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Gary J. Luckasen *

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Research Article

Are Hispanic Youth at Higher Risk for Cardiovascular Disease Due to Lower Levels of High-Density Lipoprotein Cholesterol?

Iyana Malik RN [1], Austin Pollack MS [2], Landon D Hamilton [2], Paige Lueders BS [2], Gary Luckasen [2]*

[1]School of Medicine, University of Colorado, Aurora CO 80045, USA.

[2]UCHealth Research Northern Colorado, Loveland CO 80538, USA.

***Corresponding Author:** Gary J. Luckasen, UC Health Research Northern Colorado 2500 Rocky Mountain Avenue Suite 1508, Medical Center of the Rockies Loveland, Colorado 80538, USA.

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Abstract

Background/Aim: Low levels of high-density lipoprotein (HDL) cholesterol in childhood are associated with an increased incidence of cardiovascular disease (CVD) in adulthood, making early detection of lipid abnormalities important in identifying CVD risk. Studies have shown differences in adult HDL levels between ethnic groups, suggesting that HDL is lower in Hispanic adults compared to Non-Hispanic White (NHW) adults. Since CVD and obesity are increasing in Hispanic adults disproportionately, studies on childhood risk factors affecting HDL are essential but limited. We hypothesize HDL levels differ between Hispanic and NHW children, with ethnicity and body mass index (BMI) as significant predictors of HDL levels.

Materials and Methods: The UCHealth Healthy Hearts and Minds Program in Colorado conducted biometric screenings on elementary, middle, and high school students, with 14,532 voluntary HDL assessments from 8/2019 to 1/2024. ANOVA and multivariate linear regression models were used for statistical analysis.

Results: HDL averages for Hispanic and NHW students were 46.2 mg/dL and 47.6 mg/dL, respectively (p-value <0.001). Males students had a general trend of decreasing HDL levels with advancing age while females HDL levels remained relatively constant across grade levels. The effect of BMI resulted in ~0.8 mg/dL per BMI unit increase for both sexes while controlling for BMI showed no significant difference in HDL levels between ethnic groups. However, 41.35% of Hispanic students were overweight/obese compared to 22.53% of NHW students, accounting for the perceived mean differences in HDL.

Conclusions: Observed differences in mean HDL levels between Hispanic and NHW students were due to the higher prevalence of overweight/obesity in the Hispanic sample.

Keywords: cardiovascular disease; HDL cholesterol; Hispanic; youth; racial disparities

1.Introduction

Cardiovascular disease (CVD) is the leading cause of death in the United States of America (USA), with one CVD-related death occurring every 33 seconds [1]. CVD stems from a host of non-modifiable and modifiable risk factors including hypertension, hyperlipidemia, diabetes, obesity, smoking, diet, and sedentary lifestyle [2]. Therefore, early detection of lipid abnormalities is a standard approach in evaluating CVD risk.

The Framingham Heart Study established that optimal HDL cholesterol levels are therapeutically associated with decreasing CVD mortality [3]. The inverse relation between HDL cholesterol and the development of CVD indicates lipid abnormalities constitute a significant component in the pathophysiology of this disease. The cardio-protective effects related to HDL cholesterol are commonly thought to be associated with its anti-oxidative, anti-platelet, and anti-inflammatory properties [4]. Decreased HDL levels are seen with obesity due to the altered metabolism of HDL particles [5]. Despite these established relationships, the effect of HDL cholesterol on CVD risk is not thoroughly understood across ethnic groups.

The Hispanic population comprises 18.9% of the USA population [6] with CVD being the leading cause of death among Hispanic adults [7]. The reported age-adjusted prevalence estimate of CVD is 8.3% in the Hispanic population compared with 11.1% in Non-Hispanic Whites (NHW). However, the overall prevalence of CVD in the Hispanic population is

assumed to be underestimated given health disparities and socioeconomic barriers faced by Hispanic and immigrant groups [8].

Previous studies report that 24.7% of Hispanic adults had low HDL (<40 mg/dL) compared to 17.6% of NHW adults [9], suggesting these differences are health indicators emerging during early and middle childhood [10]. There have been differences in lipid levels among ethnic groups in prior studies with Hispanics having lower HDL levels than NHW adults, suggesting that ethnicity is a significant contributing factor [11].

