarter smoked before pregnancy. The prevalence of cardiovascular risk factors, except smoking, increased with age and BMI, and was higher in married women or living with a partner. Education and income were inversely associated with overweight. Current smokers were younger, thinner and had a lower socioeconomic position, whereas former smokers were older and had a higher socioeconomic position.

Prevalence estimates of overweight and obesity in childbearing age women before pregnancy vary across

countries. In our study, the prevalence of overweight and obesity was lower than that previously described in other industrialized nations (Chu et al. 2009; Khashan and Kenny 2009; Stepan et al. 2006). A recent study from the United States (Chu et al. 2009) reported overweight and obesity rates before pregnancy of 23.0 and 18.7%, respectively. Regarding European countries, the figures were very similar between the UK (Khashan and Kenny 2009) and Germany (Stepan et al. 2006), with prevalence estimates of 28.4 and 31.0%, respectively, for overweight and 17.9 and 18.8%, respectively, for obesity. Beyond the true variation in overweight and obesity rates between populations, at least part of these differences is explained by variable methods of data collection within each study. In the American study (Chu et al. 2009), pre-pregnancy BMI was calculated based on self-reported weight and height, while in the British study (Khashan and Kenny 2009) it was calculated using measurements during the first antenatal visit, and in the German study (Stepan et al. 2006) was abstracted from a computerized perinatal database. In Portugal, the prevalence of overweight and obesity in women aged between 18 and 39 years, according to a national survey conducted in 2003–2005, in which weight and height were measured, was 30.2 and 8.5%, respectively (do Carmo et al. 2008). Relying on self-reported weight and height, the 2005/2006 Portuguese National Health Survey described prevalences of overweight and obesity very similar to ours (19.6 and 9.4%, respectively), for women aged 18–44 years old (INS 2009).

As previously described (McLaren 2007), we found an inverse association between socioeconomic characteristics and weight, probably related to less access to healthy foods (Drewnowski and Darmon 2005) and lower participation in leisure-time physical activity (Giles-Corti and Donovan 2002) among lower social classes. In addition, since education may increase the ability to obtain and understand health-related information and women in high social strata are more likely to perceive themselves as overweight or obese (Paeratakul et al. 2002; Wardle and Griffith 2001), they may have stronger expectations of a slim physical appearance and, therefore, a higher motivation for weight regulation (Gutierrez-Fisac et al. 2002; Halkjaer et al. 2003). In fact, socioeconomic differences in healthy lifestyles are associated with differences in attitudes to health, with a relevant social value placed on weight, especially for women in high socioeconomic strata (Ball et al. 2003; Wardle and Griffith 2001).

The EURO-PERISTAT study, that monitored and evaluated perinatal health in Europe, reported pre-pregnancy smoking prevalence levels ranging from 7.9% in Lithuania to 35.9% in France (EURO-PERISTAT 2008). No data for pre-pregnancy smoking in Portugal were available at that time but the prevalence of current smoking in the general population women aged between 15 and 44 years old, according to data from the National Health Survey, was 18.4% (INS 2009). The higher prevalence of smoking in our sample could reflect its urban nature. In addition, participants aged 15–24 years were more frequently smokers than that observed in the same age range (39.2 vs. 16.0%) of the general population. Women who get pregnant at younger ages are less educated and with lower income and are, probably, more likely to smoke. Moreover, in the National Health Survey (INS 2009), the prevalence may have been underestimated since the questionnaire could be answered by a proxy in case the index subject was absent and proxies might not be aware of the smoking status of these women, especially in younger ones.

Portugal was placed at stage 2 of the smoking epidemic, with a higher prevalence of smoking in women with higher educational levels (Machado et al. 2009; Santos and Barros 2004). Our results revealed a lower proportion of smokers among women at the highest category of education, which could reflect both an evolution across the tobacco epidemic stages and the effect of pregnancy planning. Given that the more educated women more frequently planned their pregnancy, it is possible that these women had stopped smoking before pregnancy, because they intended to get pregnant. The higher proportion of ex-smokers with more than 12 years of education supports this interpretation. Surprisingly, in our study obese women were less likely to be former smokers. As described for education, we believe that a large proportion of these women stopped smoking in the 3 months before pregnancy only due to pregnancy planning and, therefore, will return to their usual consumption after birth (Carmichael and Ahluwalia 2000).

