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Trends in cholesterol in the US based on nativity status have not been researched. The objective of this study was to determine and explain differences in cholesterol levels based on nativity. The National Health and Nutrition Examination Surveys were used to study trends (1971-2002) of cholesterol levels in US born and foreign born people. Logistic and linear regressions were conducted to adjust for complex sampling of NHANES. This study found mixed results for cholesterol levels based on nativity status that varied over time. Therefore, disparities in cardiovascular disease between foreign born and US born groups cannot be fully explained based on cholesterol levels. Further research is needed to determine what factors contribute to disparities in cardiovascular disease by nativity.

TRENDS IN CHOLESTEROL OVER 30 YEARS IN

THE UNITED STATES BY NATIVITY

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TRENDS IN CHOLESTEROL OVER 30 YEARS IN THE UNITED STATES BY NATIVITY

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CHAPTER 1

INTRODUCTION

Cardiovascular disease is the leading cause of death in the United States.[1,2] About 2400 Americans die from cardiovascular disease each day.[3] Cardiovascular disease has an estimated economic cost of about $448 billion for the US economy.[3,4] The prevalence of high blood pressure, heart failure, coronary heart disease and strokes remains high which can cause debilitating effects or death. Although trends in cardiovascular disease have shown a decrease in overall death rates over the past 40 years, cardiovascular disease still remains an important health topic since in 2005, it was shown that 80.7 million US Americans had some type of cardiovascular disease.[4] Cardiovascular disease unequally impacts various segments of the population, especially by gender, race/ethnicity, and socioeconomic status.[3,5]

Cholesterol is one of the largest risk factors for cardiovascular disease. Many people with high cholesterol levels go unaware that they have the condition.[6, 7] Trends in cholesterol have shown an overall decline in cholesterol but an increase in serum triglyceride levels.[6] High levels of low density lipoprotein and serum triglyceride can lead to cardiovascular disease. Disparities in cholesterol levels mirror those found in cardiovascular disease. Most research on the disparities of cardiovascular disease and risk factors such as cholesterol have been focused on gender, socioeconomic status, and race/ethnicity. Less information is available on nativity differences despite that immigrants comprise 12% of the US population according to the latest figures from US

Census. Foreign born persons tend to be healthier and have better health outcomes than US born persons.[8] Foreign born individuals are less likely to suffer from heart disease and have lower mortality rates from cardiovascular disease.[9, 10] Studying risk factors for cardiovascular disease by nativity may help inform research on factors that contribute to cardiovascular disparities.

Therefore, the purpose of the this study is to determine and explain the differences in cholesterol levels by nativity.[6,11] Nationally representative data over the past thirty years will be used to study the association of nativity and cholesterol. Trends in cholesterol may inform research on disparities in cardiovascular disease. The findings from this study will also provide more information about how immigrant health has changed over time, which is still largely unknown.

CHAPTER 2

LITERATURE REVIEW

Epidemiology of Cholesterol

Cholesterol is a substance found within the lipids in the bloodstream and in all cells in the body. Cholesterol is vital to the healthy function of the body but too much cholesterol can have detrimental effects on the body leading to cardiovascular disease. The body makes cholesterol, but the principal source of cholesterol is dietary intake of foods from animal sources such as meats and dairy products.[12] Because cholesterol cannot be dissolved in blood, lipoproteins are used to transport cholesterol to and from cells. There are two main types of lipoproteins: high density lipoproteins (HDL) and low density lipoproteins (LDL). High density lipoproteins are thought to transport cholesterol away from the arteries, therefore HDL is said to be the "good" cholesterol. By transporting cholesterol away from the arteries, HDL helps to prevent heart disease. Low density lipoproteins are the main transporters of cholesterol in the bloodstream. LDL is known as "bad" cholesterol because an excess of LDL in the bloodstream can lead to cardiovascular disease. LDL cholesterol in large amounts can build up in the walls of arteries and eventually clog them leading to heart attacks or strokes if levels of LDL cholesterol are not managed. High levels of HDL cholesterol and low levels of LDL cholesterol are optimal. It is important to study overall cholesterol levels because unhealthy levels are linked to various health problems such as cardiovascular disease.[11]

Trends in Cholesterol

A trend study was done to evaluate how HDL cholesterol, LDL cholesterol and triglyceride levels have varied over the past thirty years using NHANES data. This study found that there has been an overall decrease in total cholesterol which has been attributed to a decrease in LDL cholesterol since there has not been a significant change observed in the levels of HDL cholesterol.[6, 7] However, there has been shown to be an increase in triglyceride serum levels over the past thirty years. An increase in triglyceride serum can lead to health problems such as cardiovascular disease and obesity. As the prevalence of obesity has increased, an increase has been observed in triglyceride serum trends.[6] In the Minnesota Heart Study, it was found that although there has been an overall decline in cholesterol levels, the decline has not been the same for all age groups. A greater decline has been seen in middle aged to older people. Cholesterol levels of younger people have shown little change and recently have shown an increase in overall cholesterol levels.[3,6,7] Although trends have shown a decrease in cholesterol levels, the decrease in these levels has slowed down recently. Also, the number of individuals controlling their high levels of cholesterol is low.[13]

Contributing Factors to Cholesterol Levels

The decline seen in cholesterol trends could be related to cholesterol lowering medication, diet and physical activity. Availability of cholesterol lowering medications may have contributed to an overall decrease in cholesterol levels over the past thirty years.[5,6,13] Although this decrease has been observed, there are still about 50 percent of adults that have cholesterol levels that put them at risk for cardiovascular health complications.[7] Cholesterol lowering medication is available to less than half of the people who qualify for treatment or are considered high-risk for heart disease.[3] Also, an implication that exists with the use of cholesterol lowering medications is that regardless of the medications effects on lowering cholesterol levels, it was observed that individuals have better clinical outcomes for CVD risks when C-reactive protein levels are low.[14]

The consumption of the recommended food groups on a daily basis is vital for maintaining health. Poor dietary habits can lead to serious health problems such as obesity and cardiovascular disease.[1,5-7,15-19] A diet trend study found that over the past thirty years food consumption in both American men and women has increased.[11] As food consumption has increased, there has also been an increase in health problems such as increase in the prevalence of obesity.[15,19] The results seemed to be consistent with the increased portion sizes over the years.[20,21] The quality of diet is a major risk factor for cardiovascular disease and impacts levels of cholesterol. The consumption of meats and fats has the effect of raising overall cholesterol levels. In the past 30 years, there has been a 63% increase in consumption of fats and a 24% increase in meat consumption in

Americans.[3] An increase in triglyceride levels is only affected by the types of foods that an individual consumes.[12] Studies have shown that alcohol can help raise the level of HDL cholesterol. When the HDL cholesterol is raised, LDL cholesterol is removed and transported out of the walls of the blood vessels. It was found that moderate drinkers had 10-20 percent higher levels of HDL cholesterol than those who were non-drinkers or were heavy drinkers because higher HDL levels were associated with lowering the risk of coronary heart disease by about half.[12,22]

Physical activity has also been shown to have an effect on HDL cholesterol levels. An increase in HDL cholesterol levels have been seen in individuals that do physical activity on a regular basis.[12] Increasing HDL cholesterol levels helps lower the risk for cardiovascular disease by lowering bad cholesterol and improving other organ functions.

