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Lipid and lipoprotein profiles and prevalence of dyslipidemia in Mexican adolescents

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Abstract

The objective of the study was to determine the prevalence of different forms of dyslipidemia in an urban population of Mexican adolescents. A cross-sectional study was conducted in 1846 students from 8 randomly selected public junior high schools in Mexico City. Anthropometry, blood pressure, and 12-hour fasting lipids and lipoproteins were measured. We studied 770 male and 1076 female adolescents (13.2 ± 1 years). The most prevalent dyslipidemia was low high-density lipoprotein cholesterol (HDL-C) (<35 mg/dL) either combined with other abnormalities (17.5% for male and 12.9% for female subjects, $P < .001$) or isolated (13.5% and 9.6% for male and female subjects, respectively, $P < .001$). Obese subjects showed the highest prevalence of low HDL-C (47.2% for male and 34.4% for female subjects) and of high total cholesterol, low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG) (19.4%, 27.8%, and 36.1%, respectively, for male subjects; 9.8%, 13.1%, and 24.6%, respectively, for female subjects). Multiple regression analysis showed that waist circumference was negatively associated with HDL-C and positively associated with LDL-C and TG levels, whereas Tanner stages were negatively associated but sex was positively associated with total cholesterol, LDL-C, and TG concentrations. As in Mexican adults, low HDL-C and high TG levels were the most prevalent dyslipidemias. Increased blood lipids over long periods suggest that, as adults, these adolescents will be facing a higher risk for atherosclerosis.

1. Introduction

Atherosclerotic coronary heart disease (CHD) is a condition of multifactorial origin. A large number of clinical, pathologic, and epidemiologic studies have established that dyslipidemia (DLP) plays an important role in the development and progression of atherosclerosis. Although clinical CHD usually does not occur until the fourth or fifth decade of life, it is known that atherosclerosis is already present in youth [1]. Autopsy studies in young people have demonstrated a significant association between atherosclerotic lesions and premortem cardiovascular risk factors, including hypercholesterolemia, high blood pressure, obesity, and smoking [2]; and the severity of coronary and aortic atherosclerosis is even higher in youngsters with 3 or more antemortem risk factors [3]. Long-term cohort studies showed that increased carotid intima-media thickness in young and middle-aged adults is associated with total cholesterol (TC) [4] and low-density lipoprotein cholesterol (LDL-C) [5] measured during childhood. It has also been observed that conditions related to lipids and lipoproteins, such as unhealthy dietary habits, tobacco smoking, and physical inactivity, are acquired during childhood and adolescence [6]. Moreover, prospective longitudinal studies have tracked obesity, hyperlipidemia, and hypertension from adolescence into adulthood [7,8]. Data from the Bogalusa Heart Study [9] suggest that more than 70% of children with adverse lipid profiles tend to course with DLP in adult life. Epidemiologic surveys of CHD precursors in children have indicated that differences in lipid and lipoprotein levels among cultures and ethnic groups appear early in childhood [10-12].Therefore, it is not appropriate to extrapolate results from one population to another to establish prevention programs.

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In Mexico, as in many other developing countries, the prevalence of infectious diseases has decreased, whereas CHD has steadily increased over the past 4 decades and is currently the leading cause of death [13]. A Mexican nationwide survey conducted in a representative sample of urban adults showed a very high prevalence of low levels of high-density lipoprotein cholesterol (HDL-C), and it is among the highest reported worldwide [14]. In a large national representative sample of children and adolescents, we reported previously only the prevalence of hypercholesterolemia [15]. Thus, information on lipid and lipoprotein levels and on the prevalence of DLPs in young people is scarce in Mexico. Accordingly, the aim of this cross-sectional study was to investigate, in urban male and female adolescents, the mean plasma concentrations of lipids and lipoproteins, the prevalence of different forms of DLP, as well as their association with anthropometric measurements, sex, and pubertal maturation. We also sought to determine whether HDL-C levels are already low at the age of adolescence.

