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Prevalence of Dyslipidemia According to the Nutritional Status in a Representative Sample of São Paulo

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Abstract

Background: Overweight is one of the major public health problems in Brazil; it is associated with dyslipidemia, which is an important risk factor for cardiovascular diseases.

Objective: To evaluate the lipid profile of residents of the municipality of São Paulo, state of São Paulo, according to the nutritional status.

Methods: Data from the population-based cross-sectional study ISA-Capital 2008 on a sample of residents of São Paulo were used. Participants were categorized into groups according to body mass index and age range. The levels of total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides, and non-HDL cholesterol were measured. The association between lipid profile, nutricional status, and waist circumference was investigated. The data were processed using the survey mode of the Stata 11.0 software.

Results: The prevalence of any type of dyslipidemia in the population was 59.74%, with low HDL-cholesterol dyslipidemia being the most common type. Not overweight individuals had higher mean levels of HDL-cholesterol and lower levels of LDL-cholesterol, total cholesterol, triglycerides, and non-HDL cholesterol when compared to the overweight group. The rate of inadequacy of these variables was higher in the overweight individuals, regardless of the age group, with the exception of LDL-cholesterol in the adults and elderly. A higher prevalence of isolated hypertriglyceridemia was observed in individuals with higher waist circumference among the adults and the total population.

Conclusion: The results indicate an association between dyslipidemia and overweight in the population of the city of São Paulo. The most prevalent dyslipidemia in this population was low HDL-cholesterol. (Arq Bras Cardiol. 2014; 103(6):476-484)

Keywords: Dyslipidemias / epidemiology; Prevalence; Statistical Analysis; Nutritional Status; Obesity / complications.

Introduction

Overweight and obesity, characterized by excessive accumulation of adipose tissue in the body, represent a growing epidemiological problem worldwide and a great challenge to public health in several countries[1]. In Brazil, the prevalence of overweight [body mass index (BMI) ≥ 25 kg/m²] in men and women aged 20-59 years, increased from 18.5% to 50.1% and from 28.7% to 48.0%, respectively, between 1975 and 2009. In addition, the prevalence of obesity (BMI ≥30 kg/m²) in the adult population has increased from 2.8% to 12.4% in men and from 8.0% to 16.9% in women[2]. This increase

is a cause for concern because overweight is a risk factor for various health disorders[3,4] and causes a significant increase in direct and indirect costs[4,5].

Several studies have indicated a relationship between excessive body fat and risk for diseases that increase morbidity and mortality, including cardiovascular diseases, which are among the main leading causes of death worldwide[1,4,6,7]. Another consequence of overweight is dyslipidemia[6], which is defined by the presence of at least one alteration in the lipid profile: increased serum levels of low-density lipoprotein cholesterol (LDL-c) and triglycerides (TG) and/or decreased levels of high-density lipoprotein cholesterol (HDL-c). The increase in the number of these alterations is positively correlated with the development of atherosclerosis, which is a chronic inflammatory disease closely related to elevated serum levels of total cholesterol (TC) and leads to thickening of the medial and intimal layers of arterial walls and reduced arterial elasticity[8-10].

The epidemiological evaluation of the lipid profile is an important tool for the promotion of health policies aimed at preventing and reducing cardiovascular risk factors in

the general population[10,11]. Considering the major effects of obesity on health, the objective of the present study was to assess the lipid profile of adolescents, adults, and elderly in the municipality of São Paulo, state of São Paulo, according to the nutritional status.

Methods

Data from the cross-sectional study population ISA-Capital 2008 on a representative sample of residents of São Paulo were used[12]. In this study, 2,691 adolescents (aged 12−19 years), adults (aged 20−59 years), and elderly (aged ≥ 60 years) of both sexes were interviewed. Blood biochemistry was performed in 748 residents (158 adolescents, 302 adults, and 288 elderly). Of them, 29 residents were excluded because of incomplete socioeconomic, anthropometric, and biochemical data; and eventually, 719 (157 adolescents, 299 adults, and 263 elderly) were analyzed. The loss of sampling data from ISA-Capital 2008 occurred randomly in all the strata evaluated, without any bias regarding sex, age, income, and level of schooling[13]. In addition, weight was recalculated for the sample with biochemical data to ensure that the results were representative of the population of São Paulo.

