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Prevalence of altered total cholesterol and fractions in the Brazilian adult population: National Health Survey

Prevalência de colesterol total e frações alterados na população adulta brasileira: Pesquisa Nacional de Saúde

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ABSTRACT: ***Objective:*** To analyze the prevalence of altered total cholesterol and fractions levels in the Brazilian population, according to biochemical data from the National Health Survey. ***Methods:*** A descriptive study, using data from the National Health Survey, collected between 2014 and 2015. Total cholesterol and fractions were analyzed and population prevalences of altered values according to socio-demographic variables were calculated. The cutoff points considered were: total cholesterol ≥ 200 mg/dl; low-density lipoprotein LDL ≥ 130 mg/dL and high-density lipoprotein HDL < 40 mg/dL. ***Results:*** The prevalence of total cholesterol ≥ 200 mg/dL in the population was 32.7%, and higher in women (35.1%). The prevalence of altered HDL was 31.8%, 22.0% in females and 42.8% in males. LDL ≥ 130 mg/dL was found in 18.6% and was higher in women (19.9%). The population aged 45 years old and older and those with low levels of education presented a higher prevalence of altered cholesterol. ***Conclusion:*** Altered values of total cholesterol and fractions were frequent in the Brazilian population, especially among women, the elderly and people with low levels of education. These results may guide control and preventative actions such as healthy eating, physical activity and treatment, all of which aim to prevent coronary diseases.

Keywords: Cholesterol. Cholesterol, HDL. Cholesterol, LDL. Cardiovascular diseases. Health surveys. Laboratory test.

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RESUMO: ***Objetivo:*** Analisar as prevalências dos níveis de colesterol total e frações alterados na população brasileira, segundo dados bioquímicos da Pesquisa Nacional de Saúde. ***Métodos:*** Estudo descritivo, utilizando dados laboratoriais da Pesquisa Nacional de Saúde coletados entre os anos de 2014 e 2015. Foram analisados exames de colesterol total e frações e calculadas prevalências populacionais de valores alterados segundo variáveis sociodemográficas. Consideraram-se os seguintes pontos de corte: colesterol total ≥ 200 mg/dL; lipoproteínas de baixa densidade (LDL) ≥ 130 mg/dL e lipoproteínas de alta densidade (HDL) < 40 mg/dL. ***Resultados:*** A prevalência de colesterol total ≥ 200 mg/dL na população foi de 32,7%, mais elevada em mulheres (35,1%). A prevalência de HDL alterado foi de 31,8%, sendo de 42,8% no sexo masculino e 22,0% no feminino. LDL ≥ 130 mg/dL foi observado em 18,6%, com prevalência mais elevada em mulheres (19,9%). População com idade de 45 anos ou mais e com baixa escolaridade apresentou maiores prevalências de colesterol com alterações. ***Conclusão:*** Valores de colesterol total e frações alterados foram frequentes na população brasileira, especialmente entre mulheres, idosos e pessoas de baixa escolaridade. Esses resultados poderão orientar as ações de controle e prevenção, como alimentação saudável, atividade física e tratamento, visando à prevenção de doenças coronarianas.

Palavras-chave: Colesterol. HDL-colesterol. LDL-colesterol. Doenças cardiovasculares. Inquéritos epidemiológicos. Testes laboratoriais.

INTRODUCTION

Noncommunicable chronic diseases (NCDs) are the leading causes of morbidity and mortality worldwide. Among these diseases, cardiovascular diseases (CVD) stand out for their magnitude, and their association with disability and premature death[1]. In Brazil, about one third of deaths are due to CVD, and they are also the most significant cause of healthcare spending[2].

Cholesterol is one of the most biologically important lipids. It is a precursor to steroid hormones, bile acids and vitamin D. As a component of cell membranes, cholesterol acts on its fluidity and metabolic regulation[3]. Lipoproteins allow for lipid transport in the aqueous plasma and can be classified according to their density as a low-density lipoprotein (LDL) and a high-density lipoprotein (HDL)[3].

