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Cardiovascular risk profile of mothers of a Portuguese birth cohort: A survey 4 years after delivery ☆

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ABSTRACT

Objectives. The aim of this study is to estimate the prevalence of smoking, low fruit and vegetable intake, sedentariness, overweight/obesity, abdominal obesity, hypertension, dyslipidemia and diabetes mellitus in mothers of a Portuguese birth cohort, 4 years after delivery.

Methods. A birth cohort was assembled at public maternities of Porto (2005–2006). Children and mothers were reevaluated 4 years later. In this analysis, 5435 women were included. Socioeconomic characteristics, smoking, diet and exercise were self-reported. Anthropometrics and blood pressure were measured. A subgroup of 2483 randomly selected women provided a fasting venous blood sample for lipid and glucose measurements.

Results. Overall, 25.3% women smoked, 71.5% consumed <5 portions of fruit and vegetables per day, 81.3% were sedentary, 31.4% were overweight, 21.3% obese and 31.8% had abdominal obesity. The prevalence of hypertension, dyslipidemia and diabetes mellitus was 8.7%, 18.5% and 0.9%, respectively. At least one risk factor from each of the 3 groups (adverse lifestyles, adiposity and cardiometabolic comorbidities) was observed in 17.4% of women. Except for smoking, all risk factors were associated with unemployment, lower education and lower income.

Conclusions. The high prevalence of unfavorable lifestyles and adiposity, and the aggregation of risk factors emphasize the adverse cardiovascular risk profile at a young age.

Introduction

Cardiovascular diseases (CVD) are responsible for almost half of female deaths in Europe (Allender et al., 2008) and accounted for 36.3% of all deaths among women in Portugal in 2009 (Instituto Nacional de Estatística (INE), 2012). CVD are mainly attributable to classical risk factors, namely cigarette smoking, high blood pressure, high serum cholesterol, diabetes, overweight/obesity and adverse diet (Stamler, 2005). CVD mortality rates increase with the number of risk factors present in an individual, suggesting that the lower the risk factor profile, the lower the risk for CVD and all-cause mortality (Daviglus et al., 2004; Stamler, 2005).

Pregnancy brings a physiological stress that can uncover an underlying propensity for chronic disease (Sattar and Greer, 2002). In populations with universal free access to prenatal and postnatal care such as Portugal (DGS, 2001), pregnancy may constitute a good opportunity for health promotion and disease prevention (McBride et al., 2003), not only for the mothers but also for their children. Thus, the potential to achieve effective health promotion and disease prevention in lower socioeconomic positions (SEP), which are at higher cardiovascular risk, may be very important.

In this study, we aimed to estimate the prevalence of eight established cardiovascular risk factors (smoking, low fruit and vegetable intake, sedentariness, general overweight/obesity, abdominal obesity, hypertension, dyslipidemia and diabetes mellitus) in mothers of a Portuguese birth cohort, 4 years after delivery, and to describe their distribution by age, gravidity and indicators of SEP.

Methods

This study is based on the birth cohort Generation XXI, which has been described previously (Alves et al., 2012). The cohort was recruited at the 5 public maternity units covering the metropolitan area of Porto, Portugal (2005–2006). A total of 8495 mothers, who gave birth to 8647 infants, were enrolled in the cohort. At 4 years of the child's age, the cohort was re-evaluated (2009–2011). Overall, 67.4% of the mothers attended a face-to-face interview and physical examination at the study site, half of whom were randomly selected to provide a fasting blood sample.

Among the 5729 mothers who attended the face-to-face interview, we excluded 174 who were pregnant at the follow-up visit and 120 with at least

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one missing value on variables used in this study. The remaining 5435 women were included in the current analysis, 2483 (45.7%) of whom had biochemical laboratorial data.

At the cohort's reevaluation, an average of 4 years after delivery (median: 51 months; range: 49–55), data were collected by trained interviewers using structured questionnaires. Socioeconomic characteristics, lifestyles and obstetric history of the mother were self-reported. Marital status was grouped in two categories, according to co-habitation with a partner. Educational level was considered as the number of completed years of education and categorized as <4 years, 5–9 years, 10–12 years and >12 years. Working condition was defined as employed, unemployed, housewife and others (student or retired). Household monthly income was inquired using previously defined categories: <500€, 500–1000€, 1001–1500€, >1500€ and women who didn't know or preferred not to answer. Gravidity was recorded as the number of pregnancies for each participant, before, after and including the index pregnancy.