Data were collected by means of home visits between September 2008 and March 2009 using structured questionnaires containing pre-coded questions that were administered by trained interviewers. The items included *per capita* family income, classified as up to one minimum salary (MS) and more than one MS, according to the value in effect in 2008 (R$ 415.00), and the years of schooling of the family head, categorized as ≤ 9 years and ≥ 10 years.

Anthropometric and biochemical data were obtained during home visits by qualified nurses. Weight, height[3], and waist circumference (WC)[14] were measured, and biological samples were collected[15]. For blood collection, the individuals were instructed to fast for 12 hours before and to abstain from alcohol for 3 days before the test as well as to avoid physical activity or effort on the day of the test. The nutritional status was assessed according to the cut-off BMI [BMI = weight (kg)/[height (m)]^2] values proposed by the World health Organization (WHO)[16] for adolescents and adults[3], and by the Pan American Health Organization (PAHO)[17] for the elderly. The nutritional status was analyzed as per the following categories: not overweight, including individuals with low and normal weight; and overweight, including overweight and obese individuals. The cut-off point used for WC was 102 cm for men and 88 cm for women[14].

The biochemical variables TC, HDL-c, LDL-c, and serum TG were measured using the enzyme-colorimetric method. The values for non-HDL cholesterol were obtained by subtracting HDL-c from TC values. For sample categorization, cut-off points for inadequacy were used, according to the V Brazilian Guideline on Dyslipidemia[18]. The lipid profile of adolescents was considered inadequate when serum HDL-c level <45 mg/dL, LDL-c level ≥ 130 mg/dL, TC level ≥170 mg/dL, and TG level ≥ 130 mg/dL. For the adults and elderly, the cut-off points for inadequacy were the following: HDL-c levels ≤40 mg/dL in men and ≤ 50 mg/dL in women, LDL-c levels ≥ 160 mg/dL, TC levels ≥ 200 mg/dL, and TG levels ≥ 150 mg/dL.

The Wald test was used to compare the mean levels of the lipid variables according to the nutritional status of the population under study. Pearson's chi-square test was used to compare the prevalence of dyslipidemia among overweight and not overweight individuals and among those with adequate and inadequate WC. Quantitative variables were expressed as mean and standard error, and the qualitative variables as numbers and percentages. The analyses were performed using the *survey* mode in the Stata statistical software, version 11.0, to ensure that the obtained results would be representative of the total population of the municipality of São Paulo. The level of significance was set at 5%.

Results

Table 1 shows the profile of the population under study, according to sex, socioeconomic status (*per capita* family income and level of schooling of the family head), and anthropometric factors (BMI and WC) according to the age group. Approximately half of the study population (49.81%) had normal weight and 46.01% were overweight. Furthermore, 84.04% of the adolescents had an adequate nutritional status, whereas 37.28% elderly were obese. With regard to central obesity, 48.33% of the total population had an inadequate WC, which was higher among the elderly (74.68%). The presence of any type of dyslipidemia was observed in 59.74% of the study population.

The mean levels of the biochemical variables HDL-c, LDL-c, CT, TG, and non-HDL cholesterol were measured according to the nutritional status (overweight and not overweight) in the total population and according to age group to take into account the physiological differences between the age groups (Table 2).

When data of the total population were analyzed continuously, a positive correlation was observed between the lipid variables LDL-c, TC, TG, non-HDL cholesterol and BMI; however, the correlation was not significant for HDL-c (Figure 1). In addition, a positive correlation was observed between the lipid variables LDL-c, TC, TG, non-HDL cholesterol and WC (Figure 2).