Immigrant Health and Diet

For the purposes of this study, immigrants are defined as foreign born individuals who reside in the US. Immigrants are structurally different from the rest of the population of their country of origin. These individuals usually are not representative of the persons from their country of origin. Persons choosing to migrate to the US tend to have better health in comparison to the native born population. Studies have found that foreign born individuals have lower mortality and morbidity rates such as mental disorders, cardiovascular disease, obesity and some cancers.[9]

Although the selection effect may explain why immigrants tend to be healthier, acculturation is often used to explain how immigrant health changes over time. Acculturation is based on adaptation of the culture of the new country. Various factors are related to the level of acculturation of immigrants including years of residence, age of arrival, language, and generation.[24-26] Acculturation can be used as one of the measures for explaining the deterioration of cardiovascular health in immigrants.[27] One of the ways in which acculturation impacts the lives of immigrants is their quality of diet.[27] Fruit and vegetable intake has been shown to decrease as the number of years in the United States increases suggesting that the quality of immigrant diets may be negatively associated with time spent in the US.[28] Depending on many factors, the types of foods they were previously consuming may not be as readily available to them as in their country of origin. In addition to foods not being available, other types of foods such as the convenience of fast food is now available to them.[27,29,30] Most of the research done to this point has shown the negative effects of acculturation on diet and health.[27] This is important to study since the deterioration of dietary habits could be possibly linked to cholesterol levels.

A topic worth evaluating when studying immigrant health is the Hispanic Paradox. The Hispanic paradox suggests that Hispanics have better health than non-Hispanics despite difference in socioeconomic status.[30] For example, the evidence that shows that Hispanics of low socioeconomic status have better health outcomes than non-Hispanics of equal socioeconomic status. It has also been found that within this Hispanic paradox, Mexican Americans and in particular those at an older age have a greater

advantage in health outcomes. This paradox can help to explain the differences that exist in health outcomes between the immigrant and US born population.

STATEMENT OF PROBLEM

The immigrant population in the US is continuously growing leading to a need to identify differences that exist between immigrant and US born populations that could contribute to health disparities in other chronic diseases. In addition to documenting disparities, there is a need to understand why these disparities exist and what could potentially be done to alleviate them. By studying trends in cholesterol over a long period of time, it may be possible to link this trend with known disparities in cardiovascular disease, obesity, and other health conditions. Cholesterol trends have shown a decline in overall cholesterol levels but did not research the comparison between immigrant and non immigrant populations.[6,7] Studying disparities by nativity will promote cardiovascular disease awareness and improve assessment of cardiovascular disease needs for immigrant populations.

Therefore, this study will use nationally representative data to determine if differences in cholesterol levels over the past 30 years exist by nativity. It is expected that immigrants will have lower levels of cholesterol than the US born population, but that the gap will narrow over time. The results of this study will help inform public health professionals and policy makers to design effective interventions and treatments concerning differences by nativity in cholesterol levels, a major risk factor for cardiovascular disease.[31]

CHAPTER 3

METHODOLOGY

Data

To determine the difference in cholesterol levels over the past thirty years by nativity, this study will use secondary data collected from National Health and Nutrition Examination Surveys (NHANES): NHANES I (1971-75), NHANES II (1976-80), NHANES III (1988-94), NHANES 1999-2002. NHANES are nationally representative, cross-sectional surveys that are conducted by the National Center for Health Statistics. The sampling design of NHANES is a stratified, multistage cluster, probability sample.[36] The content of the NHANES surveys relevant to this study were demographics, diet behaviors and nutrition, acculturation, physical activity and physical fitness, and cardiovascular disease.[32-36] The data from these surveys was collected through two methods, the home interview and the health examination. In the health examination section, during which blood samples were collected to test for lipids, a mobile exam center (MEC) was used.[38] The sample sizes for each data set for measurement of total cholesterol were roughly as follows: NHANES I-(13,106) , NHANES II-(11,864), NHANES III-(13,914) and NHANES 1999-2002-(7740).[6, 32-36] This data is available for the public to download. Additional information about NHANES can be found within the NHANES documentation.[32-36]

Measures

Cholesterol is the dependent variable for this study. Cholesterol is measured in NHANES by testing blood serum through laboratory methods. The blood lipids that are measured are total cholesterol, HDL and LDL cholesterol, and triglycerides. Cholesterol was collected through venous blood serum samples from individuals who had fasted at least 9 hours prior to collection.[38,39] The blood collected is processed, stored and sent to various external labs for processing.[40] Previous studies have described the methods for determining total cholesterol, cholesterol components and triglyceride serum for NHANES surveys relevant to this study.[6,41] These blood serum samples were frozen then shipped to a laboratory to perform lipid analyses. For NHANES 1999-2002, blood serum was analyzed with the Hitachi 704 Analyzer and performed at the Lipoprotein Analytical Laboratory at John Hopkins University of Medicine.[39, 40]

There are two different measurements for cholesterol, mmol/L and mg/dL. The SI conversion factor when converting serum total, HDL and LDL to mmol/L units multiply by 0.0259. When converting serum triglyceride to mmol/L units multiply by 0.0113.[6] The American Heart Association has established clinically significant cutpoints for lipid levels that are associated with a higher risk of cardiovascular disease.[12] A total cholesterol level of less than 200 mg/dL is desirable, 200-239 mg/dL is borderline high-risk and over 240 mg/dL is high risk for CVD. HDL levels should remain high, a 60 mg/dL or higher level is protective against heart disease. LDL levels should remain below 100mg/dL. Normal triglyceride levels are less than 150 mg/dL.

Nativity is the primary predictor variable and measured by respondent self-report for place of birth. The variable is defined as born in the United States versus born outside the US. Demographic and health behavior factors will be used as control variables. Demographic factors will include years of age, race, and gender.

Statistical Analysis

All analyses will be performed with STATA SE/10 (StataCorp, College Station, TX) to adjust for the complex sampling design of NHANES. The first analysis step will be to show univariate statistics for each cross-section of NHANES. Then, bivariate analysis will be used to compare cholesterol levels by nativity for each cross-section of NHANES. Mean levels of cholesterol will be compared by nativity with a t-test used to ascertain statistical significance. Multivariate linear and logistic regression will be used to determine if other factors explain the difference in cholesterol levels by nativity. HDL and LDL ratio will be used for the linear regression because it has been found to be a better clinical measurement of healthy cholesterol levels. The clinical cutpoint score will be used for logistic regression.

CHAPTER 4

RESULTS

Descriptives

Table 1 presents the descriptive statistics used for this survey that are relevant to this study. The descriptive statistics in this study focused on some demographics such as age, gender, race, nativity, and cholesterol levels for the National Health and Nutrition Examination Survey 1971-2002. Overall mean cholesterol levels seemed to increase with mean age for each of the survey sets. For NHANES 1971-1975, NHANES 1988-1994 and NHANES 1999-2002, 51-52% of the sample was female. For NHANES 1976-1980, 18% of the sample was female. The mean percentage of those who were non-Hispanic White within the sample continuously decreased from 1971 to 2002. The mean percentage of those within the sample who were born in the United States continuously decreased from 1971-2002. Total cholesterol levels increased from 198 to 213 during 1971-1980 but then decreased from 202 to 194 during 1988-2002. NHANES 1976-1980 showed the highest level of high total cholesterol with 57% of the sample having total cholesterol levels higher than 200mg/dL. During NHANES 1999-2002, 41% of the sample had high total cholesterol levels, making it the lowest percentage seen from 1971-2002. The mean HDL levels stayed between 49.7-50.9 during NHANES 1976-2002. The percentage of the sample with low HDL levels decrease from 81% to 76% between 1976-1994 but remained the same during 1988-2002. LDL levels decreased from 126.17 to 117.04 during 1988-2002. There was also a decrease in the percentage of the sample with high levels of LDL during 1988-2002 with a decrease of 74% to 66%. Triglyceride

levels decreased between 1976-1988(138.58 to 141.66) as compared to 1988-2002(141.66 to 137.07). The percentage of the sample with high triglyceride levels stayed the same 1976-1988(31%) but decreased during 1999-2002 to 29%.