2. Methods

2.1. Characteristics of the population

Mexico City is divided into 16 political districts. A cross-sectional survey was conducted in the district of Coyoacán. This district was selected because the distribution of public junior high schools and the population size registered in the Coyoacán schools are similar to those of Mexico City as whole [16]. Eight urban public junior high schools from this district were randomly chosen from a list of high schools provided by the Public Education Ministry. All students, 12 to 16 years old, attending the selected schools were invited to participate in the study. The sample included 1846 mestizo adolescents (770 male and 1076 female). The school authorities, parents and/or guardian, and students received detailed information concerning the study purpose and the measuring procedures. The study included only students who accepted to participate and whose parents signed the informed consent. To assess potential bias introduced by differences between participants and nonparticipants, a random subsample of nonparticipant mestizo students answered the questionnaire and had anthropometry and blood pressure measurements taken. The subjects included were healthy according to self-information, with no history of cancer; diabetes mellitus; or thyroid, renal, or liver disease; and none was under long-term medical treatment. The protocol was approved by the Research Coordination of the Department of Public Health at the Medical School of the National Autonomous University of Mexico and the authorities of the Public Education Ministry.

2.2. Sources, methods, and techniques for data collection

Before beginning the survey, the study team conducted a pilot test in 60 students from a public high school to standardize the participating staff in questionnaire application, measurement of anthropometric variables and blood pressure, and the technique to collect blood samples. Results of these tests were not included in the study.

Questionnaire application, anthropometry, and blood pressure determination were performed between 8:00 and 11:00 AM from Monday to Thursday. An average of 30 subjects per day was studied. Adolescents answered questions about cigarette smoking and alcohol consumption individually; and to encourage truthful answers, students were reassured that nobody (parents and/or teachers) would receive the information about smoking or alcohol habits. A participant was defined as a smoker when he/she smoked at least one cigarette per week [17]. Subjects who drank alcoholic beverages (liquor, beer, or wine) at least once a month were considered to be alcohol users [18]. Adolescents that did not participate in any sport or physical activity in their leisure time were considered to have a sedentary lifestyle [19]. To estimate food consumption of a randomly selected subsample of 200 adolescents, a 24-hour dietary recall was used and analyzed with the Minnesota Nutrition Data System version 2.7 (University of Minnesota, Minneapolis, MN).

2.3. Blood pressure

After at least 10 minutes of rest, systolic (Korotkoff phase I) blood pressure and diastolic (Korotkoff phase V) blood pressure values were recorded with a mercury sphygmomanometer (Welch Allyn Tycos, USA) using an appropriate cuff size for each student. Three readings were recorded for each individual. The average of the second and third measurements was defined as the subject's blood pressure. The systolic and/or diastolic values above the 90th percentile adjusted for age, height, and sex were used to define high blood pressure [6].

2.4. Anthropometry measurements

Body weight was measured with a daily calibrated lever balance and recorded to the nearest 0.1 kg. Height was determined to the nearest 0.5 cm using a metallic tape placed on the wall and a metal right angle, with the subject standing upright against the wall tape. Waist circumference was measured to the nearest 0.5 cm at the midpoint between the bottom of the rib cage and above the top of the iliac crest. All these measurements were made in duplicate. Body mass index (BMI) was calculated and used as an indicator of overweight and obesity. In this study, we used the age- and sex-specific cutoff points based on child data from different countries, which present age and sex centiles for children linked to adult cutoff points of overweight (25 kg/m^2) and obesity (30 kg/m^2) [20]. In adolescents, with a mean age of 13.2 years, the BMI cutoff point values for overweight are 22.27 kg/m^2 for boys and 22.98 kg/m^2 for girls; and for obesity, they are 27.25 kg/m^2 for boys and 28.20 kg/m^2 for girls.

2.5. Lipid and lipoprotein measurements

Venous blood samples were obtained after a 12-hour overnight fast. After 20 minutes of sitting rest, 10 mL of blood was collected into EDTA-treated (1 mg/mL) tubes kept on ice. Plasma separated by centrifugation at 2500 rpm for 20 minutes within 1 hour after phlebotomy was used for glucose, lipid, and lipoprotein measurements within the 3 following days. Total cholesterol and triglycerides (TGs) were measured by enzymatic methods (Roche-Syntex/Boehringer Mannheim, Germany). High-density lipoprotein cholesterol was quantified after precipitation of lipoproteins containing apolipoprotein B with phosphotungstate/Mg^{2+}. Low-density lipoprotein cholesterol was estimated by using the Friedewald formula modified by DeLong et al [21]. Plasma glucose was determined by the glucose oxidase method (Roche-Syntex/Boehringer Mannheim). In our laboratory, accuracy and precision are under the surveillance of the Center for Disease Control, Lipid Standardization Program (Atlanta, GA). The intraassay coefficients of variation for TC, TGs, HDL-C, and glucose were 0.43%, 0.89%, 1.72%, and 1.0%, respectively. The interassay coefficients of variations for the same parameters were 1.76%, 2.03%, 3.24%, and 1.7%, respectively. *Hypercholesterolemia* (*hyper-TC*) was defined as TC ≥200 mg/dL [6]. *High LDL-C* (*hyper–LDL-C*) was defined as LDL-C ≥130 mg/dL [6]. *Hypertriglyceridemia* (*hyper-TG*) was defined as a TG level ≥150 mg/dL [6], and *low HDL-C* as <35 mg/dL [6].