In the 1960s, studies in the Framingham Heart cohort showed evidence that elevated serum cholesterol values would increase the risk of myocardial infarction in subsequent years of the study[4]. Later, other research confirmed associations between high cholesterol levels and increased risk for heart disease and stroke[5,6].

The World Health Organization estimates point out that elevated serum cholesterol causes about 2.6 million deaths and 29.7 million years of life lost due to premature death and disability[5].

Clinical trials, meta-analyzes and clinical consensus demonstrate that dyslipidemia control is associated with important benefits in reducing cardiovascular events and mortality. The most well-known, the Adult Treatment Panel III (ATP III), in 2001, has guided countries in setting cutoff points and therapeutic targets for cholesterol levels depending on the risk of having a cardiovascular incident[7].

Subsequent studies from different countries have developed guidelines that associate elevated cholesterol levels with higher risk not only of acute myocardial infarction, but also of peripheral arterial disease and stroke[8] and point out that the best predictor of cardiac risk is the LDL[8].

Investigations indicate that there is a reduction in the CVD rate when plasma cholesterol is decreased, particularly LDL-cholesterol levels[3]. Clinical trials with statins have shown that the greater the absolute reduction in LDL, the greater the reduction in CVD. However, there is still no consensus in the literature on the best LDL serum level needed to obtain the benefit[8,9].

Despite the established evidence in the scientific literature regarding the association between cholesterol and coronary artery disease, population surveys that monitor the prevalence of cholesterol in Brazil are still scarce and mostly use self-reported data[10,11]. The results of the Brazilian Longitudinal Study of Adult Health (Estudo Longitudinal de Saúde do Adulto - ELSA Brazil), conducted among employees of federal universities around the country, showed a higher prevalence of altered LDL in men, black people, the elderly and people with low levels of education[12].

In 2014 and 2015, the National Health Survey (*Pesquisa Nacional de Saúde* - PNS) collected biological material that included measurements of cholesterol and fractions[13,14], enabling, for the first time, national analyzes on the distribution of altered cholesterol in the Brazilian population. Therefore, the aim of this study was to analyze the prevalence of altered total cholesterol levels and fractions in the Brazilian population, according to PNS biochemical data.

METHODS

The present study was a descriptive, epidemiological survey, and used data from PNS laboratory exams from 2014 to 2015. PNS is a national and home-based survey conducted by the Brazilian Institute of Geography and Statistics, in partnership with the Ministry of Health. It uses three-stage probabilistic samples, and interview records were obtained from 64,348 households. More methodological details can be read in other publications[13,14].

The laboratory subsample consisted of 8,952 people, and 418 samples were excluded due to having enough material, hemolysis, sample loss and other reasons. Thus, there was a total of 8,534 exams for the current analysis. The study adopted post-stratification weights according to gender, age, education and region, aiming to establish estimates for the Brazilian adult population[14].

The research participants signed an informed consent form, and then peripheral blood was collected at any time of the day. It is also worth noting that the study followed the protocol that dispenses fasting for cholesterol measurement[3].

Total cholesterol (TC), LDL and HDL were collected in gel tubes. The next steps included waiting for 30 minutes for clot retraction and then centrifuging and forwarding

the samples, which were refrigerated at 2 to 8°C. The temperature was controlled during each of the steps. These parameters were measured by an automated enzymatic/colorimetric method.

The prevalences for each category of TC levels and fractions were described by the following intervals:

- TC: <160 mg/dL; ≥ 160 to <200 mg/dL; ≥ 200 to <220 mg/dL; ≥ 220 to <280 mg/dL; and ≥ 280 mg/dL.
- LDL cholesterol: <100 mg/dL; ≥ 100 to <130 mg/dL; ≥ 130 to <160 mg/dL; ≥ 160 to <190 mg/dL; and ≥ 190 mg/dL.
- HDL cholesterol: <25 mg/dL; ≥ 25 to <30 mg/dL; ≥ 30 to <40 mg/dL; ≥ 40 to <50 mg/dL; > 50 mg/dL.
- TC/HDL ratio: <4.0.