Unadjusted Mean Levels of Lipids by Nativity

Table 2 compares the overall cholesterol levels between individuals of the sample who are US born and those who are foreign born. In NHANES 1971-1975 total cholesterol levels were those who were foreign born(208) as compared to us born individuals(198). The percentage of the sample who were foreign born had the highest level of high total cholesterol levels(54%) as compared to those who were US born(43%). For NHANES 1976-1980, foreign born individuals had higher levels of total cholesterol(218) in comparison to those born in the US(213) as well as having a higher percentage of the sample with high cholesterol levels(62%) in comparison to the percentage for US born(57%). HDL levels were the same for both foreign born and US born(50). The percentage of those within the sample with low HDL levels was higher for foreign born(83%) than those US born(81%). Triglyceride levels were also higher for foreign born individuals(144) compared to those who were US born(138). The percentage of the sample having high levels of triglycerides was higher for foreign born individuals(34%) as compared to US born individuals(31%). For NHANES 1988-1994, total cholesterol levels were higher for those born in the US(203) in comparison to those who were foreign born(201). The portion of the sample that were born in the US had a higher percentage of individuals with high cholesterol(50%) as compared to the portion of the sample that were foreign born(46%). HDL levels were also higher for US born

individuals(51) as compared to those who were foreign born(50). A higher percentage of the sample who were foreign born had low levels of HDL(77%) in comparison to those who were US born(75%). Triglyceride levels were higher for those foreign born within the sample(145) as compared to the US born(141). The percentage of those within the sample with high triglyceride levels were the same for both foreign(31%) and US born persons(31%). LDL levels were higher for US born individuals(127) than levels for foreign born(124). A higher percentage of those born in US had high LDL levels(75%) as compared to foreign born(73%). For NHANES 1999-2002, the foreign born portion of the sample had a higher mean of total cholesterol(197) compared to the US born(194) and a higher percentage of the foreign born sample had high levels of total cholesterol(42%) in comparison to US born(40%). HDL levels were about the same for foreign(50) and US born(51) however, foreign born sample had a higher percentage of those with low levels of HDL(78%) compared to US born(76%). Triglyceride levels were higher for foreign born individuals(143) than those for US born(136). The percentage of the sample that had high levels of triglycerides was about the same for foreign born(30%) and US born(29%). LDL levels and percentage of the sample with high LDL levels were also about the same for both groups with foreign born having mean LDL levels of 118 with 67% having high levels of LDL in comparison to US born having mean LDL levels of 117 with 66% of them having high levels of LDL.

Figure 1 shows a slight upward trend for both population samples from NHANES 1971-1975 to NHANES 1976-1980. A downward trend is observed for both population samples after NHANES 1976-1980. Cholesterol levels remained higher for foreign born individuals throughout the survey sets observed.

Figure 2 shows an upward trend in high cholesterol levels in both populations between NHANES 1971-1975. After NHANES 1976-1980 a downward trend is seen in both populations for high cholesterol. However, it seems as though high cholesterol levels leveled off between NHANES 1988-2002. Percentage of high total cholesterol levels remained higher for foreign born individuals throughout the survey sets observed.

Figure 3 shows that US born HDL levels increased over the years and have increased more than foreign born levels. Foreign born HDL levels have stayed about the same but decreased slightly between NHANES 1988-1994. These trends show higher HDL levels for US born individuals. HDL levels began higher for foreign individuals in NHANES 1976-1980 and by NHANES 1999-2002 US born HDL levels were much higher.

Figure 4 shows that low HDL levels decreased slightly between NHANES 1976-1988. However, low HDL levels did slightly increase between NHANES 1988-2002. The trends for both groups were similar although lower percentages of low HDL levels were seen in foreign born individuals.

Figure 5 shows that there was an increase in triglyceride levels from NHANES 1976-1988 and a decrease from NHANES 1988-2002 for both US born and foreign born groups. The trend for both groups has been similar although triglyceride levels remained higher for the foreign born sample over the years.

Figure 6 shows that high triglyceride levels have slightly decreased for both groups. At NHANES 1976-1980 a higher percentage of high triglyceride levels were seen in the foreign born sample but over the years the gap that existed between these groups has reduced.

Figure 7 shows that LDL levels have decreased for both US born and foreign born samples. However, in NHANES 1988-1994 US born individuals had higher LDL levels but by NHANES 1999-2002, foreign born individuals had higher LDL levels.

Figure 8 shows that a decrease was seen in both populations between NHANES 1988-2002. The trend in percentage of high LDL levels is consistent with the trend that was seen for LDL levels, in that at NHANES 1988-1994 US born individuals had a higher percentage of high LDL levels and by NHANES 1999-2002 the foreign born population had a higher percentage of high LDL levels.

Total Cholesterol

Table 3 presents the results for the linear regression of total cholesterol on the independent variables(nativity, age, gender and race) to adjust for the complex sampling design of NHANES. This linear regression explained variance of the survey sets for total cholesterol as follows: NHANES 1971-1975(31%), NHANES 1976-1980(11%), NHANES 1988-1994(15%) and NHANES 1999-2002(17%). For NHANES 1971-1975, the analysis showed that all variables except for nativity were statistically significant. For NHANES 1976-1980, it was found that only age was statistically significant. In NHANES 1988-1994, age and gender were the only variables found to be statistically significant. For NHANES 1999-2002, all variables except gender were found to be statistically significant.

Table 4 provided analysis of the logistic regression of high cholesterol levels on the independent variables to adjust for the complex sampling design of NHANES. The control variables that were analyzed through logistic regression were nativity, age, gender and race. Although nativity is the principal control variable that is being studied, it was found to overall not be significant in the outcome of cholesterol levels.

Triglycerides

Table 5 presents the analysis results for the linear regression of triglycerides on the independent variables to adjust for the complex sampling design of NHANES. This linear regression explained variance of the survey sets for triglycerides as follows: NHANES 1976-1980(2%), NHANES 1988-1994(10%) and NHANES 1999-2002(5%). For NHANES 1976-1980, all variables were found to be statistically significant except for nativity. In NHANES 1988-1994 and NHANES 1999-2002, all variables were found to be statistically significant.

Table 6 provided analysis of the logistic regression of high triglycerides levels on the independent variables to adjust for the complex sampling design of NHANES. The control variables that were analyzed through logistic regression were nativity, age, gender and race. Although nativity is the principal control variable that is being studied, it was found to overall not be significant in the outcome of cholesterol levels.

HDL

Table 7 presents the results for the linear regression of HDL cholesterol on the independent variables to adjust for the complex sampling design of NHANES. This linear regression explained variance of the survey sets for HDL as follows: NHANES 1976-1980(3%), NHANES 1988-1994(10%) and NHANES 1999-2002(9%). For NHANES 1976-1980, all variables except for nativity were found to be statistically significant. In NHANES 1988-1994, all variables except for age were found to be

statistically significant. For NHANES 1999-2002, all variables except for race were found to be statistically significant.