2.6. Pubertal development

Sexual development was assessed using the method described by Tanner [22]. Self-assessment is a valid method to assess sexual maturity in clinical evaluation and as a research tool [23-25]. In the case of girls, the date of menarche was also recorded.

2.7. Statistical analysis

Descriptive statistics including mean and SDs for continuous variables and proportions for categorical variables were calculated. All variables were tested for normality using the Kolmogorov-Smirnov test. Variables that were not normally distributed were log transformed, and then parametric statistics were used. Comparison of means by sex was evaluated by 2-tailed t test. Prevalence values among sex and among adolescents with or without high blood pressure, overweight, and obesity were compared using χ^2 test. The independence of associations between plasma lipids and lipoproteins and other variables was determined by stepwise multiple regression analysis using, in the model, the metabolic variables as dependent variables, and age, sex, Tanner stage, BMI, waist circumference, cigarette smoking, and physical inactivity as independent variables. Subjects at Tanner stages 1 and 2 were combined because there were a small number of participants at stage 1. Statistical significance was set at $P < .05$. Statistical analysis was performed using SPSS version 10 software (SPSS, Chicago, IL).

3. Results

The overall participation rate was 40.1%. Comparison of participants with the randomly selected subsample of 126 nonparticipants showed that age was lower in the former (13.43 ± 1.9 vs 13.65 ± 1.5, $P = .044$) but that mean values for BMI, waist circumference, Tanner score, smoking, and blood pressure were not significantly different between participants and nonparticipants, indicating that both populations were similar. Compared with boys, girls had a higher BMI (20.2 ± 3.4 vs 21.3 ± 3.7, $P < .001$) but lower waist circumference (73.3 ± 9.8 vs 71.0 ± 8.4 cm, $P < .001$), systolic blood pressure (107.6 ± 11 vs 106.4 ± 9.6 mm Hg, $P < .05$), and glucose levels (86.9 ± 9.7 vs 84.9 ± 9.1 mg/dL, $P < .001$). Mean energy consumption of a randomly selected subsample of 200 adolescents was 2023 ± 742 cal. The intake of protein (74.5 ± 30.3 g/d), carbohydrate (278.2 ± 115.9 g/d), and total fat (73.8 ± 37.9 g/d) represented 15% ± 3.9%, 55% ± 9.1%, and 32.1% ± 7.2%, respectively, of the total caloric intake. Cholesterol intake was 253.1 ± 165.8 mg/d.

Tanner-adjusted lipid values and prevalence rates of DLP are shown in Table 1. Low HDL-C level was the most prevalent abnormality in both sexes, but particularly in male adolescents (boys, 17.5%; girls, 12.9%; $P < .001$); and in more than 70% of the cases, this DLP was found in its isolated form (boys, 13.5%; girls, 9.6%; $P < .001$). Hypertriglyceridemia was the second most common lipid

Table 1
Adjusted mean lipid concentration and prevalence of several abnormal lipoprotein patterns in the population studied

	Boys (n = 770)	Girls (n = 1076)
Mean values		
TC (mg/dL)	150.4 ± 26.9	155.5 ± 26.8 *
TG (mg/dL)	87.7 ± 40.5	96.5 ± 40.0 *
LDL-C (mg/dL)	91.6 ± 23.9	96.3 ± 23.6 *
HDL-C (mg/dL)	43.9 ± 9.9	44.9 ± 9.7
TC/HDL-C	3.59 ± 0.9	3.61 ± 0.9
Prevalence		
Hyper-TC ≥200 mg/dL	5.1	5.8
Hyper–LDL-C ≥130 mg/dL	6.6	7.7 *
Hyper-TG ≥150 mg/dL	7.7	9.6 **
Low HDL-C <35 mg/dL	17.5	12.9 ***
Hyper-TG + low HDL-C	3.4	3.4
Hyper-TC alone	3.3	4.0
Hyper-TG alone	2.8	4.4 ***
Low HDL-C alone	13.5	9.6 ***
Without DLP	75.3	77.1 *

Lipid values (mean ± SD) and prevalence rates (percentage) were adjusted for Tanner score. Mean values were compared by Student t test and prevalence rates by χ^2 test.