Across ethnic groups in the USA, Hispanic youth have the highest rates of certain CVD risk factors, including obesity, poor dietary habits, and reduced physical activity [10]. Increasing obesity trends have been observed with the greatest incidence of obesity reported in Hispanic children (boys = 29.36%; girls = 23.0%) in comparison to NHW children (boys = 17.6%; girls = 15.4%) [12].

A previous study evaluating HDL trends over two decades noted an increase in NHW youth HDL levels compared to a static HDL level for Mexican American students [13]. However, limited information is available comparing the incidence of low HDL levels between Hispanic and NHW children, and the factors impacting this finding. In this study, we are interested in determining if there are differences in HDL cholesterol levels between Hispanic and NHW children and if there are significant predictors of HDL levels in children in Colorado.

Materials and Methods

The data used in this study was collected in eight Colorado school districts from August 2019– January 2024 by the UC Health Healthy Hearts and Minds (HHM) program. All students within the eight school districts were included in this study if parental consent was provided and they self-described their ethnicity as Hispanic or Non-Hispanic White. Other ethnicities were excluded due to the small representation in the Colorado sample. No other exclusion criteria were considered. Spanish language interpreters, translated school materials, and permission forms were provided as needed (Appendix A). The screening questionnaire captured familial risk factors reported by the parent and/or legal guardian (Appendix B). The onsite screening visit recorded student age, height, weight, body mass index (BMI), total and HDL cholesterol, and blood pressure (BP). All students had the option to decline individual screening measures.

HDL values were reported as means, standard deviations, and percentages (Tables 1, 2, and 4). Normality of data was assessed using the Shapiro-Wilk test and verified visually with box plots and quantile-quantile plots (theoretical vs. sample quantiles). Significant predictors of HDL in school-age students were identified using saturated multivariate linear regression models (Table 3), including measures for ethnicity, total cholesterol, systolic blood pressure, diastolic blood pressure, height, weight, and BMI. Backward elimination was used for variable selection to indicate the best model fit. The model with the lowest Aikaike Information Criteria was selected with the residuals plotted and visually inspected to determine appropriate fit. These models predicted HDL levels for Hispanic and NHW students while controlling for selected variables. ANOVA and t-test models included significant regression variables to determine differences between significant predictors and ethnicities. Chi-square models were used to determine differences in proportions (Table 1). Data was analyzed using R-Studio version 4.2.1 with significance set at $\alpha < 0.05$.

The Colorado Multiple Institutional Review Board reviewed this study and determined it exempt from full Institutional Review due to the utilization of de-identified data (Protocol #: 24-0935).

Results

Overall, 3,342 Hispanic students and 14,098 NHW students were screened in this HHM program from August 2019 through January 2024. Voluntary HDL levels were assessed on 2,851 and 11,681 Hispanic and NHW students, respectively (Table 1). BMI values were calculated for 2,955 Hispanic students and 12,724 NHW students.

Hispanic students had an average HDL level of 46.2 mg/dL, and NHW students averaged 47.6 mg/dL (p-value <0.001). Of the elementary school (ES) aged students (8-11 years), 13.8% of Hispanics had very low HDL levels (<35) compared to the 9.3% in the NHW students (p-value <0.001). In the overall sample studied, 56.9% of Hispanic children were in the healthy BMI category compared to 73.6% of NHW (p-value <0.001). In all instances, Hispanic students had higher percentages of overweight and obesity compared to NHW students.

All Students	Hispanic (n=2851)	Non-Hispanic White (n=11681)	Significance
Age (years)	13.30 (2.20)	13.02 (2.11)	<0.001***
Sex (%female)	56.67	50.70	<0.001***
Body Mass Index (kg/m^2)	22.49 (5.35)	20.13 (4.19)	<0.001***
Overweight (≥85th-<95th) (%)	18.98	13.37	<0.001***
Obese % (≥95th) (%)	22.37	9.16	<0.001***
Elementary School: Biometric Values	Hispanic (n=938)	Non-Hispanic White (n=3987)	Significance
Age (years)	10.75 (0.54)	10.68 (0.60)	<0.001***
Sex (%female)	54.29	50.05	0.024*
Body Mass Index (kg/m^2)	21.01 (4.97)	18.33 (3.46)	<0.001***
Overweight (≥85th-<95th) (%)	18.33	13.56	<0.001***
Obese % (≥95th) (%)	27.99	9.20	<0.001***
Middle School: Biometric Values	Hispanic (n=682)	Non-Hispanic White (n=3739)	Significance
Age (years)	12.91 (0.71)	12.95 (0.57)	0.051
Sex (%female)	56.31	49.44	0.001***
Body Mass Index (kg/m^2)	21.95 (5.05)	20.03 (3.88)	<0.001***
Overweight (≥85th-<95th) (%)	18.30	12.67	<0.001***
Obese % (≥95th) (%)	20.71	8.72	<0.001***
High School: Biometric Values	Hispanic (n=1231)	Non-Hispanic White (n=3955)	Significance