Table 3 shows a higher prevalence of inadequacy of the recommended lipid profile parameters in overweight individuals. A higher percentage of dyslipidemia was observed in overweight adults and elderly in all categories, but this difference was not significant for LDL-c (isolated hypercholesterolemia) in both age groups. The adolescent group was not assessed separately because of the low prevalence of dyslipidemia (1.02%) but was included in the calculation of the total population.

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Table 1 – Profile of the study population; São Paulo, state of São Paulo, 2008, according to the age group*

	Adolescents		Adults		Elderly		Total	
	%	95% CI*	%	95% CI*	%	95% CI*	%	95% CI*
Gender								
Male	50.1	41.4-58.8	48.2	42.0-54.4	39.6[‡]	33.5-46.0	47.1	42.7-51.5
Female	49.9	41.2-58.6	51.8	45.6-58.0	60.4[‡]	54.0-66.5	52.9	48.5-57.3
***Per capita* family income[†]**								
≤1 MS	60.5[‡]	51.3-69.0	37.6[‡]	29.5-46.5	37.9[‡]	30.0-46.4	40.5[‡]	34.0-47.2
>1 MS	39.5[‡]	31.0-48.7	62.4[‡]	53.6-70.5	62.2[‡]	53.7-70.0	59.5[‡]	52.8-66.0
Level of schooling of the family head								
≤ 9 years	41.2[‡]	33.8-48.9	43.4	33.1-54.3	64.3[‡]	55.4-72.3	46.3	38.4-54.5
≥10 years	58.9[‡]	51.1-66.2	56.6	45.7-66.9	35.7[‡]	27.8-44.6	53.7	45.5-61.7
BMI								
Low weight	2.5	0.1-6.9	2.2	1.0-4.7	15.1	11.3-19.9	4.2	2.9-6.0
Eutrophy	84.0	76.6-89.5	46.8	41.1-52.6	36.6	30.9-42.7	49.8	45.6-54.1
Overweight	11.0	6.7-17.5	31.1	25.6-37.1	11.1	7.2-16.6	25.6	21.2-30.5
Obesity	2.4	1.0-6.0	20.0	15.1-25.9	37.3	32.5-42.3	20.5	16.9-24.5
Waist circumference								
Adequate	80.0[‡]	70.7-86.8	52.4	46.2-58.6	25.3[‡]	20.1-31.4	51.7	47.1-56.2
Inadequate	20.1[‡]	13.2-29.3	47.6	41.4-53.8	74.7[‡]	68.6-79.9	48.3	43.8-52.9
Dyslipidemia								
Absence	44.3	35.6-53.3	39.7[‡]	33.5-46.2	39.7[‡]	32.9-46.9	40.3[‡]	35.8-44.8
Presence	55.7	46.7-64.4	60.3[‡]	53.8-66.5	60.3[‡]	53.1-67.1	59.7[‡]	55.2-64.2
Total	12.3	9.7-15.6	72.4	68.2-76.2	15.3	12.5-18.7	100.0	

Weighted values according to sampling design; [†] MS was R$ 415.00 at the time of the study; [‡] significant difference (95% CI) between the categories of the dichotomous variables, by age group. The results are expressed as percentages and 95% CI. 95% CI: 95% confidence interval; MS: minimum salary; BMI: body mass index.

Table 4, shows the prevalence of dyslipidemia according to the adequacy of WC in the total population and by age group. A higher prevalence of any type of dyslipidemia was observed in individuals with inadequate WC, and was statistically significant for low HDL-c among the adults and elderly, for isolated hypertriglyceridemia in adults and the total population, and for any type of dyslipidemia in adults and the total population. The adolescent category was not assessed separately because of the low prevalence of dyslipidemia (1.02%) but was included in the calculation of the total population.

Discussion

The results of the present study indicate an association between overweight and dyslipidemia in a sample population in the city of São Paulo. The most prevalent dyslipidemia in the study population was low HDL-c.