Table 8 provided analysis of the logistic regression of low HDL levels on the independent variables to adjust for the complex sampling design of NHANES. The control variables that were analyzed through logistic regression were nativity, age, gender and race. Although nativity is the principal control variable that is being studied, it was found to overall not be significant in the outcome of cholesterol levels.

LDL

Table 9 presents the results for the linear regression of LDL cholesterol on the independent variables to adjust for the complex sampling design of NHANES. This linear regression explained variance of the survey sets for LDL as follows: NHANES 1988-1994(10%) and NHANES 1999-2002(11%). For NHANES 1988-1994 and NHANES 1999-2002, age and gender were found to be statistically significant.

Table 10 provided analysis of the logistic regression of high LDL levels on the independent variables to adjust for the complex sampling design of NHANES. The control variables that were analyzed through logistic regression were nativity, age, gender and race. Although nativity is the principal control variable that is being studied, it was found to overall not be significant in the outcome of cholesterol levels.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

The purpose of this study was to explain difference in cholesterol levels based on nativity in the United States using a nationally representative sample. Clinical cutoff points were used to measure the association of cholesterol levels based on nativity. Variables that were found to be statistically significant varied by survey set and by type of cholesterol. The two variables that were most often found to be statistically significant were gender and race. Nativity was not found to be as statistically significant as originally hypothesized. A trend that was observed through the years analyzed in this study was the decrease of the mean percentage of those who were non-Hispanic White within the sample and the mean percentage of those within the sample who were born in the United States. This is consistent with data that shows the immigrant population is consistently growing each year.

The downward trend that was observed in total cholesterol levels in both US born and foreign born groups could possibly be explained by the use of cholesterol lowering medication. Cholesterol lowering medication could also be used to explain the trend seen in the decrease of LDL levels. Although these levels have decreased over time, they seem to have leveled off in recent years and have remained higher than the clinical cutoff point observed in healthy LDL levels. This could be explained by little variation in cholesterol lowering methods. HDL levels slightly increased over the years but not significantly and have remained below the clinical cutoff point. This is of concern

because HDL should be high for healthy cardiovascular levels. Triglycerides slightly decreased but have overall have remained below the cutoff point that is observed in unhealthy triglyceride levels.

It is important to observe the disparity that exists between both populations for all cholesterol levels. In particular, the data provided by the figures shows a large gap in HDL levels between the two populations being studied. Since HDL levels are vital for good cardiovascular health, more research needs to be done to explain why US born individuals have much higher HDL levels than foreign born individuals.

Throughout this study it was observed that overall the sample of foreign individuals had higher levels of unhealthy levels of all types of cholesterol analyzed for this study. This is a problem because little is known and not enough research has been done on immigrant health to explain this discrepancy. The overall high levels in cholesterol for foreign born individuals could be possibly explained by diet, lack of physical activity, acculturation or lack of access to healthcare resources that would enable them to help them lower their overall cholesterol levels.

Strength and Limitations

The main strength of this study is that it used a nationally representative data set that provided a large sample size. This provided opportunity for use of several different control variables. Analyzing NHANES data from 1971-2002, helped to show if a trend existed in cholesterol levels over the thirty year period. Studying trends is important in predicting future trends that may exist in populations such as immigrant populations. The

focus of this study was comparing cholesterol levels by nativity. However, acculturation is a complex, multidimensional construct that was not measured in this study beyond nativity status. NHANES does not have sufficient measurement of acculturation but future studies may be able to combine the use of objective markers of diet and well-established measures of acculturation. Another limitation of this study was that cholesterol levels were derived from serum levels. Although serum levels are a more objective source of data than self-report measures, these levels can only suggest cholesterol intake within the past 24 hours. Further, physiological processes other than dietary intake of products containing cholesterol may influence serum levels of cholesterol.

Conclusion

This study presented information to explain why differences in health outcomes related to cardiovascular disease, exist between immigrants and US born individuals. This study found mixed results that cholesterol levels have varied over time by nativity. Therefore, the disparities in cardiovascular disease between foreign born and US born groups cannot be fully explained by differences in cholesterol levels. More research is needed to explore other factors that contribute to disparities in cardiovascular disease by nativity status. As the immigrant population continues to grow, more healthcare resources need to be provided to this population to educate them on preventing or managing cardiovascular disease. Public health initiatives lack in the area of immigrant health and information of management of cholesterol in this population should be made

more readily available. Future research in this topic should focus on studying trends in cardiovascular disease in both of these populations to determine future patterns and to provide the appropriate resources in the United States for everyone in the population.

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APPENDICES

TABLES

TABLE 1. Descriptive Statistics: NHANES 1971-2002

	NHANES 1971-1975		**NHANES 1976-1980**		**NHANES 1988-1994**		**NHANES 1999-2002**	
	N	Mean or %	N	Mean or %	N	Mean or %	N	Mean or %
AGE, years	20749	30.61	20322	43.08	20050	43.25	21004	35.57
FEMALE, %	20749	51	20322	18	20050	52	21004	51
WHITE, %	20749	87	20322	86	20050	76	21004	67
US BORN, %	20749	94	20150	93	19499	88	20982	87
CHOLESTEROL, mg/dL*	20022	198.37	11864	213.20	17107	202.37	15716	194.17
CHOLESTEROL ≥ 200 mg/dL*, %	20022	44	11864	57	17107	49	15716	41
HDL, mg/dL*			9797	49.70	16988	50.64	15711	50.90
HDL ≤ 60 mg/dL*, %			9797	81	16988	76	15711	76
LDL, mg/dL*					7184	126.17	6814	117.04
LDL ≥ 100 mg/dL*, %					7184	74	6814	66
TRIGLYCERIDE, mg/dL**			5732	138.58	17069	141.66	7491	137.07
TRIGLYCERIDE ≥150 mg/dL, %**			5732	31	17069	31	7491	29

*To convert mg/dL for serum total, HDL and LDL to mmol/L units multiply by 0.0259.
**To convert mg/dL for triglycerides to mmol/L units multiply by 0.0113.

Table 2. Cholesterol Levels: US Born vs. Foreign Born

	NHANES 1971-1975				NHANES 1976-1980				NHANES 1988-1994				NHANES 1999-2002			
	US		FOREIGN		US		FOREIGN		US		FOREIGN		US		FOREIGN	
	N	Mean (CI)	N	Mean (CI)	N	Mean (CI)	N	Mean (CI)	N	Mean (CI)	N	Mean (CI)	N	Mean (CI)	N	Mean (CI)
TOTAL CHOLESTEROL, mg/dL*	18697	198(196, 199)	1325	208(204, 212)	10908	213(211, 215)	853	218(212, 224)	13525	203(201, 204)	3119	201(198, 204)	12753	194(192, 195)	2956	197(193, 200)
CHOLESTEROL ≥ 200 mg/dL*, %	18697	43(43, 44)	1325	54 (49, 58)	10908	57(54, 60)	853	62(44, 79)	13525	50(44, 55)	3119	46(29, 63)	12753	40(38, 47)	2956	42(37, 47)
HDL, mg/dL*					9106	50(48, 51)	611	50(39, 61)	13429	51(50, 52)	3099	50(42, 58)	12749	51(50, 52)	2955	50(49, 50)
HDL ≤ 60 mg/dL*, %					9106	81(72, 89)	611	83(45, 122)	13429	75(54, 97)	3099	77(51, 103)	12749	76(75, 77)	2955	78(73, 84)
TRIGLYCERIDE, mg/dL**					5281	138(135, 142)	401	144(-12, 300)	13492	141(137, 146)	3114	145(98, 193)	6068	136(129, 143)	1420	143(130, 155)
TRIGLYCERIDE ≥150 mg/dL, %**					5281	31(-4, 66)	401	34(-11, 79)	13492	31(23, 39)	3114	31(1, 62)	6068	29(24, 33)	1420	30(26, 34)
LDL, mg/dL*									5688	127(125, 128)	1286	124(119, 129)	5519	117(115, 119)	1292	118(117, 119)
LDL ≥ 100 mg/dL*, %									5688	75(70, 80)	1286	73(68, 77)	5519	66(64, 68)	1292	67(58, 76)

*To convert mg/dL for serum total, HDL and LDL to mmol/L units multiply by 0.0259.