Recently, a national survey on hypertension in pregnancy reported a prevalence of chronic hypertension very similar to ours (1.5%; 95% CI 1.2–1.8%) (Povoa et al. 2008). Our low prevalence of diabetes mellitus is in accordance with a population-based study from the United States (Rosenberg et al. 2005), in which data were collected from the New York City birth register that contained a specific category for chronic diabetes (including types 1 and 2), reporting a prevalence of 0.3% before pregnancy. Similarly, a population-based study from the UK reported a prevalence of 0.47%, considering women with diabetes diagnosed at least 6 months prior to pregnancy (Bell et al. 2008). We were not able to find data regarding dyslipidemia before pregnancy available in the literature. Even in studies considering the general population, the heterogeneity of definitions of dyslipidemia impairs a comparison with our results. In the Bogalusa Heart Study, performed in a cohort of young adults (younger than 45 years), the self-reported prevalence of dyslipidemia in white females was 5.8% (Frontini et al. 2003). The lower prevalence described in our study may be explained by the specific

characteristics of our sample, since we studied a sample of women who successfully led a pregnancy to a live born, which may imply that these women were on average healthier than the general population of the same age group. This assumption is supported by data from the Portuguese National Health Survey that reported a prevalence of 7.2 and 2.7% for hypertension and diabetes mellitus, respectively, in women aged between 15 and 44 years old (INS 2009) However, when comparing these data, we must take into consideration that in our study we only considered the presence of these comorbidities after a medical diagnosis, while in the National Health Survey the report of those conditions did not imply such diagnosis. Therefore, participants may have reported to have hypertension or diabetes mellitus even not fulfilling objective criteria for a medical diagnosis.

We intended to estimate the prevalence of overweight, obesity, smoking, hypertension, dyslipidemia and diabetes mellitus before pregnancy to establish a baseline overview with which to compare these women's cardiovascular profile during a prospective follow up. Since multigestae were included and a previous pregnancy can affect both the prevalence of the studied features and their associations with socio-demographic determinants, we compared the prevalence of the five cardiovascular risk factors between these two groups of women. Although we found a lower prevalence of overweight and obesity in women who had never been pregnant before, restriction of our analysis to primigestae did not change the prevalence estimates of the other cardiovascular risk factors or the relations of each risk factor with determinants considered.

The tendency for the three cardiometabolic comorbidities to cluster was evident in these women of childbearing age. It has been recognized that these cardiovascular risk factors are associated with each other and their effects tend to be synergistic rather than additive (Wilson et al. 1999). In our study, the prevalence of having at least two of these cardiometabolic comorbidities was 0.2%, which is 4 times higher than the prevalence expected by the individual contribution of each risk factor. The aggregation found between these risk factors in our sample suggests that the pathogenic process is initiated early in life. The prevalence of overweight, obesity and smoking was very high. As expected, overweight and obesity were major contributing factors for the development of the three cardiometabolic comorbidities considered, independently of age.

This is the first study that presents the prevalence of several cardiovascular risk factors in young Portuguese women that achieved a successful pregnancy. However, some limitations should be pointed. Despite the large sample size, the precision of estimates of the prevalence of hypertension, dyslipidemia and diabetes before pregnancy is low due to their very low prevalence. Besides, the absence of objective measurements of blood pressure, fasting blood lipids and glucose can lead to an underestimation of the prevalence of these cardiometabolic comorbidities. According to a previous study, in 2003 the awareness of hypertension in Portuguese women aged below 35 years was only 21.9%, which can be explained by the fact that younger women had measured their blood pressure fewer times in the past (Macedo et al. 2005). Similar awareness estimates in young women were found for dyslipidemia and diabetes mellitus in other populations (Scuteri et al. 2009). Also, pre-pregnancy weight and smoking were both self-reported after delivery. Overall, weight tends to be underreported by women (Brunner Huber 2007), which may lead to an underestimation of the overweight and obesity prevalence, and social desirability may lead to biased recall of smoking in new mothers. However, since 99.3% of the participants had more than three prenatal visits, they were probably more aware of their health status. Therefore, we believe that our estimates truly reflect the prevalence of the five cardiovascular risk factors in women of childbearing age.

Our findings reveal that women in a lower socioeconomic position have a higher pre-pregnancy prevalence of cardiovascular risk factors, suggesting a higher risk of developing cardiovascular disease in the future. Therefore, women from the lowest educational and income strata should be the main target group for educational intervention regarding these risk factors. In this context and since low health literacy is associated with a range of adverse health outcomes (Dewalt et al. 2004), health education should be literacy sensitive to enhance health knowledge and self-efficacy to promote the adoption of healthier lifestyles (Osborn et al. 2011).

To the best of our knowledge, there are no published studies on educational programs regarding overall cardiovascular risk in women after delivery. However, data from a systematic review (Hoedjes et al. 2010) revealed that individual and group counseling, use of diaries or other correspondence materials were shown to be effective interventions for prevention in weight loss, smoking cessation and prevention of smoking relapse in the postpartum. These results support that women of childbearing age would benefit from the development of specific educational programs, after giving birth.

In conclusion, the clustering of hypertension, dyslipidemia and diabetes mellitus, as well as the high prevalence of overweight, obesity and smoking, shows an adverse cardiovascular risk profile of Portuguese young mothers and highlight the importance of implementing preventive interventions at early stages of life to modulate cardiovascular risk.

Ethical standards The study protocol was approved by the Ethics Committee of Hospital de S. João and written

informed consent was obtained from all participants, in compliance with the current laws of Portugal.

Conflict of interest The authors declare that they have no conflict of interest.

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