The average of cholesterol levels and the TC/HDL ratio were calculated for the general population and according to age groups (18 to 29 years; 30 to 44 years; 45 to 59 years; 60 years or older).

Dichotomous analysis was performed (having altered cholesterol or not), and the population prevalence of altered TC and fractions were calculated, considering the following cutoff points: TC ≥ 200 mg/dL; LDL ≥ 130 mg/dL and HDL levels < 40 mg/dL, in accordance with the clinical treatment parameters recommended by the ATPIII[7]. Prevalence was stratified by gender, age group (18-29 years; 30-44 years; 45-59 years; 60 years or older), education (0 to 8; 9 to 11, 12 years of schooling or more), race/color (white, dark-skinned black, light-skinned black and others) and regions of the country (North, Northeast, South, Southeast and Midwest).

To estimate differences between strata, Pearson's χ^2 test was used. The data were analyzed using the Data Analysis and Statistical Software (Stata), version 14, based on the set of commands for analyzing data from surveys with a complex sample (survey).

The PNS was approved by the National Research Ethics Commission (*Comissão Nacional de Ética em Pesquisa* - CONEP) of the National Health Council (*Conselho Nacional de Saúde* - CNS), of the Ministry of Health. Adult participation in the research was voluntary and confidentiality of their information was guaranteed. Subjects selected for the research provided informed consent for all of the research procedures, including interviewing and blood and urine collection.

RESULTS

The mean TC in the population was 185 mg/dL. It was 181.7 mg/dL in males and 198.7 mg/dL in females. The average was higher with the increase in age – in the age group 18 to 29 years, for example, it was 169.4 mg/dL reaching higher averages between 45 and 59 years of age.

Regarding HDL, the population average was 46.5 mg/dL - 43 mg/dL for males and 49.6 mg/dL for females. In general, in all age groups, the HDL values were similar, around 46.5 mg/dL.

Regarding LDL, the population average was 104.7 mg/dL - 102.9 mg/dL in males and 106.2 mg/dL in females. In the age group of 18-29 years, the average LDL was 93.1 mg/dL. Higher values were observed between 40 and 59 years old (112.2 mg/dL).

The TC/HDL ratio was high in the total population (4.3) in both men (4.6) and women (4.0). It was less than 4 only for the total population aged 18 to 29 years and women between 18 and 44 years old (Table 1).

TC values for the total population were: <160 mg/dL (26.3%), ≥ 160 to <200 mg/dL (41%), ≥ 200 to <220 mg/dL (15.4%), ≥ 220 to <280 mg/dL (15.8%) and ≥ 280 mg/dL (1.5%). For HDL, the values were: <25 mg / dL (2%), ≥ 25 to <30 mg / dL (4.8%), ≥ 30 to <40 mg/dL (25%), ≥ 40 to < 50 mg/dL (33.2%) and ≥ 50 mg/dL (35.1%). LDL values were: <100 mg/dL (45.7%), ≥ 100 to <130 mg/dL (35.7%), ≥ 130 to <160 mg/dL (14.1%), ≥ 160 to <190 mg/dL

Table 1. Population average of total cholesterol (TC), high-density lipoprotein cholesterol (HDL), low-density lipoprotein cholesterol (LDL), and TC/HDL ratio by gender and age group. Brazil, National Health Survey (*Pesquisa Nacional de Saúde* - PNS), 2014–2015.