Current smokers included daily (at least one cigarette per day) and occasional smokers (less than one cigarette per day), and ex-smokers did not smoke for at least 6 months. The frequency of fruits, vegetable soup and "vegetables on the dish" intake, without considering portion sizes, was assessed through questions adapted from a food frequency questionnaire, which has been previously validated in Portuguese adult non-pregnant adults (Lopes et al., 2007). Low fruit and vegetable intake was defined as the combination of items from any of these groups summing <5 per day. Physical exercise was considered as the structured and regular practice of any sport or physical exercise of mild, moderate or vigorous intensity.

Weight and height were measured and the mothers' body mass index (BMI) was categorized according to the World Health Organization (1998) 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). Waist circumference was measured midway between the lowest rib and the superior border of the iliac crest. Abdominal obesity was defined as waist circumference >88 cm (Grundy et al., 2005). Blood pressure was measured on a single occasion by non-physician trained interviewers. Two measurements of blood pressure separated by at least 5 min were taken with an automatic upper arm blood pressure monitor (OMRON M6 comfort (HEM-7000-E)) after 10-minute rest, on the dominant upper arm resting at the heart level. The mean was calculated and when the difference was larger than 5 mm Hg for systolic or diastolic blood pressure a third measurement was taken and the mean of the 2 closest values was considered. Arterial hypertension was defined as systolic and/or diastolic blood pressure ≥140/90 mm Hg (Hypertension Guidelines, 2007) and/or self-reported antihypertensive drug therapy prescribed for hypertension.

Dyslipidemia was considered when one of these conditions was verified: total cholesterol ≥240 mg/dL, high-density lipoprotein (HDL) ≤40 mg/dL, low-density lipoprotein (LDL) ≥160 mg/dL, triglycerides ≥200 mg/dL National (Third Report, 2002) or self-reported antidyslipidemic drug therapy. Diabetes mellitus was defined as fasting plasma glucose concentration ≥126 mg/dL (WHO, 1999) or self-reported antidiabetic drug therapy prescribed specifically for diabetes.

Statistical analysis was performed using the statistical software Stata 9.0 (College Station, TX, 2005). Cardiovascular risk factors were grouped into unfavorable lifestyles (smoking, low fruit and vegetable intake, and sedentariness), adiposity (overweight/obesity and abdominal obesity) and cardiometabolic risk factors (hypertension, dyslipidemia and diabetes mellitus). Possible combinations of the presence of at least one factor from each group were analyzed, in the subsample with information on all risk factors. Unconditional binary logistic regression models were fitted to compute age-adjusted odds ratios (OR) and 95% confidence intervals (95%CI) for dichotomous risk factors, 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 São João and by the Portuguese Authority of Data Protection. Written informed consent was obtained from the participants.

Table 1
Participant's characteristics in the overall study sample and those with fasting blood sample (Portugal, 2009–2011).

	All women	With fasting blood sample
	n = 5435	n = 2483
Age (years), n (%)		
<25	240 (4.4)	115 (4.6)
25–29	829 (15.2)	407 (16.4)
30–34	1780 (32.8)	819 (33.0)
35–39	1784 (32.8)	795 (32.0)
≥40	802 (14.8)	347 (14.0)
Gravidity, n (%)		
1	2007 (36.9)	926 (37.3)
2	2172 (40.0)	1014 (40.9)
≥3	1256 (23.1)	543 (21.9)
Marital status, n (%)		
Married/living with a partner	4843 (89.1)	2177 (87.7)
Single/divorced/widow	592 (10.9)	306 (12.3)
Education (years), n (%)		
≤4	345 (6.4)	177 (7.1)
5–9	2088 (38.4)	968 (39.0)
10–12	1516 (27.9)	671 (27.0)
>12	1486 (27.3)	667 (26.9)
Working condition, n (%)		
Employed	4117 (75.8)	1869 (75.3)
Unemployed	928 (17.1)	446 (18.0)
Housewife	254 (4.7)	106 (4.3)
Others	136 (2.5)	62 (2.5)
Household monthly income (€), n (%)		
<500	224 (4.1)	125 (5.0)
500–1000	1296 (23.9)	641 (25.8)
1001–1500	1523 (28.0)	648 (26.1)
>1500	2304 (42.4)	1030 (41.5)
Does not know/prefers not to answer	88 (1.6)	39 (1.6)