* $P < .05$.

** $P < .005$.

*** $P < .001$.

Table 2
Multiple regression analyses of plasma lipids and lipoproteins, age, BMI, waist circumference, and Tanner in male and female adolescents

Dependent variables	Independent variables	β	R^2 (%)
TC	Sex	0.163	1.87 **
	Tanner	−0.140	1.53 **
LDL-C	Sex	0.124	1.12 **
	Tanner	−0.115	1.04 **
	Waist circumference	0.098	0.23 *
	BMI	0.138	0.45 *
TGs	Sex	0.184	2.68 **
	Tanner	−0.085	0.64 **
	Waist circumference	0.377	3.65 **
	Age	−0.116	1.36 **
HDL-C	Waist circumference	−0.232	1.32 **
	Tanner	−0.053	0.23 *

Model included sex (male subjects are reference), Tanner (stages 1 and 2 were combined), BMI, waist circumference, age, cigarette smoking, and physical inactivity as independent variables. For Tanner, BMI, waist circumference, and age, a change in one unit of the independent variable means that there is an increase or decrease (β value) of the dependent variable.

* $P < .05$.

** $P < .001$.

abnormality in this population. Unlike low–HDL-C subjects, more than 50% of hypertriglyceridemic adolescents showed some other defects. Elevated TC and LDL-C levels were less common. Overall, 25% of the population studied had some form of DLP.

In multiple regression analysis with lipid and lipoproteins as dependent variables and with sex, Tanner stage, BMI, waist circumference, age, cigarette smoking. and physical inactivity as independent variables (Table 2), we identified that sex and Tanner stage were independently associated with TC, LDL-C, and TG levels. Body mass index and waist circumference were also associated with LDL-C levels, and waist circumference and age were associated with TG levels. Waist circumference and Tanner score were independently associated with HDL-C concentrations.

In this study, we also assessed the impact of overweight and obesity on the prevalence of different forms of DLP. As shown in Table 3, 36 boys (4.7%) and 61 girls (5.7%) were obese; overweight was observed in 18.3% of the boys and 24.3% of the girls. Most DLPs were common in these subpopulations, but low HDL-C was the abnormality most frequently observed. Its prevalence was remarkably higher in obese than in overweight and normal-BMI subjects (boys—47.2%, 29.1%, and 12.3%, respectively; $P < .001$; girls—34.4%, 19.5%, and 8.6%, respectively; $P < .001$). Whereas in normal-weight adolescents, isolated low HDL-C accounted for four fifths or more of the total cases with low HDL-C, in approximately half of obese adolescents, low HDL-C was combined with other DLPs, mainly hyper-TG (boys, 16.7%; girls, 14.8%). Hypertriglyceridemia was also very common in obese individuals (boys, 36.1%; girls, 24.6%) and in most cases was associated with other defects. Obesity also increased the prevalence of hyper-TC and hyper–LDL-C, particularly in boys, in whom these abnormalities affected one fifth and one fourth of them, respectively. The prevalence rates of most DLPs in overweight subjects were significantly higher than those in normal-weight individuals. Hypertriglyceridemia, low HDL-C, and hyper-TG + low HDL-C were significantly higher in obese than in overweight female subjects, whereas in male subjects, low HDL-C was the only DLP more common in obese than in overweight subjects. Only 38.9% of boys and 49.2% of girls with obesity were found to be free of DLPs.