Gender	Age range (years)	TC		HDL		LDL		TC/HDL	
		Average	95%CI	Average	95%CI	Average at	95%CI	Average	95%CI
Total (n = 8,534)	18–29	169.4	166.9 – 171.9	46.9	46.0 – 47.9	93.1	91.3 – 94.8	3.9	3.8 – 4.0
	30–44	185.1	183.2 – 186.9	46.2	45.6 – 46.9	105.2	103.8 – 106.6	4.3	4.2 – 4.4
	45–59	195.8	193.9 – 197.7	46.4	45.7 – 47.2	112.2	110.6 – 113.8	4.6	4.5 – 4.6
	≥ 60	192.0	189.7 – 194.3	46.3	45.5 – 47.1	109.8	108.0 – 111.6	4.4	4.3 – 4.5
	Total	185.0	183.9 – 186.1	46.5	46.1 – 46.9	104.7	103.8 – 105.5	4.3	4.2 – 4.3
Male (n = 3,551)	18–29	164.9	160.7 – 169.0	43.2	41.9 – 44.5	90.1	87.7 – 92.5	4.1	3.9 – 4.3
	30–44	187.5	184.5 – 190.5	43.1	42.2 – 44.0	107.0	104.7 – 109.3	4.7	4.5 – 4.8
	45–59	191.7	189.0 – 194.4	43.3	42.1 – 44.4	109.6	107.3 – 111.8	4.8	4.7 – 4.9
	≥ 60	183.4	180.1 – 186.7	42.0	41.0 – 43.0	106.0	103.4 – 108.6	4.6	4.5 – 4.8
	Total	181.7	179.9 – 183.5	43.0	42.4 – 43.5	102.9	101.6 – 104.2	4.6	4.5 – 4.6
Female (n = 4,983)	18–29	173.9	171.1 – 176.7	50.6	49.3 – 51.8	96.0	93.6 – 98.3	3.6	3.6 – 3.7
	30–44	182.9	180.7 – 185.2	49.0	48.2 – 49.8	103.6	101.9 – 105.4	3.9	3.9 – 4.0
	45–59	199.6	196.9 – 202.2	49.3	48.3 – 50.3	114.6	112.4 – 116.8	4.3	4.2 – 4.4
	≥ 60	198.6	195.7 – 201.7	49.6	48.5 – 50.8	112.8	110.3 – 115.2	4.3	4.2 – 4.4
	Total	198.7	186.6 – 189.3	49.6	49.1 – 50.1	106.3	105.2 – 107.4	4.0	4.0 – 4.1

95%CI: 95% confidence interval.

(3.8%) and ≥ 190 mg/dL (0.7%). The TC/HDL ratio > 4 was found in 50% of the total population (Table 2).

The prevalence in the adult population of TC ≥ 200 mg/dL was 32.7%, and was higher in women (35.1%). The prevalence of high cholesterol was higher among those aged over 45 years and lower among those with higher levels of education (p <0.001) (Table 3).

The prevalence of HDL lower than 40 mg/dL in the adult population was 31.8%, and was approximately twice as high in males (42.8%) compared to females (22%). Altered HDL values were lower in the population with higher levels of education. Regarding the regions,

Table 2. Distribution of total cholesterol (TC), high-density lipoprotein cholesterol (HDL) and low-density lipoprotein cholesterol (LDL) levels according to different cutoff points. Brazil, National Health Survey 2014 – 2015.