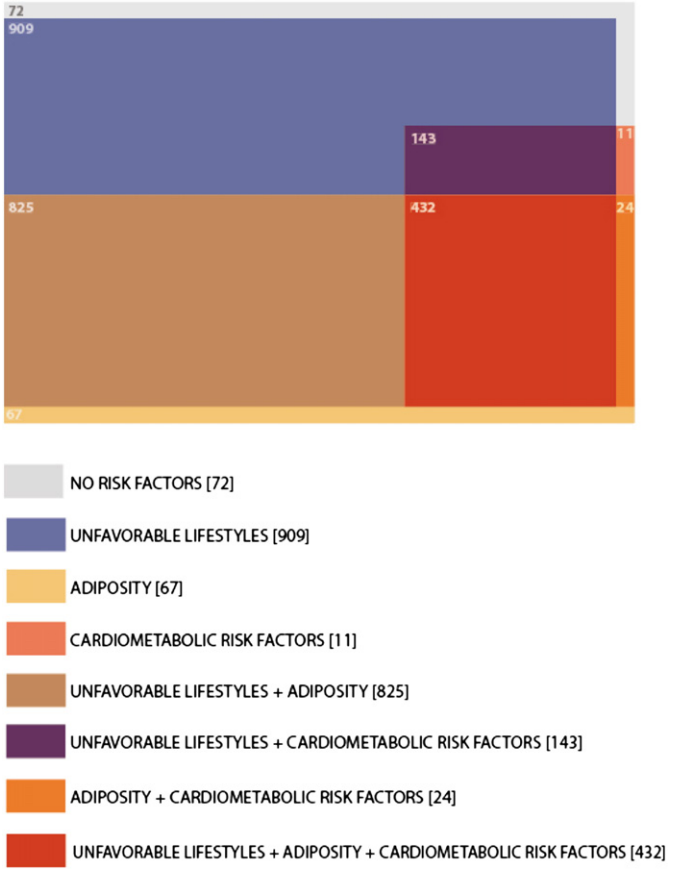

Fig. 1. Number of women with no risk factors or at least one risk factor from each of the 3 groups considered: unfavorable lifestyles, adiposity and cardiometabolic comorbidities (Portugal, 2009–2011). The area of the individual rectangles and overlap areas are proportional to the number of women in the respective level of exposure. Only the subsample with information available for all risk factors was considered (n = 2483).

Results

Overall, the socio-demographic characteristics of the participants were similar between all the women and those with a fasting blood sample collection (Table 1). Almost half of the mothers were more than 36 years old and approximately 37% only had the index pregnancy. Most of the mothers were married or lived with a partner, approximately 27% had >12 years of education, more than 75% were employed and more than 40% had a household monthly income >1500€.

An average of 4 years after delivery, 25.3% (95%CI: 24.1–26.5) of women smoked, while 71.5% (95%CI: 70.3–72.7) had a low intake of fruit and vegetables whereas 81.3% (95%CI: 80.2–82.3) did not practice physical exercise. At that time, 31.4% (95%CI: 30.2–32.7) were overweight, 21.3% (95%CI: 20.2–22.4) obese and 31.8% (95%CI: 30.6–33.1) had abdominal obesity. Regarding cardiometabolic comorbidities, 8.7% (95%CI: 7.9–9.5) of the women had hypertension and, among those that provided a fasting blood sample collection, the prevalence of dyslipidemia and diabetes mellitus was 18.5% (95%CI: 17.0–20.1) and 0.9% (95%CI: 0.6–1.3), respectively. Overall, 17.4% had at least one risk factor from each of the 3 groups (unfavorable lifestyles, adiposity and cardiometabolic comorbidities) and more than 30% presented both adverse lifestyles and adiposity (Fig. 1).

Above 30 years of age, the prevalence of smoking, low intake of fruit and vegetables and sedentariness was approximately half that of younger women. Those with ≥3 pregnancies were 31% and 38% more likely to smoke and to be sedentary, whereas those not living with a partner were almost 3-fold more frequently smokers. In general, adverse lifestyles were inversely associated with education and income, independently of age. When compared with employed women, the unemployed were 40% more likely to smoke and 24% more likely to have a low intake of fruit and vegetables, while housewives were 37% less likely to smoke. Four years after delivery, smokers were 28% less likely to be obese, while those who did not practice any physical exercise were 27% more likely to be obese. The prevalence of former smoking increased with age and educational level, and was lower among housewives (Table 2).

Women aged >40 years were 62% more frequently overweight and just above 30% more likely to have overall and abdominal obesity, compared to women aged <30 years. Gravidity was also associated with both outcomes, independently of age. A significant inverse association was observed for education and monthly household for both variables. Women living with a partner were more likely to have excessive weight or abdominal obesity, as well as housewives and unemployed, when compared with employed women (Table 3).