Several studies in Brazil have reported that overweight and obesity are associated with dyslipidemia[6,10,19,20]. In the present study, considering the total population, the mean lipid levels were within those recommended by the V Brazilian Guidelines on Dyslipidemia and Atherosclerosis Prevention[18], with the exception of TG in overweight individuals and for HDL-c, when considering the cut-off point for women. Previous studies have demonstrated that, although overweight individuals can have higher levels of TC than normal-weight individuals, the main dyslipidemia associated with the accumulation of adipose tissue is characterized by elevated TG and decreased HDL-c levels[19,21-24].

The number of deaths by cardiovascular disease has increased in Brazil mainly because of elevated BMI[9] (Figure 1). A study conducted with adolescents in Campina Grande (PB) showed an association between BMI and TC and its LDL fraction[6]. Santos et al[25] and Liberato et al[26] reported a negative correlation between HDL-c and BMI.

Another condition associated with dyslipidemia is abdominal obesity[27-29]. The results of the present study are in line with those of Rezende et al[30] and Alvarez et al[31], who demonstrated an association between WC and cardiovascular risk factors.

Table 2 – Mean, standard error, and *p* value of the levels of lipid variables in the residents of São Paulo, state of São Paulo, in 2008, according to nutritional status

Variables	Not overweight		Overweight		p value	Total	
	Mean	SE	Mean	SE		Mean	SE
Total population							
HDL-c	50	1	45	1	0.001	48	1
LDL-c	104	3	116	3	0.002	110	2
TC	175	3	194	3	0.000	184	2
TG	104	5	164	10	0.000	132	6
Non-HDL	125	3	148	3	0.000	135	2
Adolescents							
HDL-c	47	1	41	1	0.002	47	1
LDL-c	74	2	83	5	0.105	76	2
TC	137	3	145	7	0.281	138	2
TG	75	3	105	10	0.006	79	3
Non- HDL	89	2	104	6	0.023	91	2
Adults							
HDL-c	50	2	45	1	0.003	48	1
LDL-c	109	4	115	3	0.171	112	3
TC	181	5	192	4	0.034	187	3
TG	109	8	167	12	0.000	139	8
Non- HDL	130	4	148	4	0.001	139	3
Elderly							
HDL-c	55	1	49	1	0.001	52	1
LDL-c	124	4	129	4	0.338	126	3
TC	202	4	210	5	0.232	206	3
TG	121	4	162	11	0.000	141	6
Non-HDL	148	4	161	5	0.048	154	3

HDL-c: high-density lipoprotein; LDL-c: low-density lipoprotein; SE: standard error; TC: total cholesterol; TG: triglycerides.

International studies indicate that dyslipidemia is a global problem. Data from the National Health and Nutrition Examination Survey (NHANES) showed that 12.9% of North American adults have elevated TC levels ($\geq$ 240 mg/dL) and 17.4% of these adults have low HDL-c levels (< 40 mg/dL)[32]. In a population-based study conducted in Shanghai, China, with 14,385 adults of both sexes, 36.5% of the population had dyslipidemia, 3.8% had mixed hyperlipidemia, 24.9% had isolated hypertriglyceridemia, 3.2% had isolated hypercholesterolemia, and 4.7% had low HDL-c[33]. Dyslipidemia was associated with BMI, WC, age, and gender, as observed in the present study.

In the present study, 59.74% of the population of São Paulo (overweight and not overweight) had dyslipidemia (Table 1). Of these individuals, 39.58% had low HDL-c levels, 9.39% had elevated LDL-c levels (isolated hypercholesterolemia), 26.82% had elevated TG levels (isolated hypertriglyceridemia), and 7.13%