4. Discussion

The findings of the present study reveal that low HDL-C is the most common form of DLP in our adolescents, followed by hyper-TG. Low HDL-C was more frequently found among boys than girls, particularly in those with obesity in whom the prevalence was as high as 50%. By doing a more comprehensive characterization of the lipoprotein profile, we also found that in both boys and

Table 3
Prevalence of abnormal lipid profiles by sex and BMI

	Boys			P	Girls			P
	Obese	Overweight	Normal		Obese	Overweight	Normal	
n	36	141	593		61	261	754	
Hyper-TC	19.4 *	10.6 *	3.0	<.001	9.8	8.4 *	4.4	.018
Hyper–LDL-C	27.8 *	14.9 *	3.9	<.001	13.1 *	13.0 *	5.7	.002
Hyper-TG	36.1 *	21.3 *	3.4	<.001	24.6 *, **	16.1 *	6.6	<.001
Low HDL-C	47.2 *, **	29.1 *	12.3	<.001	34.4 *, **	19.5 *	8.6	<.001
Hyper-TG + low HDL-C	16.7 *	9.2 *	1.5	<.001	14.8 *, **	6.9 *	1.5	<.001
Hyper-TC alone	0	5.7	3.0	NS	6.6	5.0	3.3	NS
Hyper-TG alone	5.6	7.1 *	1.9	.003	8.2	5.7	4.1	NS
Low HDL-C alone	19.4	19.1 *	10.8	.013	18.0 *	12.3 *	7.2	.002
Without DLP	38.9 *	53.9 *	82.8	<.001	49.2 *, **	66.7 *	82.9	<.001

Obesity and overweight defined according to Cole et al [20]. χ^2 test. NS indicates not significant.

* $P < .05$ vs normal.

** $P < .05$ vs overweight.

Table 4
Comparison of lipid and lipoprotein levels among Mexican and other adolescent populations.

	TC		LDL-C		HDL-C		TGs	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Spaniards [28]	175	178	104	107	55	56	65	71
Polish [29]	165	167	77	77	73	75	81	75
Australians [30]	158	172	ND	ND	50	52	ND	ND
Non-Hispanic whites from the United States [31]	162	166	91	100	48	50	95	99
Mexicans [a]	150	156	92	96	44	45	88	97
Navajo Indians [32]	153	141	ND	ND	45	41	79	97
Costa Ricans [33,41]	152	165	86	94	44	44	104	110
Venezuelans [34]	156	161	91	96	38	38	137	139
Iranians [35]	166	171	101	104	44	43	106	121

Values indicate mean concentration (in milligrams per deciliter). References are given in parenthesis. ND indicates not done.
[a] This study.

girls, isolated low HDL-C accounted for most of the low HDL-C seen in normal-weight subjects; however, increases in BMI to overweight and obesity led to decrements in isolated low HDL-C and concomitant increments in the combination of low HDL-C + hyper-TG (Table 3). Compared with low HDL-C and hyper-TG, the prevalence rates of elevated TC and LDL-C were lower. Mixed DLPs and other combined abnormalities were less common.

The high frequency of low HDL-C in this adolescent population is similar to what has been found in Mexican adults. Studies conducted in selected adult samples showed that low HDL-C and hyper-TG are common in Mexican adults [26,27]. The 1992-1993 National Survey of Chronic Diseases [14] confirmed that low HDL-C levels were the most prevalent abnormality, affecting 46.2% of men and 28.7% of women aged 20 to 69 years. Hypertriglyceridemia, observed in 31.9% of men and 18.8% of women, was the second most prevalent form of DLP. Our results suggest that HDL-C levels in the Mexican population are low from adolescence to adulthood.

Lipid and lipoprotein abnormalities result from the interaction of genetic and environmental factors. As shown in Table 4, compared with adolescents from Spain [28], Poland [29], Australia [30], and the United States [31], Mexicans of the same age have remarkably lower HDL-C levels. In contrast, adolescents from Native American tribes, such as the Navajo Indians [32]; mestizo populations of Latin American countries, such as Costa Rica [33] and Venezuela [34]; and some Asian populations [35] have HDL-C concentrations similar to those found in our study. These differences among populations suggest the influence of genetic factors on the circulating HDL-C.