Table 2
Prevalence of smoking, low fruit and vegetable intake, and sedentariness, 4 years after delivery, and age-adjusted odds ratios for the association with age, gravidity, socio-economic characteristics and BMI, in mothers of a Portuguese birth cohort, 2009–2011 (n = 5435).

	Smoking status[a]				Fruit and vegetable intake		Physical exercise	
	Current		Former		<5 portions/day		Sedentariness	
	n (%)	Age-adjusted OR (95%CI)[b]	n (%)	Age-adjusted OR (95%CI)[b]	n (%)	Age-adjusted OR (95%CI)[b]	n (%)	Age-adjusted OR (95%CI)[b]
Age (years)								
<30	409 (38.3)	1[c]	136 (12.7)	1[c]	877 (82.0)	1[c]	939 (87.8)	1[c]
30–34	424 (23.8)	0.49 (0.41–0.58)	238 (13.4)	0.82 (0.65–1.04)	1292 (72.6)	0.58 (0.48–0.70)	1414 (79.4)	0.53 (0.43–0.66)
35–39	371 (20.8)	0.43 (0.36–0.51)	303 (17.0)	1.05 (0.84–1.32)	1201 (67.3)	0.45 (0.37–0.54)	1397 (78.3)	0.50 (0.40–0.62)
≥40	172 (21.5)	0.47 (0.38–0.58)	164 (20.5)	1.36 (1.05–1.76)	516 (64.3)	0.39 (0.32–0.49)	666 (83.0)	0.68 (0.52–0.88)
Gravidity								
1	507 (25.3)	1[c]	295 (14.7)	1[c]	1508 (75.1)	1[c]	1605 (80.0)	1[c]
2	531 (24.5)	1.10 (0.95–1.27)	347 (16.0)	1.04 (0.87–1.24)	1517 (69.8)	0.85 (0.74–0.98)	1759 (81.0)	1.14 (0.97–1.33)
≥3	338 (26.9)	1.31 (1.10–1.56)	199 (15.9)	1.01 (0.82–1.25)	861 (68.6)	0.85 (0.72–1.00)	1052 (83.8)	1.38 (1.14–1.68)
Marital status								
Married/living with a partner	1100 (22.7)	1[c]	772 (15.9)	1[c]	3453 (88.9)	1[c]	3940 (81.4)	1[c]
Single/divorced/widow	276 (46.6)	2.71 (2.24–3.27)	69 (11.7)	1.08 (0.82–1.43)	433 (11.1)	0.97 (0.79–1.17)	476 (80.4)	0.84 (0.68–1.05)
Education (years)								
≤4	75 (21.7)	1[c]	43 (12.5)	1[e]	259 (75.1)	1[e]	319 (92.5)	1[e]
5–9	650 (31.1)	1.51 (1.13–2.00)	269 (12.9)	1.33 (0.93–1.91)	1590 (76.2)	0.91 (0.69–1.19)	1833 (87.8)	0.57 (0.37–0.87)
10–12	377 (24.9)	1.23 (0.92–1.65)	260 (17.2)	1.76 (1.23–2.52)	1130 (74.5)	0.86 (0.65–1.13)	1201 (79.2)	0.31 (0.21–0.48)
>12	274 (18.4)	0.96 (0.71–1.29)	269 (18.1)	1.63 (1.14–2.33)	907 (61.0)	0.52 (0.40–0.68)	1063 (71.5)	0.22 (0.14–0.33)
Working condition								
Employed	985 (23.9)	1[c]	653 (15.9)	1[c]	2912 (74.9)	1[c]	3308 (80.4)	1[c]
Unemployed	299 (32.2)	1.40 (1.19–1.66)	139 (15.0)	1.07 (0.87–1.31)	707 (76.2)	1.24 (1.05–1.47)	773 (83.3)	1.13 (0.94–1.38)
Housewife	48 (18.9)	0.63 (0.45–0.88)	28 (11.0)	0.57 (0.38–0.85)	171 (67.3)	0.84 (0.64–1.10)	217 (85.4)	1.35 (0.94–1.93)
Others	44 (32.4)	1.35 (0.91–1.99)	21 (15.4)	1.14 (0.69–1.87)	96 (70.6)	0.86 (0.59–1.26)	118 (86.8)	1.45 (0.87–2.40)
Household monthly income (€)								
<500	94 (42.0)	1[c]	26 (11.6)	1[c]	166 (74.1)	1[c]	201 (89.7)	1[c]
500–1000	390 (30.1)	0.61 (0.45–0.83)	160 (12.4)	0.88 (0.55–1.40)	976 (75.3)	1.12 (0.80–1.55)	1129 (87.1)	0.81 (0.51–1.29)
1001–1500	368 (24.2)	0.50 (0.37–0.68)	239 (15.7)	1.09 (0.69–1.72)	1169 (76.8)	1.26 (0.91–1.75)	1303 (85.6)	0.74 (0.47–1.17)
>1500	495 (21.5)	0.48 (0.36–0.66)	403 (17.5)	1.19 (0.76–1.86)	1516 (65.8)	0.80 (0.58–1.09)	1711 (74.3)	0.38 (0.24–0.59)
Does not know/prefers not to answer	29 (33.0)	0.77 (0.44–1.33)	13 (14.8)	1.09 (0.51–2.32)	59 (67.1)	0.79 (0.46–1.36)	72 (81.8)	0.53 (0.27–1.07)
Body mass index (kg/m²)								
<24.9	735 (28.6)	1[c]	384 (15.0)	1[c]	1878 (73.1)	1[c]	2071 (80.6)	1[c]
25.0–29.9	378 (22.1)	0.72 (0.62–0.84)	276 (16.2)	0.97 (0.81–1.15)	1199 (70.2)	0.89 (0.78–1.02)	1370 (80.2)	0.98 (0.84–1.14)
≥30	263 (22.7)	0.72 (0.61–0.85)	181 (15.6)	0.95 (0.78–1.15)	809 (69.9)	0.86 (0.74–1.00)	975 (84.3)	1.27 (1.06–1.54)