Age (years)	15.45 (1.04)	15.45 (1.00)	0.805
Sex (%female)	58.66	52.55	<0.001***
Body Mass Index (kg/m^2)	23.91 (5.42)	22.05 (4.32)	<0.001***
Overweight (≥85th-<95th) (%)	19.90	13.85	<0.001***
Obese % (≥95th) (%)	18.78	9.55	<0.001***

Table 1: Descriptive Statistics: Biometric Values for all School-Aged Students (Mean (SD) or Percentage)

*** indicates a statistically significant difference between Hispanic and Non-Hispanic White students with $\alpha < 0.05$ using an ANOVA for means or chi-squared difference of proportions.

HDL Levels Hispanic	Hispanic	Non-Hispanic White
Elementary School	Mean (mg/dL) *(SD)*	Mean (mg/dL) *(SD)*
Males	48.51 (13.9) *‡§	51.31 (13.2) *†‡§
Females	47.16 (11.9) *	49.61 (12.5) *†‡§
Middle School	Mean (mg/dL) *(SD)*	Mean (mg/dL) *(SD)*
Males	45.72 (12.3) *†‡¶	47.30 (12.5) *†‡¶
Females	48.48 (13.1) †	48.51 (12.2) †‡
High School	Mean (mg/dL) *(SD)*	Mean (mg/dL) *(SD)*
Males	39.95 (10.6) †§¶	40.14 (10.5) †§¶
Females	47.71 (12.5) †	48.33 (11.9) †§

Table 2: Means and Standard Deviations of HDL for Hispanic/NHW of Different Grade Levels and Sexes

** Significantly different between Hispanic and Non-Hispanic White students of the same sex using ANOVA*

† Significantly different between males and females of the same ethnicity in the same grade level using ANOVA

‡ Significantly different between elementary/middle school students of the same ethnicity and sex using ANOVA

§ Significantly different between elementary/h

igh school students of the same ethnicity and sex using ANOVA

¶ Significantly different between middle/high school students of the same ethnicity and sex using ANOVA

Table 2 shows the differences in HDL levels in students of different grade levels, sexes, and ethnicities. On average, males tend to have lower HDL levels compared to females, especially in middle school (MS; 11-14 years) and high school (HS; 14-18 years). HDL levels decrease in males through the grade levels compared to females' levels remaining relatively constant. There were significant differences in HDL levels between Hispanic and NHW ES students, but this difference became less pronounced in the MS and HS age groups.

Male Linear Regression Model				
Coefficients:	Estimate	Confidence Interval	Std. Error	P-Value
(Intercept)	86.28407	[83.4, 89.2]	1.47122	<0.001***
Age	-1.48106	[-1.6, -1.3]	0.07314	<0.001***
Ethnicity: White	-0.47913	[-1.2, 0.3]	0.38143	0.209
Systolic BP	-0.04163	[-0.1, -0.01]	0.01448	0.004**
BMI	-0.79364	[-0.9, -0.7]	0.03467	<0.001***
Female Linear Regression Model				
Coefficients:	Estimate	Confidence Interval	Std. Error	P-Value
(Intercept)	56.07670	[53.1, 59.1]	1.54139	<0.001***
Age	0.52265	[0.4, 0.7]	7.452	<0.001***
Ethnicity: White	-0.35340	[-1.0, 0.3]	-1.026	0.305
Systolic BP	0.02616	[-0.002, 0.05]	1.823	0.068
BMI	-0.80862	[-0.9, -.7]	-22.605	<0.001***

Table 3: Sex-Specific Linear Regression Models for Age, Ethnicity, Systolic BP, and BMI to Predict HDL

**** Indicates a statistically significant difference between Hispanic and NHW students with $\alpha < 0.05$.*

Table 3 shows linear regression model analyses of HDL levels between males and females, analyzing for age, ethnicity, systolic BP, and BMI. These factors were chosen using backward selection from a saturated model. Models were generated separately for both sexes because of the identified differences between males and females in Table 2. In both instances, BMI had the strongest negative correlation with HDL levels. HDL decreases at approximately 0.8 per unit increase in BMI for both sexes. These models suggest that when controlling for BMI, there is no difference between Hispanic and NHW students in males and females (p-values 0.21, 0.31).