Although several factors modulate its effects, diet is an established important determinant of plasma lipids. Serum cholesterol levels correlate with cholesterol and saturated fat intake [36]. On the other hand, replacement of fat by carbohydrates in the diet results in significant reduction of HDL-C concentration [37,38]. One study [39] comparing HDL-C levels in boys from 5 different countries reported that the higher the carbohydrate content of the diet, the lower the HDL-C levels. Compared with Mexican Americans living in San Antonio, Mexican adults residing in Mexico City have a higher carbohydrate intake (58% to 62% vs 39% to 43%) and higher TGs and lower HDL-C concentrations [40]. Our adolescents and the Costa Rican adolescents reported by Monge-Rojas [41] consumed a diet high in carbohydrates (55% and 56% of their caloric intake, respectively), and the HDL-C values are similarly low in both populations (Table 4). These findings are in sharp contrast to those reported in Spain [28]. Spanish adolescents have HDL-C values ~55 mg/dL (Table 4), and their fat (45%) and carbohydrate (41%) intake is remarkably different from that of our study. It has long been known that high-carbohydrate diets are also associated with increased TG levels [42]. This has been observed in both children [41] and adults [40]. Our study subjects showed higher TG levels than those observed in adolescents with lower carbohydrate consumption [28]. Together, these findings suggest that ethnic, genetic, and dietary factors explain, at least in part, the 2 types of DLP found in our study.

Obesity is associated with increased rates of DLP and other cardiovascular risk factors [43]. Obese adolescents with elevated lipid concentrations show higher rates of DLP later in life [44]. In our study, elevated cholesterol and TG levels and low HDL-C concentrations were more common in overweight and obese adolescents than in normal-weight participants. In Mexican adults, Aguilar-Salinas et al [14] reported a similar prevalence of DLP in overweight and obese individuals. In contrast, we found that hyper-TG, low HDL-C, and hyper-TG + low HDL-C in female and low HDL-C in male subjects were significantly higher in obese than in overweight subjects. Multiple regression analysis revealed that BMI was positively and independently associated to LDL-C only, whereas waist circumference was associated to LDL-C and more strongly to TGs and HDL-C, suggesting that even at this early age, abdominal fat deposition contributes to an adverse lipid profile. This is in line with a previous study showing that waist measurement is correlated with an abnormal lipid profile in teenage subjects [45].

Epidemiologic, clinical, and experimental evidence show that elevated TC and LDL-C levels increase the risk of cardiovascular disease. Several studies have also consistently shown that low HDL-C concentrations are an independent risk factor for atherosclerotic vascular disease [46]. High TGs in association with low HDL-C predicted a higher incidence of cardiovascular events in the Prospective Cardiovascular Munster Study [47]. Another study reported that low–HDL-C subjects have an abnormal HDL subclass distribution, with lower levels of large particles and increased levels of small HDL [48]. This abnormality in

HDL subpopulations is associated with CHD prevalence [49] and increased recurrence of coronary events [50]. Although all these information come from reports in adults, many studies have shown that atherosclerosis begins early in life and that its initial stages are associated with adverse lipid profiles in children and adolescents [1-4,8,9]. Therefore, the abnormalities found in our adolescents may well be contributing to an increased coronary risk later in life.

There are several potential limitations of this study. First, there is the possibility of selection bias in the recruitment process. The schools studied were randomly selected, but the participation of adolescents was voluntary. However, mean values for anthropometric variables, Tanner score, blood pressure, proportion of smokers, and heart rate were not significantly different in adolescents who declined participation as compared with those who were enrolled, reasonably indicating that both populations were similar. Second, the cross-sectional nature of these data does not allow causal inferences and limits any assumption about the duration of the existence of any of the blood lipid levels. Third, Tanner scores were obtained by self-assessment. However, several studies [23-25] have found a good agreement between the scoring by this method and that obtained by direct observation. Therefore, it seems unlikely that our conclusions are invalidated by the use of self-assessed puberty. Fourth, because of geographic, socioeconomic, cultural, and ethnic differences among regions in the country, the results cannot be generalized to all Mexican adolescents. However, the data provide some insights into the risk of cardiovascular disease in mestizo adolescents living in Mexico City.

These findings show that, as in Mexican adults, low HDL-C and high TG levels are the most prevalent DLPs in adolescents. Genetic and environmental factors seem to explain, in part, these lipid abnormalities. Increased blood lipids over long periods suggest that, as adults, these adolescents will face a higher risk for atherosclerosis, contributing to an increased incidence of cardiovascular disease in our country. Therefore, early intervention to encourage appropriate nutrition and physical activity at early ages could be relevant strategies to prevent and/or reduce the high risk for atherosclerosis in our population.

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