95%CI, 95% confidence interval; BMI, body mass index, OR, odds ratio.
[a] Reference class of outcome: never smokers.
[b] Except for age.
[c] Reference class.

Table 3
Prevalence of overweight, obesity and abdominal obesity, 4 years after delivery, and age-adjusted odds ratios for the association with age, gravidity and socio-economic characteristics, in mothers of a Portuguese birth cohort, 2009–2011 (n = 5435).

	BMI[a]				Abdominal obesity	
	Overweight		Obesity			
	n (%)	Age-adjusted OR (95%CI)[b]	n (%)	Age-adjusted OR (95%CI)[b]	n (%)	Age-adjusted OR (95%CI)[b]
Age (years)						
<30	299 (28.0)	1[c]	240 (22.5)	1[c]	329 (30.9)	1[c]
30–34	542 (30.5)	1.12 (0.94–1.34)	380 (21.4)	0.98 (0.81–1.19)	546 (30.7)	1.00 (0.84–1.17)
35–39	576 (32.3)	1.18 (0.99–1.41)	346 (19.4)	0.89 (0.73–1.08)	555 (31.1)	1.02 (0.86–1.20)
≥40	292 (36.4)	1.62 (1.31–2.01)	191 (23.8)	1.32 (1.04–1.67)	298 (37.2)	1.33 (1.10–1.62)
Gravidity						
1	598 (29.8)	1[c]	382 (19.0)	1[c]	565 (28.2)	1[c]
2	697 (32.1)	1.12 (0.97–1.29)	447 (20.6)	1.18 (1.00–1.39)	694 (32.0)	1.19 (1.04–1.36)
≥3	414 (33.0)	1.28 (1.07–1.51)	328 (26.1)	1.71 (1.41–2.06)	469 (37.3)	1.47 (1.26–1.72)
Marital status						
Married/living with a partner	1539 (31.8)	1[c]	1052 (21.7)	1[c]	1588 (32.8)	1[c]
Single/divorced/widow	170 (28.7)	0.81 (0.66–0.99)	105 (17.7)	0.70 (0.55–0.88)	140 (23.7)	0.63 (0.52–0.78)
Education (years)						
≤4	132 (38.3)	1[c]	123 (35.7)	1[c]	169(49.0)	1[c]
5–9	684 (32.8)	0.63 (0.47–0.84)	565 (27.1)	0.54 (0.40–0.73)	817 (39.1)	0.73 (0.58–0.93)
10–12	483 (31.9)	0.48 (0.36–0.65)	284 (18.8)	0.30 (0.22–0.40)	437 (28.8)	0.45 (0.36–0.58)
>12	410 (27.6)	0.32 (0.23–0.42)	185 (12.5)	0.15 (0.11–0.21)	305 (20.5)	0.27 (0.21–0.35)
Working condition						
Employed	1282 (31.2)	1[c]	778 (18.9)	1[c]	1185 (28.8)	1[c]
Unemployed	296 (31.9)	1.33 (1.12–1.58)	267 (28.8)	1.94 (1.62–2.33)	376 (40.5)	1.70 (1.47–1.98)
Housewife	90 (35.4)	1.60 (1.18–2.17)	75 (29.5)	2.19 (1.59–3.02)	115 (45.3)	2.02 (1.56–2.61)
Others	41 (30.2)	1.19 (0.79–1.79)	37 (27.2)	1.70 (1.12–2.60)	52 (38.2)	1.57 (1.10–2.34)
Household monthly income (€)						
<500	75 (33.5)	1[c]	62 (27.7)	1[c]	91 (40.6)	1[c]
500–1000	422 (32.6)	0.96 (0.68–1.34)	370 (28.6)	1.02 (0.72–1.46)	523 (40.4)	0.98 (0.73–1.31)
1001–1500	494 (32.4)	0.83 (0.60–1.16)	366 (24.0)	0.75 (0.53–1.07)	537 (35.3)	0.77 (0.58–1.03)
>1500	693 (30.1)	0.58 (0.42–0.80)	340 (14.8)	0.35 (0.24–0.50)	546 (23.7)	0.42 (0.32–0.56)
Does not know/prefers not to answer	25 (28.4)	0.61 (0.34–1.10)	19 (22.5)	0.57 (0.31–1.08)	31 (35.2)	0.75 (0.45–1.26)