**To convert mg/dL for triglycerides to mmol/L units multiply by 0.0113.

Table 3. Linear Regression of Total Cholesterol on Independent Variables

	NHANES 1971-1975			**NHANES 1976-1980**			**NHANES 1988-1994**			**NHANES 1999-2002**		
	Coefficient	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**
US BORN	-0.011	1.61	0.995	-.96	1.97	0.628	-1.10	1.73	0.530	-3.76	1.63	0.028
AGE	1.38	0.02	<0.001	1.03	.03	<0.001	0.95	0.04	<0.001	0.83	0.02	<0.001
FEMALE	2.48	0.79	0.002	.62	1.28	0.632	2.82	0.90	0.003	1.51	0.84	0.084
WHITE	-2.49	1.18	0.035	2.12	1.69	0.217	0.94	1.13	0.408	2.02	0.97	0.047
CONSTANT	156.14	1.86	<0.001	165.19	2.79	<0.001	160.25	2.21	<0.001	163.62	1.52	<0.001
R^2	0.3105			0.1084			0.1530			0.1675		
N	20022			11761			18649			16954		

Table 4. Logistic Regression of High Cholesterol on Independent Variables

	NHANES 1971-1975			**NHANES 1976-1980**			**NHANES 1988-1994**			**NHANES 1999-2002**		
	Odds Ratio	**95% Confidence Interval**		**Odds Ratio**	**95% Confidence Interval**		**Odds Ratio**	**95% Confidence Interval**		**Odds Ratio**	**95% Confidence Interval**	
US BORN	0.93	0.78	1.11	0.94	0.77	1.15	1.06	0.90	1.24	0.86	0.76	0.98
AGE	1.07	1.06	1.07	1.04	1.04	1.05	1.04	1.04	1.05	1.04	1.04	1.05
FEMALE	1.06	0.97	1.16	1.01	0.90	1.13	0.98	0.89	1.08	1.05	0.96	1.14
WHITE	0.92	0.82	1.02	1.15	0.98	1.35	1.01	0.89	1.15	1.13	1.02	1.25
N	20022			11761			18649			16954		

Table 5. Linear Regression of Triglycerides on Independent Variables

	NHANES 1976-1980			NHANES 1988-1994			NHANES 1999-2002		
	Coefficient	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**
US BORN	-4.62	8.10	0.573	2.01	0.59	0.002	-12.47	5.86	0.042
AGE	0.75	0.10	<0.001	0.01	0.01	<0.001	1.29	0.09	<0.001
FEMALE	-18.24	3.18	<0.001	9.50	0.40	<0.001	-24.39	5.27	<0.001
WHITE	17.10	3.99	<0.001	-2.12	0.55	<0.001	11.62	4.96	0.026
CONSTANT	96.65	11.62	<0.001	45.11	0.78	<0.001	102.04	6.96	<0.001
R^2	0.02			0.10			0.05		
N	5682			18535			8733		

*NHANES 1971-1975 is not included because data was not available for this data set.

Table 6. Logistic Regression of High Triglycerides on Independent Variables

	NHANES 1976-1980			NHANES 1988-1994			NHANES 1999-2002		
	Odds Ratio	95% Confidence Interval		Odds Ratio	95% Confidence Interval		Odds Ratio	95% Confidence Interval	
US BORN	0.90	0.64	1.27	0.79	0.66	0.94	0.78	0.57	1.06
AGE	1.01	1.01	1.02	1.03	1.02	1.03	1.03	1.02	1.03
FEMALE	0.66	0.55	0.79	0.57	0.50	0.65	0.72	0.63	0.83
WHITE	1.58	1.24	2.02	1.29	1.14	1.46	1.37	1.05	1.78
N	5682			18612			8733		

*NHANES 1971-1975 is not included because data was not available for this data set.

Table 7. Linear Regression of HDL on Independent Variables

	NHANES 1976-1980			NHANES 1988-1994			NHANES 1999-2002		
	Coefficient	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**
US BORN	0.51	.6654	0.448	2.01	0.59	0.001	1.90	0.56	0.002
AGE	0.04	.0105	<0.001	0.01	0.01	0.243	0.06	0.01	<0.001
FEMALE	5.19	.4599	<0.001	9.50	0.40	<0.001	8.19	0.32	<0.001
WHITE	-3.49	.5559	<0.001	-2.12	0.55	<0.001	-1.19	0.68	0.092
CONSTANT	49.42	.9363	<0.001	45.11	0.78	<0.001	43.45	0.56	<0.001
R^2	0.03			0.10			0.09		
N	9717			18535			16949		

*NHANES 1971-1975 is not included because data was not available for this data set.

Table 8. Logistic Regression of Low HDL on Independent Variables

	NHANES 1976-1980			NHANES 1988-1994			NHANES 1999-2002		
	Odds Ratio	95% Confidence Interval		Odds Ratio	95% Confidence Interval		Odds Ratio	95% Confidence Interval	
US BORN	0.77	0.59	0.99	0.82	0.67	1.00	0.84	0.69	1.02
AGE	0.99	0.99	1.00	1.00	0.99	1.00	0.99	0.99	0.99
FEMALE	0.52	0.45	0.60	0.29	0.25	0.34	0.33	0.30	0.36
WHITE	1.54	1.30	1.82	1.22	1.05	1.41	1.13	0.92	1.38
N	9717			18535			16949		

*NHANES 1971-1975 is not included because data was not available for this data set.

Table 9. Linear Regression of LDL on Independent Variables

	NHANES 1988-1994			NHANES 1999-2002		
	Coefficient	**SE**	**p-value**	**Coefficient**	**SE**	**p-value**
US BORN	0.66	2.35	0.780	-1.82	2.03	0.377
AGE	0.66	0.04	<0.001	0.55	0.03	<0.001
FEMALE	-5.12	1.28	<0.001	-4.24	1.17	0.001
WHITE	1.22	1.47	0.412	1.48	1.38	0.296
CONSTANT	98.61	2.65	<0.001	98.54	2.26	<0.001
R^2	0.10			0.11		
N	9318			8056		

*NHANES 1971-1975 and NHANES 1976-1980 are not included because data was not available for this data set.

Table 10. Logistic Regression of High LDL on Independent Variables

	NHANES 1988-1994			NHANES 1999-2002		
	Odds Ratio	**95% Confidence Interval**		**Odds Ratio**	**95% Confidence Interval**	
US BORN	1.06	0.79	1.44	0.92	0.72	1.16
AGE	1.04	1.03	1.05	1.03	1.03	1.04
FEMALE	0.73	0.62	0.86	0.84	0.74	0.94
WHITE	0.99	0.81	1.22	1.09	0.90	1.32
N	9318			8056		

*NHANES 1971-1975 and NHANES 1976-1980 are not included because data was not available for this data set.