Categories	Total			Male			Female		
	%	95%CI		%	95%CI		%	95%CI	
Total Cholesterol									
< 160	26.3	25.0	27.6	29.7	27.6	31.8	23.2	21.7	24.8
≥ 160 and < 200	41.0	39.6	42.4	40.2	38.1	42.4	41.7	39.9	43.5
≥ 200 and < 220	15.4	14.5	16.5	14.9	13.5	16.5	15.9	14.6	17.2
≥ 220 and < 280	15.8	14.8	16.8	13.9	12.5	15.4	17.4	16.1	18.8
≥ 280	1.5	1.2	1.9	1.2	0.9	1.8	1.8	1.4	2.3
HDL									
< 25	2.0	1.6	2.4	3.2	2.6	4.1	0.8	0.6	1.2
≥ 25 and < 30	4.8	4.2	5.5	7.2	6.1	8.5	2.7	2.2	3.2
≥ 30 and < 40	25.0	23.8	26.3	32.4	30.3	34.5	18.5	17.2	20.0
≥ 40 and < 50	33.2	31.8	34.5	33.1	31.0	35.2	33.3	31.6	35.0
≥ 50	35.1	33.7	36.4	24.1	22.3	26.1	44.8	42.9	46.6
LDL									
< 100	45.7	44.3	47.2	48.0	45.7	50.2	43.8	42.0	45.6
≥ 100 and < 130	35.7	34.3	37.1	34.9	32.8	37.1	36.4	34.6	38.2
≥ 130 and < 160	14.1	13.2	15.1	13.7	12.3	15.2	14.5	13.3	15.8
≥ 160 and < 190	3.8	3.3	4.4	3.0	2.3	3.8	4.5	3.8	5.3
≥ 190	0.7	0.5	0.9	0.5	0.3	0.8	0.9	0.6	1.3
TC/HDL									
≥ 4	50.0	48.6	51.5	58.3	56.1	60.6	42.7	40.9	44.5

95%CI: 95% confidence interval.

altered HDL was less frequent in the Southern Region for the general population and in both genders (Table 4).

The prevalence of LDL ≥ 130 mg/dL was 18.6%, higher in women (19.9%) and among participants aged 45 and over (p<0.001). Regarding education levels, it was more frequent in the range of zero to eight years of education for the total population (21.5%) and among women (24.9%) (p <0.001) (Table 5).

Table 3. Population prevalence of total cholesterol ≥ 200 mg/dL according to gender, age, education level, skin color and region. Brazil, National Health Survey 2014 – 2015.

	Total			Male			Female		
	%	95%CI	P	%	95%CI	p	%	95%CI	p
Total	32.7	31.5 – 34.1		30.1	28.2 – 32.1		35.1	33.4 – 36.8	< 0.001
Age range									
18 to 29	17.9	15.7 – 20.4	< 0.001	13.9	11.2 – 17.4	< 0.001	21.9	18.7 – 25.5	< 0.001
30 to 44	31.0	28.7 – 33.4		34.9	31.2 – 38.8		27.6	24.9 – 30.5	
45 to 59	43.4	40.8 – 46.0		39.4	35.7 – 43.4		47.0	43.5 – 50.5	
≥ 60	41.9	39.1 – 44.8		33.5	29.5 – 37.9		48.4	44.7 – 52.2	
Education level (years)									
0 to 8	37.1	35.2 – 39.1	< 0.001	31.6	28.9 – 34.5	0.237	42.2	39.6 – 44.8	< 0.001
9 to 11	28.6	25.5 – 32.0		26.6	22.2 – 31.6		30.6	26.4 – 35.2	
≥ 12	30.4	28.4 – 32.5		30.0	26.9 – 33.3		30.8	28.3 – 33.4	
Skin color									
White	33.9	31.9 – 36.0	0.146	30.8	27.8 – 33.9	0.669	36.6	33.9 – 39.4	0.196
Dark-skinned black	33.2	29.0 – 37.6		30.0	23.9 – 37.0		36.0	30.5 – 41.8	
Light-skinned black	31.5	29.8 – 33.3		29.5	26.9 – 32.4		33.4	31.1 – 35.7	
Other	23.3	14.8 – 34.6		19.6	9.7 – 35.4		25.8	14.2 – 42.2	
Region									
North	32.5	30.4 – 34.6	0.195	31.0	27.9 – 34.3	0.376	33.9	31.2 – 36.7	0.291
Northeast	34.0	32.3 – 35.8		30.2	27.7 – 33.0		37.4	35.1 – 39.8	
Southeast	31.5	29.1 – 34.1		28.7	25.1 – 32.6		34.1	30.9 – 37.4	
South	34.7	31.7 – 37.8		33.4	28.9 – 38.3		35.8	32.0 – 39.8	
Midwest	31.7	28.7 – 34.8		30.1	25.7 – 34.9		33.0	29.1 – 37.2	

95%CI: 95% confidence interval.