95%CI, 95% confidence interval; BMI, body mass index, OR, odds ratio.
[a] Reference class of outcome: BMI < 25 kg/m^2.
[b] Except for age.
[c] Reference class.

Women aged >40 years were more likely to have hypertension (6.82-fold), dyslipidemia (1.55-fold) and diabetes (4.57-fold), while obesity was associated with a 4-fold increase in the prevalence of hypertension and a 3-fold increase in the prevalence of dyslipidemia or diabetes. Overall, an inverse association was observed with income for the three cardiometabolic comorbidities, and a similar association was observed with education, with a more relevant effect for hypertension (>12 years vs. ≤4 years: age-adjusted OR = 0.51; 95%CI: 0.35–0.73). Unemployed women were more frequently hypertensive, dyslipidemic or diabetic, when compared with employed women. Marital status was associated with a 3-fold increase in the prevalence of diabetes among women without a partner (Table 4).

Discussion

In this study, 4 years after delivering a live born, more than 90% of the participants presented at least one unfavorable lifestyle, more than half had a marker of adiposity and a quarter presented at least one cardiometabolic comorbidity. Overall, 17% of the women presented an aggregation of factors from all three risk factor groups. Smoking, low fruit and vegetable intake and sedentary lifestyle were more common in younger women, while adiposity and cardiometabolic risk factors were more frequent in older women. The prevalence of hypertension, dyslipidemia, diabetes and sedentariness increased with BMI. Unemployment, education and income were inversely associated with all risk factors, except smoking.

This study quantifies the prevalence of several cardiovascular risk factors in a large sample of young Portuguese women, with the major advantage of objective measurements of weight, height, blood pressure, fasting blood lipids and glucose. Despite the lack of blood sample for the whole cohort, the prevalence of risk factors was not significantly different between women with and without a fasting blood sample (data not shown), making the former subgroup representative of the whole sample.

In Portugal (2005/2006), the prevalence of smoking was 17% among women aged 15 to 54 years (INS, 2009). This prevalence may have been underestimated, since the questionnaire could be answered by a proxy. Moreover, the higher prevalence of smoking in our sample could reflect its urban nature as well as the higher educational level of the women. The World Health Survey (2002–2003), described a prevalence of fruit and vegetable consumption very similar to the one described, for Spanish women aged >17 years (Hall et al., 2009). In 2000, 36.7% of European female students, aged 18 to 30 years, reported to practice some kind of physical exercise (Steptoe et al., 2002), while less than 20% of women reported it in the present study. The adverse lifestyles present in this cohort highlight the need for societal change for timely effective cardiovascular prevention. The implications for the health of the family and particularly of their children, both through the shared environment and their responsibility as role models, are a major indirect consequence of these unfavorable behaviors.

In a national survey (2003–2005), the prevalence of overweight and obesity in women aged 18 to 49 years was 34.0% and 10.6%, respectively, while 11.2% and 19.9% of women aged 20 to 29 years and 30 to 39 years

Table 4
Prevalence of hypertension (n = 5435), dyslipidemia and diabetes mellitus (n = 2483 with fasting blood sample), 4 years after delivery, and age-adjusted odds ratios for the association with gravidity, socio-economic characteristics and BMI, in mothers of a Portuguese birth cohort, 2009–2011.