FIGURES

Figure 1.

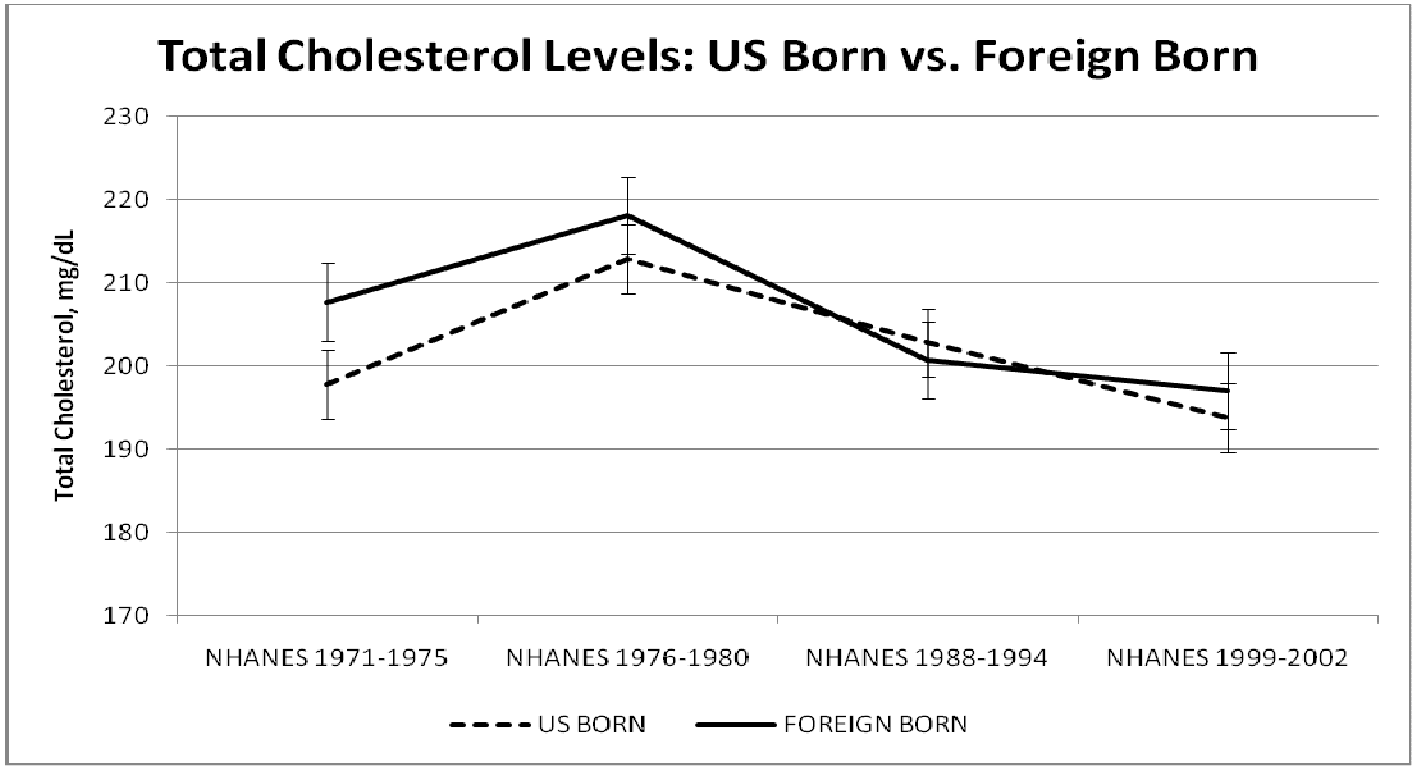


Figure 2.

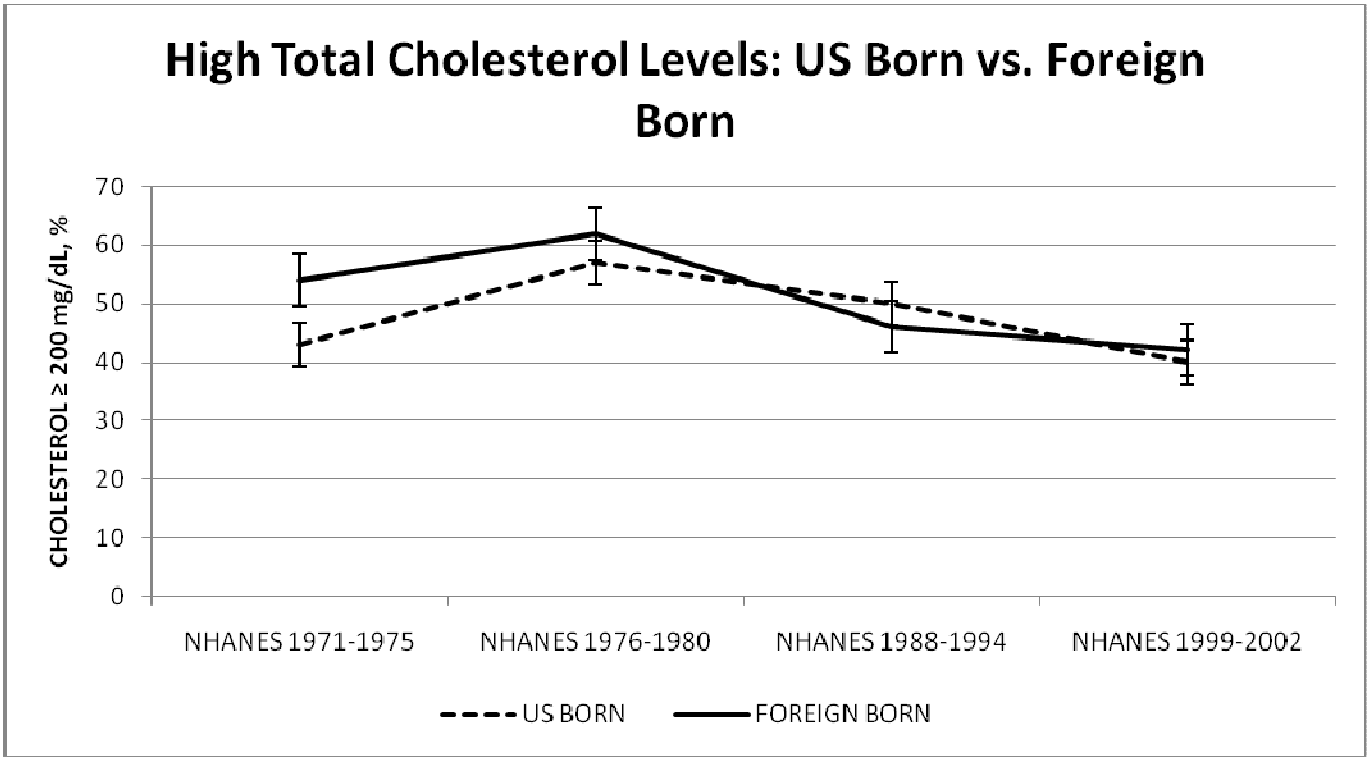

High Total Cholesterol Levels: US Born vs. Foreign Born
CHOLESTEROL ≥ 200 mg/dL, %
70
60
50
40
30
20
10
0
NHANES 1971-1975
NHANES 1976-1980
NHANES 1988-1994
NHANES 1999-2002
US BORN
FOREIGN BORN

Figure 3.