had mixed hyperlipidemia. Furthermore, this population was characterized considering the increased LDL-c and TG levels, and mixed hyperlipidemia was defined as TG levels $\geq$ 400 mg/dL and TC levels $\geq$ 200 mg/dL. Another population-based cross-sectional study conducted in São Paulo in 2001-2002 demonstrated that the total prevalence of dyslipidemia, adjusted for age, in the age group 15-59 years was 8.1% for TC ($\geq$ 240 mg/dL), 27.1% for HDL-c (< 40 mg/dL), and 14.4% for TG ($\geq$ 200 mg/dL)[34]. A study that evaluated a population sample from Rio de Janeiro showed that the prevalence of any type of dyslipidemia was 24.2%, with 18.3% for low HDL-c (< 40 mg/dL), 3.5% for elevated LDL-c ($\geq$ 160 mg/dL), 4.2% for isolated hypercholesterolemia ($\geq$ 240 mg/dL), and 17.1% for isolated hypertriglyceridemia ($\geq$ 200 mg/dL)[10]. The prevalence in these studies was lower than that found in the present study; however, those authors did not analyze the correlation between these variables and
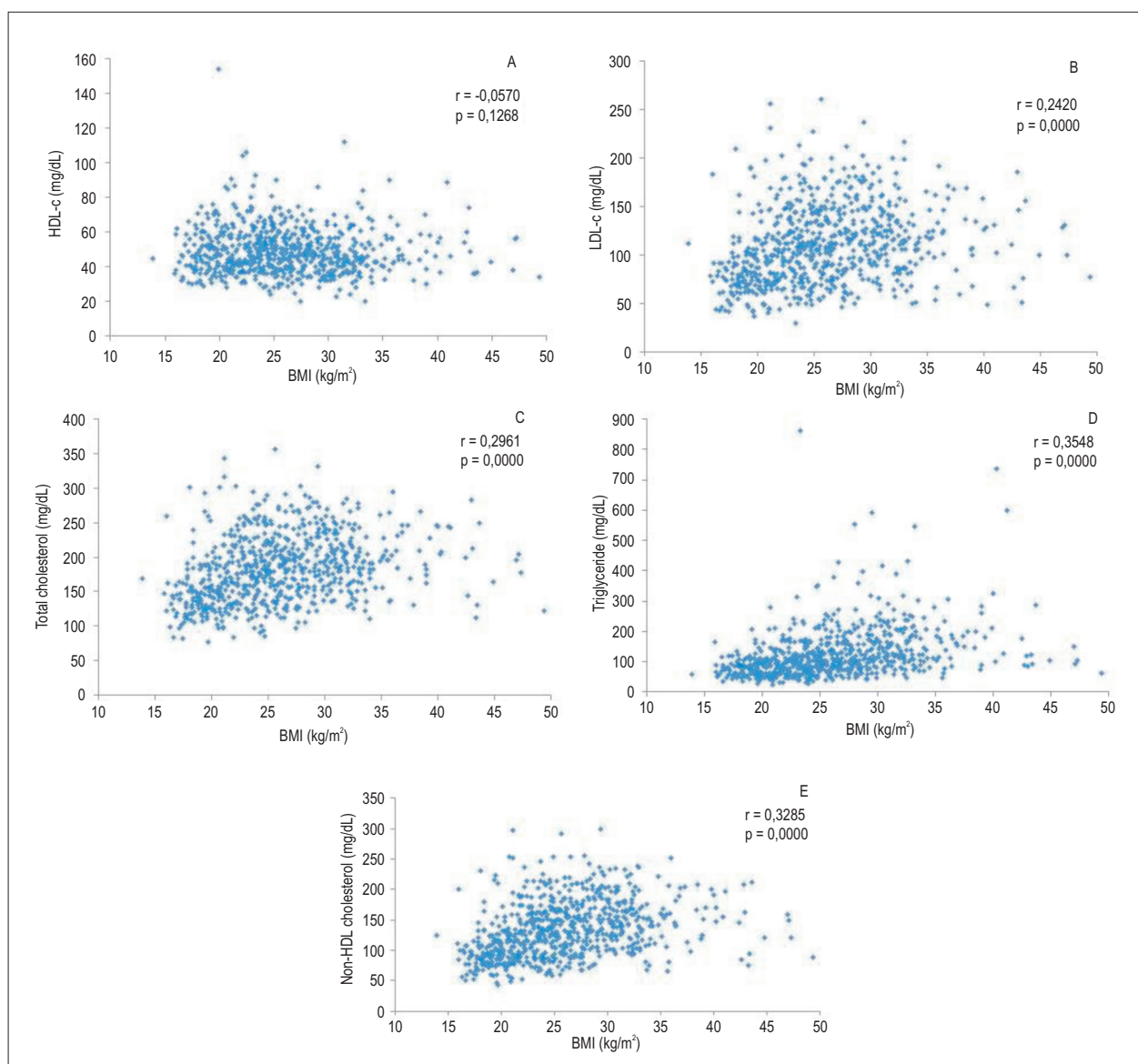
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Figure 1 – *Scatter plots of the correlation between high-density lipoprotein cholesterol (HDL-c) (A), low-density lipoprotein cholesterol (LDL-c) (B), total cholesterol (C), triglycerides (D), non-HDL cholesterol (E) and body mass index (BMI) in the total population. São Paulo (SP), 2008.*