	Hypertension		Dyslipidemia		Diabetes mellitus	
	n (%)	Age-adjusted OR (95%CI)[a]	n (%)	Age-adjusted OR (95%CI)[a]	n (%)	Age-adjusted OR (95%CI)[a]
Age (years)						
<30	33 (3.1)	1[b]	81 (15.5)	1[b]	2 (0.4)	1[b]
30–34	117 (6.6)	2.21 (1.49–3.28)	146 (17.8)	1.18 (0.88–1.59)	2 (0.2)	0.64 (0.09–4.53)
35–39	179 (10.0)	3.50 (2.40–5.12)	156 (19.6)	1.33 (0.99–1.78)	12 (1.5)	3.98 (0.89–17.88)
≥40	143 (17.8)	6.82 (4.62–10.09)	77 (22.2)	1.55 (1.10–2.20)	6 (1.7)	4.57 (0.92–22.80)
Gravidity						
1	152 (7.6)	1[b]	157 (17.0)	1[b]	6 (0.7)	1[b]
2	187 (8.6)	0.90 (0.72–1.14)	187 (18.4)	1.06 (0.83–1.34)	10 (1.0)	1.14 (0.41–3.21)
≥3	133 (10.6)	0.95 (0.73–1.23)	116 (21.4)	1.24 (0.94–1.63)	6 (1.1)	1.12 (0.35–3.63)
Marital status						
Married/living with a partner	432 (8.9)	1[b]	409 (18.8)	1[b]	16 (0.7)	1[b]
Single/divorced/widow	40 (6.8)	0.88 (0.62–1.23)	51 (16.7)	0.90 (0.65–1.25)	6 (2.0)	3.39 (1.29–8.91)
Education (years)						
≤4	51 (14.8)	1[b]	32 (18.1)	1[b]	2 (1.1)	1[b]
5–9	180 (8.6)	0.78 (0.56–1.11)	195 (20.1)	1.26 (0.83–1.92)	13 (1.3)	1.66 (0.36–7.59)
10–12	129(8.5)	0.75 (0.52–1.07)	126 (18.8)	1.14 (0.74–1.76)	3 (0.5)	0.57 (0.09–3.47)
>12	112 (7.5)	0.51 (0.35–0.73)	107 (16.0)	0.86 (0.55–1.33)	4 (0.6)	0.54 (0.10–2.99)
Working condition						
Employed	337 (8.2)	1[b]	329 (17.6)	1[b]	14 (0.8)	1[b]
Unemployed	93 (10.0)	1.37(1.07–1.75)	102 (22.9)	1.42 (1.10–1.83)	6 (1.4)	1.79 (0.68–4.72)
Housewife	30 (11.8)	1.43 (0.95–2.14)	21 (19.8)	1.17 (0.71–1.92)	1 (0.9)	1.16 (0.15–9.00)
Others	12 (8.8)	1.34 (0.72–2.47)	8 (12.9)	0.72 (0.34–1.53)	1 (1.6)	2.63 (0.33–20.63)
Household monthly income (€)						
<500	24 (10.7)	1[b]	24 (19.2)	1[b]	2 (1.6)	1[b]
500–1000	130(10.0)	0.89 (0.56–1.44)	126 (19.7)	1.03 (0.63–1.68)	10 (1.6)	0.94 (0.20–4.41)
1001–1500	127 (8.3)	0.68 (0.43–1.10)	127 (19.6)	1.00 (0.61–1.63)	6 (0.9)	0.54 (0.11–2.78)
>1500	186 (8.1)	0.57 (0.36–0.91)	175 (17.0)	0.80 (0.49–1.29)	3 (0.3)	0.14 (0.02–0.88)
Does not know/prefers not to answer	5 (5.7)	0.39 (0.14–1.06)	8 (20.5)	1.02 (0.41–2.50)	1 (2.6)	1.21 (0.11–14.00)
Body mass index (kg/m^2)						
<24.9	116 (4.5)	1[b]	135 (11.6)	1[b]	6 (0.5)	1[b]
25.0–29.9	158 (9.3)	2.02 (1.57–2.59)	165 (21.1)	2.00 (1.56–2.56)	6 (0.8)	1.40 (0.45–4.38)
≥30	198 (17.1)	4.38 (3.43–5.59)	160 (29.9)	3.24 (2.50–4.20)	10 (1.9)	3.60 (1.30–9.99)

95%CI, 95% confidence interval; BMI, body mass index; OR, odds ratio.
[a] Except for age.
[b] Reference class.

presented abdominal obesity (do Carmo et al., 2008). Adiposity is increasing in Portugal, with overweight and obesity prevalences increasing 3.2% and 7.4% among women, between 1995 and 2005 (Carreira et al., 2012). Moreover, these women had been pregnant 4 years before, and approximately 20% had a subsequent pregnancy. Thus, the higher prevalences observed in our study may also reflect an incomplete weight recovery (Amorim et al., 2007).