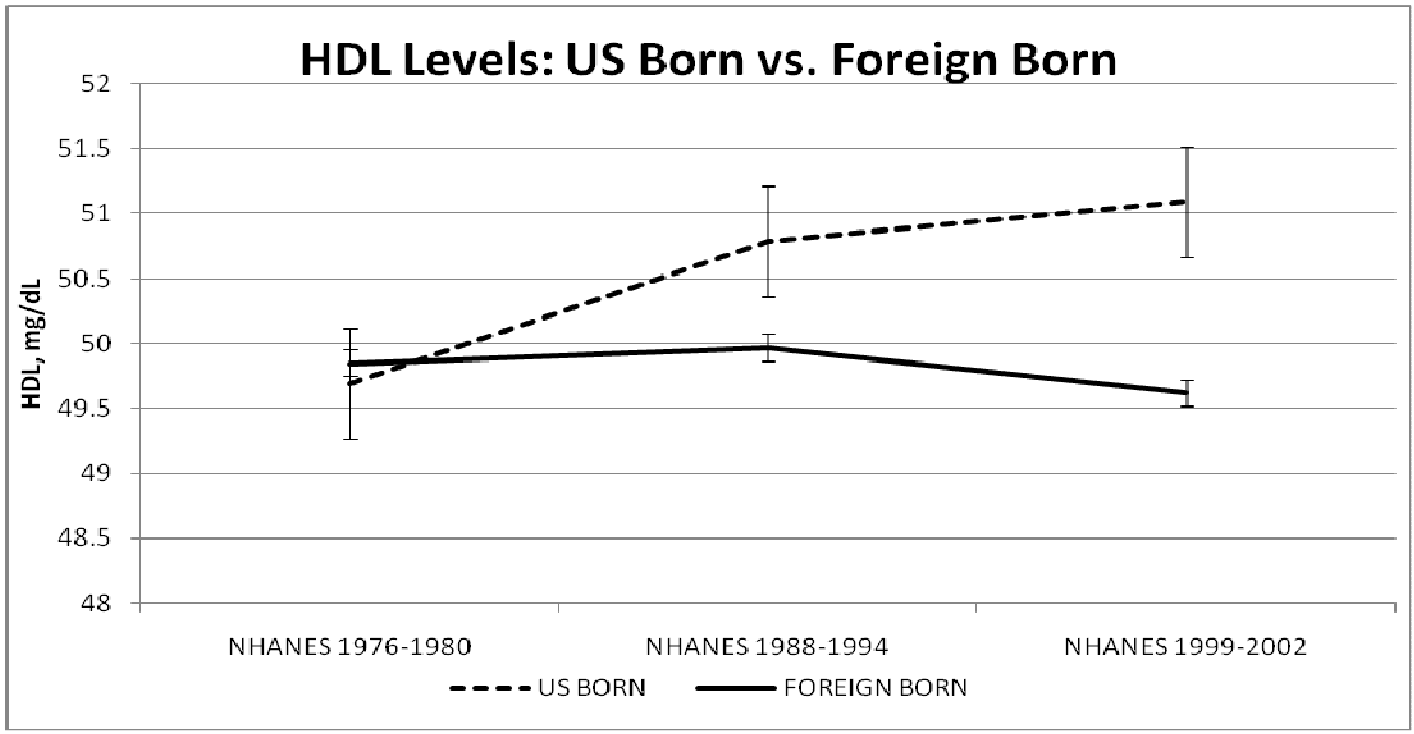

HDL Levels: US Born vs. Foreign Born
HDL, mg/dL
52
51.5
51
50.5
50
49.5
49
48.5
48
NHANES 1976-1980
NHANES 1988-1994
NHANES 1999-2002
US BORN
FOREIGN BORN

Figure 4.

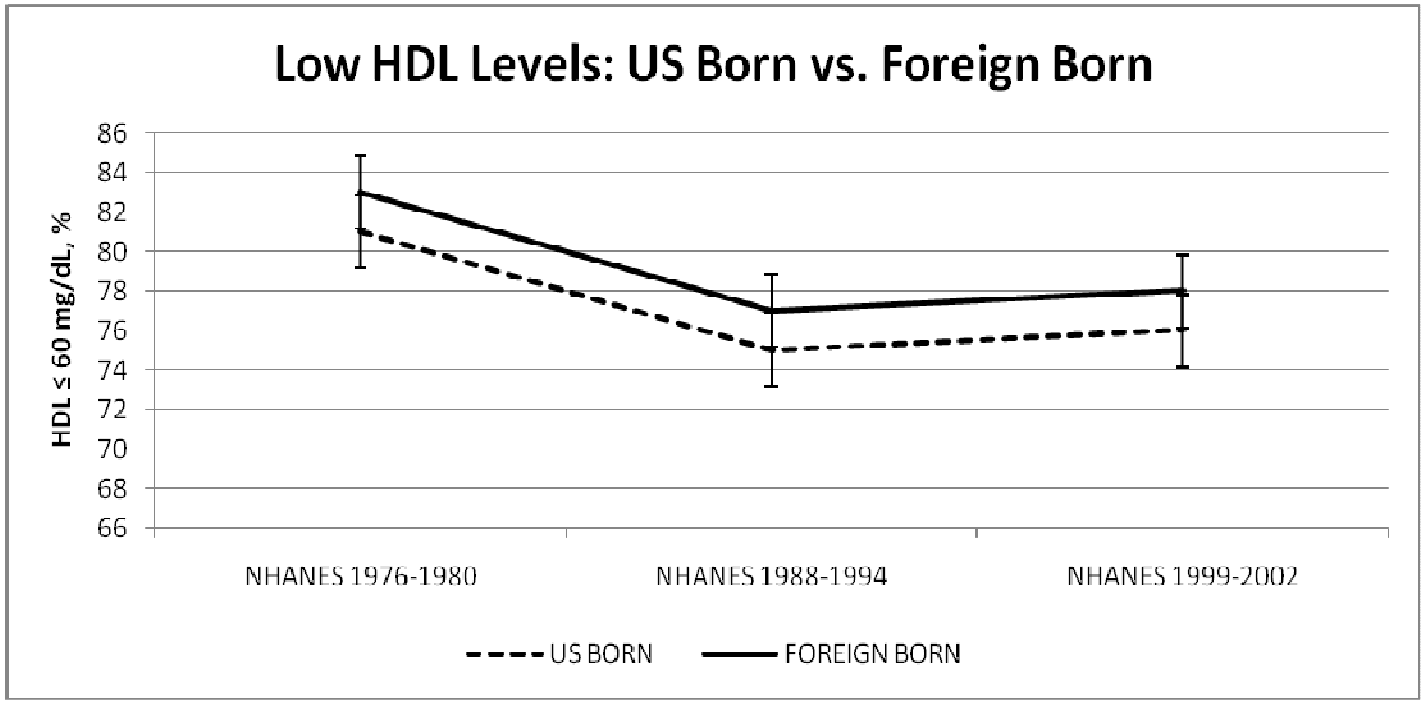

Low HDL Levels: US Born vs. Foreign Born
HDL ≤ 60 mg/dL, %
86
84
82
80
78
76
74
72
70
68
66
NHANES 1976-1980
NHANES 1988-1994
NHANES 1999-2002
US BORN
FOREIGN BORN

Figure 5.