the nutritional status of the population. The prevalence differences between the present study and other studies may be explained by the cut-off points used to determine dyslipidemia, which were higher for TC, TG, and HDL-c in women because the authors of those studies followed the recommendations in force at the time. In the present study, the updated criteria proposed in the V Brazilian Guideline on Dyslipidemia and Atherosclerosis Prevention of the Brazilian Society of Cardiology[18] were used, and took into account the differences between age groups for adults and elderly as well as gender. In addition, this result may be due to lifestyle changes that have occurred in recent years. The current dietary pattern, the so-called "Western diet," which is high in fats, cholesterol, refined sugar, and low in

fiber[35], and a sedentary lifestyle[36] are factors that contribute to the increased prevalence of dyslipidemia.

According to the results of the present study, low HDL-c was the major contributor to dyslipidemia in this population. Diet and lifestyle changes, such as weight loss, decreased intake of saturated and trans fatty acids, exercise, and smoking cessation have a significant impact on HDL-c levels[18]. With regard to cardiovascular risk, the primary therapeutic goal in cases of dyslipidemia is LDL-c because the prevalence of this type of dyslipidemia was low in the total population (9.39%), whereas that of low HDL-c was 39.58%.

Although smoking is established to be a major health problem, its global use remains high. Brazil is the second largest producer of tobacco in the world and the largest