A systematic review that assessed trends in hypertension prevalence in Portugal, estimated, in 2005, a prevalence of 23.2% for women at average age 35 years, higher than the one observed in the present study (Pereira et al., 2012). Regarding dyslipidemia, the heterogeneity of definitions among different studies is a universally recognized difficulty for their comparison. No Portuguese study could be identified using similar methodology and criteria. In the United States, the prevalence of high blood cholesterol or low HDL was 25.9% in women aged between 20 and 39 years (Brown et al., 2000). Among Portuguese women aged 20 to 39 years, the prevalence of type 2 diabetes was 0.6% (Correia et al., 2010). Since this estimate does not include type 1 diabetes and 15% of our cohort was aged above 40 years, the 0.9% prevalence reported in our study is probably lower than in the general Portuguese female population within this age range. Overall, the lower prevalence of cardiometabolic characteristics in our sample suggests that these women were on average healthier than the general population of the same age group.

The high prevalence of young women with at least one cardiovascular risk factor, as well as their co-occurrence, highlights the adverse cardiovascular profile of these women. Less than 5% had none of the risk factors studied. The assessment of several risk factors intended to appreciate global cardiovascular risk, beyond the fragmented view of individual risk factors. In Europe, the SCORE system is recommended to evaluate overall CVD risk (Conroy et al., 2003), but it tends to underestimate CVD risk in younger people (Graham et al., 2007). Therefore, we believe that the aggregation of risk factors is more informative of risk at younger ages than a risk score.

We previously reported the pre-pregnancy prevalence of cardiovascular risk factors, in this sample of women based on data self-reported at delivery (Alves et al., 2012). Only 4 years after delivery, the prevalence of all risk factors, except smoking, increased drastically. Overweight/obesity increased from 30.1% to 52.7%, while the prevalence of hypertension, dyslipidemia and diabetes was 5, 11 and 1.5-times higher, respectively. Although part of this increase may be due to underreport of weight by women (Brunner Huber, 2007) and to the lack of awareness of clinical diagnoses in young ages (Macedo et al., 2005; Scuteri et al., 2009), it is unlikely that these reasons would totally explain such a huge increase in prevalence. When applying a correction factor to the baseline self-reported risk factor prevalence, based on the ratio between the prevalence of objectively defined risk factors and self-reported exposure, calculated in women aged 18 to 40 years from a population-based study from the region of Porto (Pereira et al., 2010) we still observed an increase in prevalence of 15% for hypertension, 30% for overweight/obesity, 50% for diabetes and 8.5-fold for dyslipidemia.

In the present study, indicators of socio-economic position were inversely associated with all risk factors. The economic improvements experienced in Portugal in the last decades (Costa et al., 2000), may have contributed to a higher frequency of adverse lifestyles, especially among the lower social classes (Drewnowski and Darmon, 2005; Giles-Corti and Donovan, 2002). In this context, health education should be literacy sensitive in order to enhance health knowledge and self-efficacy to promote the adoption of healthier lifestyles (Osborn et al., 2011).

In conclusion, the prevalence of unfavorable lifestyles and adiposity was very high among women, as early as 4 years after delivery, and the co-occurrence of risk factors emphasizes the unfavorable cardiovascular risk profile at a young age. This is a population expected to be in general healthy and whose characteristics and exposures have implications not only for themselves but also for their children. Also, practically all these women had contact with health care services, mostly the National Health Service which is universal and free of charge in Portugal, and our results show that this opportunity has not been effectively used to control the level of cardiovascular risk within the scope of maternal health care. However, the potential for prevention is vast, especially when considering the modifiable nature of the most important risk factors. These data emphasize the need to implement coherent and effective strategies of health promotion and disease prevention at early stages of life in order to optimize women's current and future health. Since early detection of individuals with modifiable and treatable cardiovascular risk factors may result in saving lives, and reducing the burden of disease and healthcare costs, lifestyle interventions, should be considered a national public policy priority.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

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