DISCUSSION

The collection of biological material performed in the PNS and the inclusion of cholesterol and fractions represent a major advance for Brazil. For the first time, this study traces the biochemical profile of clinical or preclinical conditions of TC, LDL, HDL and TC/HDL levels in the Brazilian population. Thus, PNS laboratory data may support the identification of cardiovascular risk in the population[9].

Table 4. Population prevalence of high-density lipoprotein cholesterol (HDL) < 40 mg/dL according to gender, age, education level, skin color and region. Brazil, National Health Survey 2014 – 2015.

	Total			Male			Female		
	%	95%CI	P	%	95%CI	p	%	95%CI	p
Total	31.8	30.5 – 33.1		42.8	40.6 – 45.0		22.0	20.6 – 23.5	< 0.001
Age range									
18 to 29	29.1	26.2 – 32.2	0.070	39.7	34.9 – 44.7	0.159	18.7	15.9 – 21.9	0.046
30 to 44	31.8	29.4 – 34.2		41.8	37.9 – 45.7		23.0	20.4 – 25.9	
45 to 59	34.1	31.6 – 36.6		44.8	40.9 – 48.8		24.3	21.5 – 27.4	
≥ 60	32.4	29.8 – 35.2		46.5	42.1 – 51.1		21.5	18.7 – 24.6	
Education level (years)									
0 to 8	33.7	31.8 – 35.7	< 0.001	43.3	40.2 – 46.4	0.006	24.9	22.8 – 27.2	< 0.001
9 to 11	38.5	34.9 – 42.2		50.0	44.3 – 55.6		27.0	22.9 – 31.5	
≥ 12	27.8	25.9 – 29.9		39.6	36.2 – 43.2		18.1	16.1 – 20.3	
Skin color									
White	31.0	29.0 – 33.1	0.072	43.0	39.7 – 46.5	0.586	20.6	18.4 – 23.0	0.006
Dark-skinned black	28.5	24.3 – 33.2		41.8	34.5 – 49.4		16.6	12.6 – 21.6	
Light-skinned black	33.5	31.7 – 35.4		43.0	40.0 – 46.1		24.8	22.8 – 27.0	
Other	24.7	15.8 – 36.5		27.7	15.1 – 45.2		22.7	11.6 – 39.5	
Region									
North	36.6	34.4 – 38.8	< 0.001	47.2	43.7 – 50.7	0.036	26.7	24.2 – 29.4	< 0.001
Northeast	34.8	33.0 – 36.6		44.3	41.4 – 47.2		26.4	24.3 – 28.6	
Southeast	30.8	28.3 – 33.4		43.1	38.9 – 47.3		20.0	17.4 – 22.9	
South	26.1	23.3 – 29.0		36.3	31.6 – 41.2		16.8	14.1 – 20.0	
Midwest	34.3	31.1 – 37.6		45.0	39.8 – 50.3		24.7	21.2 – 28.6	

95%CI: 95% confidence interval.

According to the results, over one third of the adult population had a high TC (above 200 mg/dL). It was higher in women than in men, higher in the older population and lower in the population that had higher levels of education. HDL less than 40 mg/dL affected one third of adults. The TC/HDL ratio ≥ 4 was also present in half of the Brazilian population. LDL above 130mg/dL reached one fifth of the adult population.

As in Brazil, population-based studies conducted in some countries have shown a high prevalence of dyslipidemia. In China, research with cut-off points based on Chinese guidelines

Table 5. Population prevalence of low-density lipoprotein cholesterol (LDL) ≥ 130 mg/dL according to gender, age, education level, skin color and region. Brazil, National Health Survey 2014 – 2015.