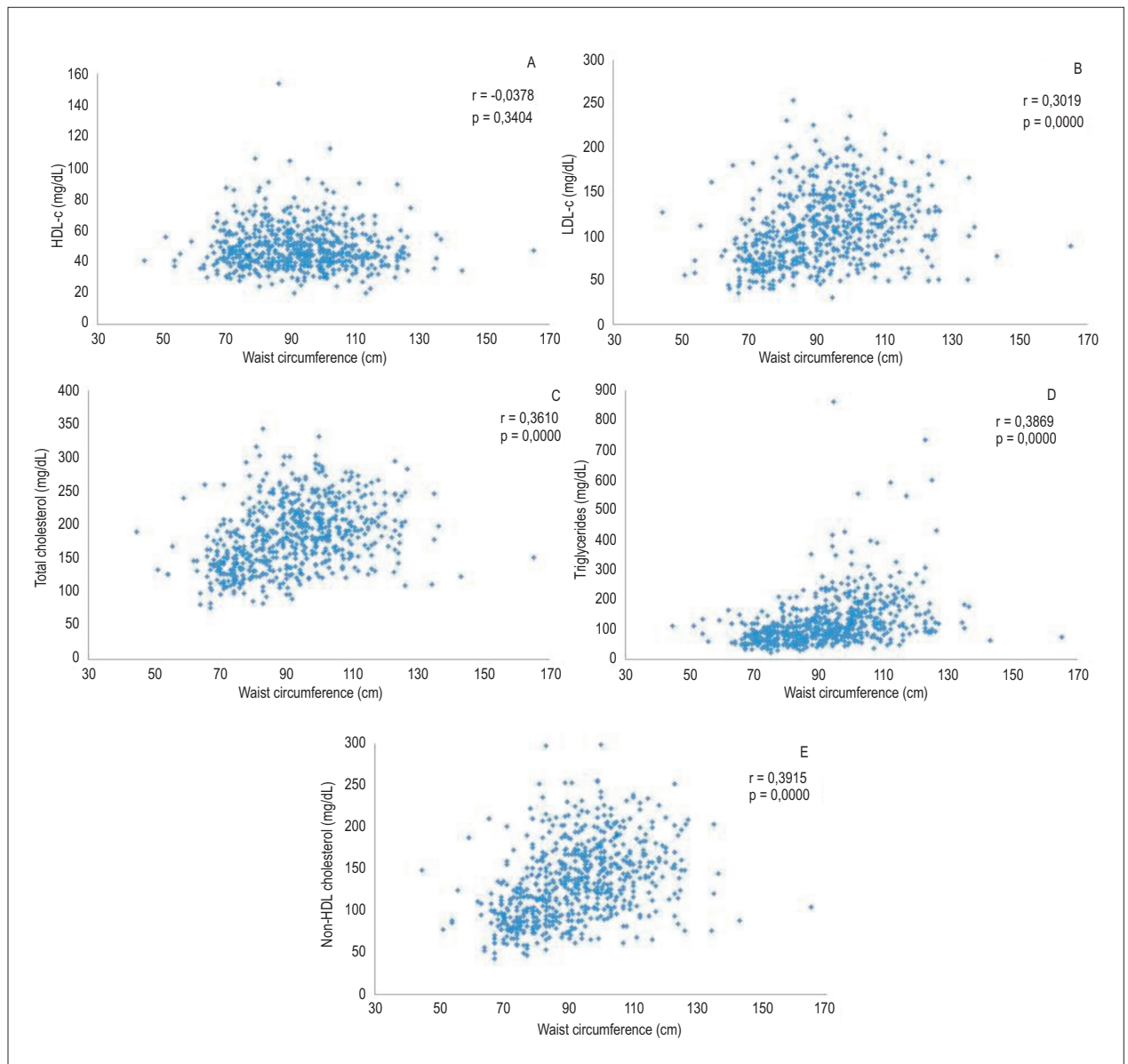
Figure 2 – *Scatter plots of the correlation between high-density lipoprotein cholesterol (HDL-c) (A), low-density lipoprotein cholesterol (LDL-c) (B), total cholesterol (C), triglycerides (D), non-HDL cholesterol (E) and waist circumference (WC) in the total population. São Paulo (SP), 2008.*

exporter of leaf tobacco; however, it has managed to resist this trend[37]. The prevalence of tobacco use in the population aged ≥18 years in São Paulo is 21.5% and 23.8% among men. No significant difference in the smoking prevalence between 2008 (21.5%) and 2003 (21.2%) in the general population of both genders was observed[38].

An epidemiological study conducted in São Paulo showed that only one third of the population performs any type of physical activity, which indicates a high prevalence of sedentarism[36]. A formative analysis of the local environmental factors associated with overweight in adults residing in São Paulo showed an inverse correlation between the prevalence of overweight and the density of parks and public sport facilities. Most parks are concentrated in the central and richest area of the city, which exhibits the lowest obesity rate and higher physical activity[39]. This scenario is a cause of concern because physical activity is a decisive factor for the increase in HDL-c levels.

A limitation of the present study was the fact that the individuals using medications to control dyslipidemia or other drugs that could interfere with the lipid profile were not excluded. However, these individuals represented only 7.13% of the sample group.