Demographics	Mean (mg/dL)	SD	n=	P-Value
Healthy Weight HDL Averages- all grades				
Hispanic	49.41	12.90	1555	0.164
White	48.92	12.75	8431	
Overweight HDL Averages- all grades				
Hispanic	43.60	11.16	541	0.466
White	44.00	11.03	1532	
Obese HDL Averages- all grades				
Hispanic	39.66	9.98	613	0.025*
White	40.81	10.05	1048	

** Significantly different between Hispanic and Non-Hispanic White students of the same BMI status using ANOVA*

Table 4: Average HDL Levels in Differing BMI Classifications

Table 4 evaluates HDL levels in Hispanic and NHW students when categorizing them based on BMI status. There were no significant HDL differences between Hispanic and NHW students in the healthy-weight and overweight categories. There was a significant difference in HDL levels between Hispanic and NHW students in the obese category, however this difference is not clinically meaningful.

Discussion

Based on population characteristics and results reported in this large diverse sample, Hispanic students in Colorado have lower mean HDL levels than NHW students. However, when controlling for BMI, the association between ethnicity and HDL was no longer significant, with students in similar weight categories exhibiting comparable HDL values between both groups. The greater proportion of Hispanic students in the overweight and obese categories likely accounts for the observed differences in mean HDL levels between the Hispanic and NHW students. This finding is not addressed in other studies – specifically, the effect of BMI on HDL does not seem to be accounted for in different ethnic groups, as other studies have only analyzed differences within the ethnic categories [9].

This study suggests that BMI is the driving force of HDL levels, regardless of ethnicity. Hispanic students are found to comprise the overweight and obese categories in higher numbers than the NHW students. This further explains the lower HDL levels noted in the Hispanic population. These results suggest that treatment should not be based on ethnicity but should be targeted at treating BMI. Focused treatment for weight loss and exercise seems to be the most effective route for managing HDL disparities, regardless of ethnicity [4]

Given that the Hispanic population is estimated to double by the year 2050, in the United States, changes to reduce the CVD risk in these individuals starting from a young age are imperative. An American Heart Association Presidential Advisory projected there to be a marked increase in CVD risk factors over the next 30 years, which will disproportionately affect minority populations, especially the Hispanic ethnic group [14]. Prolonged childhood risk factors have clear implications in adulthood CVD progression, and early interventions lead to better healthcare outcomes than adulthood interventions, irrespective of demographics [15]. This is especially true for abnormalities in BMI and cholesterol levels, including HDL, as it is a well-defined factor in the progression of atherosclerotic disease [5].

Limitations

This study has some potential limitations. The screening data was collected from a one-time screening of blood samples. Triglycerides and other anti-aging genes may have an impact on increased CVD risk however were not collectable in this non-fasting fingerstick research study. Reported BMI values in this study serve as a proxy measure for adiposity and do not account for actual body composition. Direct measures of adiposity might improve studied associations with student HDL levels and better account for variance in body composition between ethnic categories. The children's ethnicity was self-reported by the parent/guardian. Additionally, the Hispanic population in Colorado is considered homogenous, with a lack of subgroup representation.

Conclusion

Though it appears Hispanics have lower average HDL levels compared to NHW students, when controlling for BMI, ethnicity does not play as big of a role in impacting HDL levels. Students in the overweight or obese categories, in both ethnic groups, have significantly lower HDL levels compared to those who are in the healthy BMI category. However, since Hispanic students have a higher prevalence of overweight/obese, their HDL level appears to be significantly lower than their NHW peers. This novel finding has not been addressed in other childhood-based HDL

studies. Future direction needs to consider that low HDL levels may be related to obesity rather than ethnic disparities.

Declaration of competing interest:

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Gary J. Luckasen reports employment by University of Colorado Health.

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