	Total			Male			Female		
	%	95%CI	p	%	95%CI	p	%	95%CI	p
Total	18.6	17.5 – 19.7		17.1	15.6 – 18.8		19.9	18.5 – 21.3	0.012
Age range									
18 to 29	8.8	7.2 – 10.7	< 0.001	6.6	4.8 – 9.0	< 0.001	11.0	8.7 – 14.0	< 0.001
30 to 44	17.5	15.7 – 19.5		20.2	17.3 – 23.6		15.2	13.0 – 17.6	
45 to 59	25.6	23.3 – 27.9		23.2	20.0 – 26.7		27.7	24.7 – 30.9	
≥ 60	24.5	22.2 – 27.0		19.5	16.3 – 23.2		28.4	25.1 – 31.9	
Education level (years)									
0 to 8	21.5	20.0 – 23.2	< 0.001	17.8	15.7 – 20.1	0.525	24.9	22.8 – 27.2	< 0.001
9 to 11	16.8	14.3 – 19.7		15.2	11.8 – 19.3		18.5	15.0 – 22.6	
≥ 12	16.7	15.1 – 18.4		17.2	14.8 – 20.0		16.2	14.2 – 18.4	
Skin color									
White	20.1	18.5 – 21.9	0.009	18.8	16.4 – 21.4	0.131	21.3	19.1 – 23.8	0.095
Dark-skinned black	16.6	13.6 – 20.2		15.2	10.9 – 20.8		17.9	13.9 – 22.7	
Light-skinned black	17.4	16.1 – 18.8		15.9	13.9 – 18.1		18.8	17.0 – 20.7	
Other	10.1	6.0 – 16.6		8.6	3.6 – 19.1		11.2	5.7 – 20.7	
Region									
North	16.2	14.7 – 17.9	0.136	15.5	13.2 – 18.1	0.355	17.0	14.9 – 19.2	0.195
Northeast	19.8	18.4 – 21.3		17.5	15.5 – 19.8		21.9	19.9 – 23.9	
Southeast	17.9	16.0 – 19.9		16.1	13.4 – 19.3		19.4	16.8 – 22.2	
South	20.0	17.6 – 22.6		19.8	16.2 – 24.0		20.1	17.1 – 23.5	
Midwest	17.8	15.4 – 20.4		17.8	14.3 – 21.9		17.8	14.8 – 21.3	

95%CI: 95% confidence interval.

considering LDL levels ≥ 130 mg/dL and similar HDL levels for men and women found 33.5% TC, 0.6% LDL and 8.8% for altered HDL[15]. In Turkey, using the ATP III[7] cutoff points, 43% of people had TC> 200 mg/dL. The prevalence of elevated TC, LDL-cholesterol and triglyceride (TG) levels increased with age[16].

In Brazil, studies conducted in the state of São Paulo followed the ATP III[7] recommendations for defining the reference value the cutoff points for dyslipidemia. It was reported that dyslipidemia affected 61.9% of the population, especially those older than 40 years of age, in the city of Ribeirão Preto[17]. In São Paulo, desirable levels of TC were similar between women (64.7%) and men (64.9%). For LDL, approximately 20% of men and women had levels between 130 and 159 mg/dL. Levels were considered to be high (≥ 160 mg/dL) in 11.8% of men and 13.6% of women. Desirable levels (40 mg/dL) of HDL-cholesterol were found in 68% of women and 54.3% of men[18].

The biochemical data of the PNS differ from the self-reported data found in the Survey of Risk Factors and Protection for Chronic Diseases by Telephone Survey (*Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico* - Vigitel), which identified 22.6% of the adult population in Brazilian capital cities with high cholesterol[19]. In the PNS, using the self-reported questionnaire, the prevalence of high cholesterol was even lower (12.5%)[11]. In addition, the PNS also measured the population who said they had never measured their cholesterol or TG (14.3%)[11]. Therefore, the biochemical data described here identified higher prevalences, about one third of the population, which may partly reflect the lack of access to the tests[11].