It is essential to investigate the prevalence of dyslipidemia and obesity in the population with the aim of promoting preventive and curative measures for

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Table 3 – Prevalence of dyslipidemia in overweight and not overweight individuals, São Paulo (SP), 2008

Lipid variables	Adults			Elderly			Total population*			Total
	Not EW	EW	p value	Not EW	EW	p value	Not EW	EW	p value	
	n (%)	n (%)		n (%)	n (%)		n (%)	n (%)		n (%)
Low HDL	54 (31.8)	78 (47.3)	0.03	28 (20.1)	50 (41.1)	0.01	148 (33.4)	143 (46.9)	0.021	291 (39.6)
Isolated hypercholesterolemia	11 (6.8)	16 (9.7)	0.30	26 (19.2)	25 (22.3)	0.63	38 (7.4)	44 (11.8)	0.058	82 (9.4)
Isolated hypertriglyceridemia	17 (10.6)	64 (45.3)	0.00	38 (26.0)	58 (46.8)	0.00	60 (11.6)	128 (44.7)	0.000	188 (26.8)
Mixed hyperlipidemia	5 (3.2)	14 (10.6)	0.01	11 (6.9)	19 (18.1)	0.01	17 (3.2)	35 (11.7)	0.000	52 (7.1)
Any dyslipidemia	77 (47.0)	112 (73.1)	0.00	73 (51.4)	82 (69.9)	0.01	220 (48.4)	214 (73.0)	0.000	434 (59.7)

* Total population includes adolescents, adults, and elderly; EW: overweight; HDL: high-density lipoprotein.

Table 4 – Prevalence of dyslipidemia according to the adequacy of the waist circumference (WC) by age group, São Paulo (SP), 2008

Lipid variables	Adults			Elderly			Total*			Total*
	WC adequacy†	WC inadequacy‡	p value	WC adequacy†	WC inadequacy‡	p value	WC adequacy†	WC inadequacy‡	p value	
	n (%)	n (%)		n (%)	n (%)		n (%)	n (%)		n (%)
Low HDL-c	58 (33.6)	74 (46.4)	0.05	13 (19.0)	65 (34.0)	0.05	135 (35.8)	156 (43.6)	0.121	291 (39.6)
Isolated hypercholesterolemia	12 (7.5)	15 (9.1)	0.62	14 (19.1)	27 (21.2)	0.75	27 (7.1)	55 (11.9)	0.102	82 (9.4)
Isolated hypertriglyceridemia	28 (19.3)	53 (38.2)	0.00	18 (27.1)	78 (39.1)	0.15	51 (17.0)	13.7 (37.4)	0.000	188 (26.8)
Mixed hyperlipidemia	9 (7.2)	10 (6.8)	0.92	7 (8.8)	23 (14.6)	0.36	17 (6.0)	35 (8.3)	0.368	52 (7.1)
Any dyslipidemia	84 (51.2)	105 (70.4)	0.00	35 (48.8)	120 (64.2)	0.06	187 (51.6)	247 (68.5)	0.001	434 (59.7)

* Total population included adolescents, adults, and elderly; †adequate WC: ≤ 102 cm in men and ≤ 88 cm in women; ‡inadequate WC: > 102 cm in men and > 88 cm in women.

cardiovascular diseases. Because São Paulo is the most populous city in the Brazil[40], the results of this study are an important analysis instrument for the creation or remodeling of public health programs to improve the health of the population in all age groups.

Conclusion

Obesity and its consequences have major negative effects on the health of the Brazilian population. The results of the present study indicate an association between dyslipidemia and overweight in the residents of São Paulo. In addition, the most prevalent dyslipidemia in this population was low HDL-c.

Author contributions

Conception and design of the research and Acquisition of data: Marchioni DML, Fisberg RM; Analysis and interpretation of the data: Garcez MR, Pereira JL, Fontanelli MM, Marchioni DML, Fisberg RM; Statistical analysis: Pereira JL, Fontanelli MM; Obtaining financing: Fisberg RM; Writing of the manuscript: Garcez MR; Critical revision of the manuscript for intellectual content: Pereira JL, Fontanelli MM, Marchioni DML, Fisberg RM.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Study Association

This study is not associated with any thesis or dissertation work.

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