Regarding gender, self-reported diagnostic estimates from the PNS coincide with laboratory test data presented in this study. The diagnosis was more frequent in women (15.1%) than in men (9.7%)[11]. Similar results were also found in Vigitel, with higher prevalences among women (25.9%) than among men (18.8%)[19].

The study found a higher prevalence among women, which is well documented in the literature[3,20,21]. The high prevalence of dyslipidemia in women is described during menopause[20], pregnancy and the use of birth control pills, corticosteroids and anabolic steroids, probably due to the reduction in estrogen[21]. Gestational hypertriglyceridemia occurs in order to meet increased maternal energy demands as a precursor to hormones for the placenta, and to provide cholesterol and fatty acids to the fetus[3].

The current study shows that TC and LDL are higher as age increases, with a slight decrease in the elderly population over 60 years of age. Lowering cholesterol in the elderly can be explained by loss of weight, improved eating habits, or comorbidities that may worsen food absorption[22].

The Southern Region presented the lowest proportion of altered HDL, with no difference in relation to the regions for TC and LDL. PNS studies with self-reported data showed a high prevalence among residents of the South and Southeast macro-regions of the country, which could be explained in part by greater access to health services and diagnostic opportunities in these areas[11].

The study states that altered cholesterol is less frequent in the more educated population, which was also found in research with self-reported measures[11]. Data from Vigitel indicate that the diagnosis of high cholesterol was more frequent in the low-educated population, ranging from 29 (zero to eight years of study) to 19.4% (12 years or more)[19], which may be explained by the higher access to prevention, promotion and care practices in the population with higher levels of education and income[23].

It is worth noting that half of the adult population has a TC/HDL ratio greater than 4. Epidemiological studies, including Framingham, show that the TC/HDL ratio is inversely associated with the incidence of coronary atherosclerotic disease[24], in this regard high prevalence rates of a TC/HDL ratio greater than 4 suggest possible future cardiovascular events[24]. The ratio, in this study, showed a high prevalence and therefore the importance of monitoring TC levels and fractions as a means of preventing cardiovascular disease[3]. The 10% reduction in serum cholesterol in 40-year-old men was pertinent to a 50% decrease in cardiovascular disease over a five-year period and by 20% in 70-year-old men[25,26]. Further studies showed a significant decrease in mortality from statin use[8].

Investigations reveal that, in addition to statin treatments, diet and regular physical activity can also contribute to cholesterol reduction in the elderly, as well as for all age groups[3,9]. Physical exercise plays an important role in preventing and controlling cardiovascular disease [3,27].

The data collected from the PNS also help in defining specific reference values for the Brazilian population and may influence new definitions of cardiovascular risk[3,8] , which should be estimated based on the joint analysis of characteristics that increase the chance of an individual developing the condition, such as age, smoking, high blood pressure, diabetes, previous cardiovascular events, among others. Thus, future PNS studies could define and prioritize populations who are at risk for cardiovascular diseases and help support prevention, monitoring and treatment.

Among the limitations of the study are laboratory collection losses, however the use of sample weights allowed for adequate population estimates, and data generalization is relatively safe for national and macro-region projections[15,16]. The cutoff points adopted were defined according to protocol[3] and may vary according to the consensus review.

CONCLUSION

For the first time in Brazil, this study shows the prevalence of of altered serum TC, LDL and HDL levels points out that about one third of adults have cholesterol alterations. These results may guide control and preventative actions, such as healthy eating, physical activity and treatment of coronary diseases, which represent the leading cause of death in Brazil and worldwide. Furthermore, they can guide routine monitoring and pharmacological measures when indicated.

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