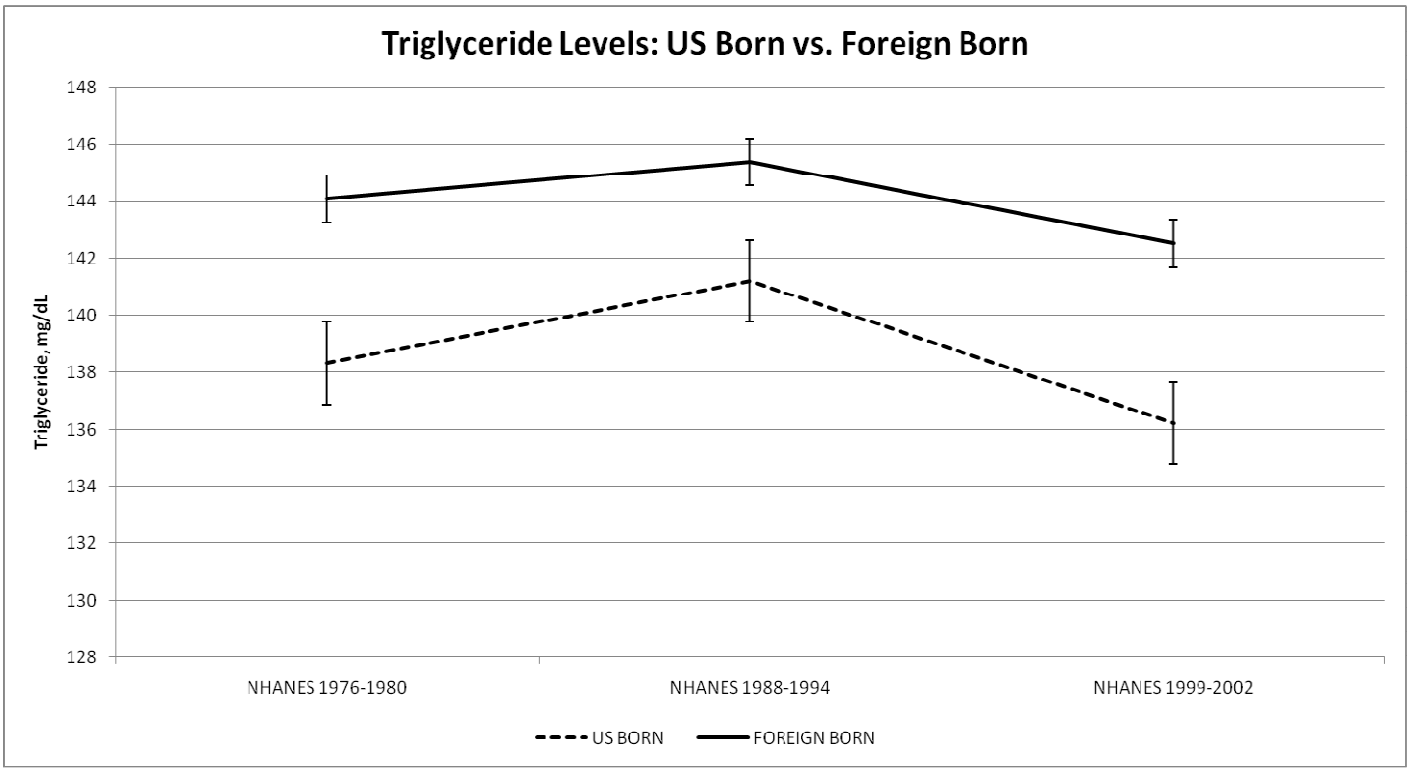

Triglyceride Levels: US Born vs. Foreign Born
148
146
144
142
140
138
136
134
132
130
128
Triglyceride, mg/dL
NHANES 1976-1980
NHANES 1988-1994
NHANES 1999-2002
US BORN
FOREIGN BORN

Figure 6.

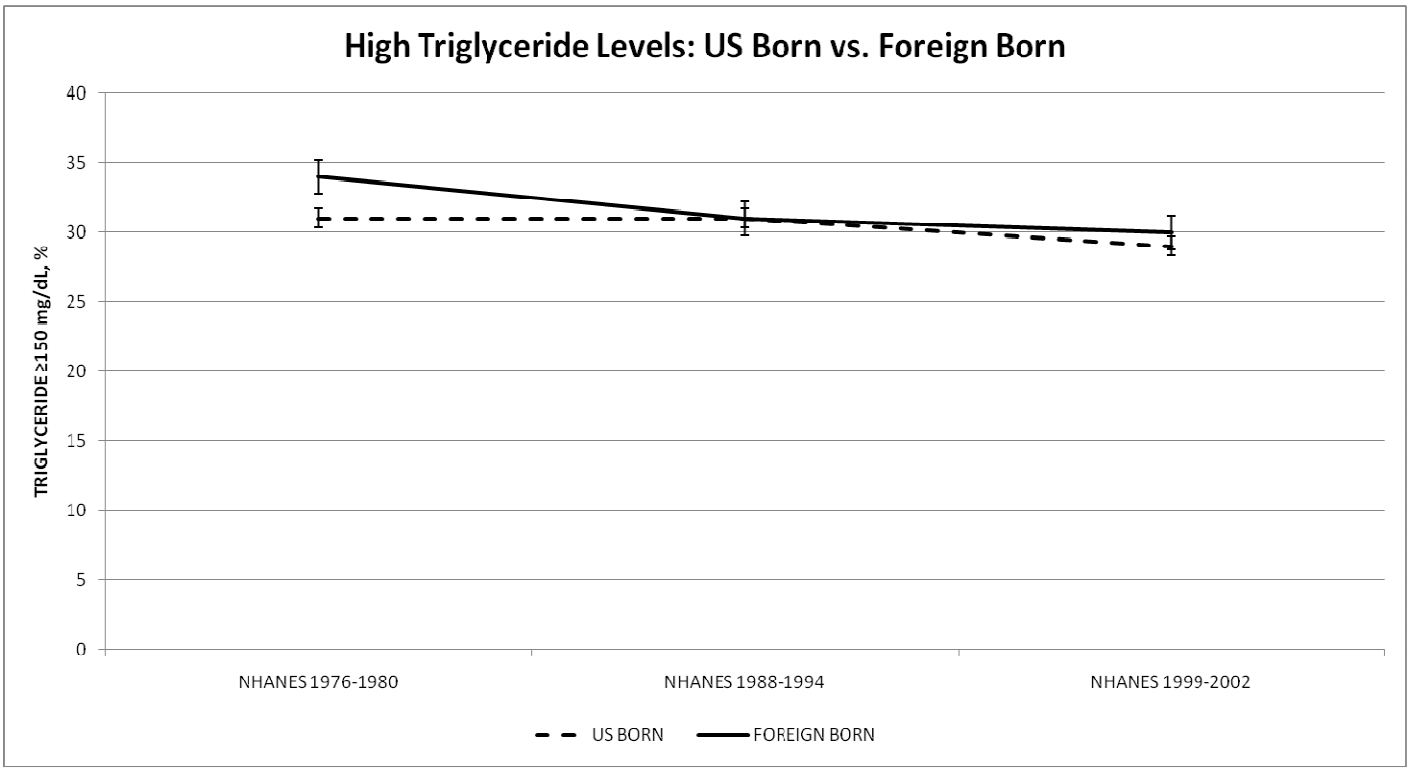

High Triglyceride Levels: US Born vs. Foreign Born
TRIGLYCERIDE ≥150 mg/dL, %
40
35
30
25
20
15
10
5
0
NHANES 1976-1980
NHANES 1988-1994
NHANES 1999-2002
US BORN
FOREIGN BORN

Figure 7.

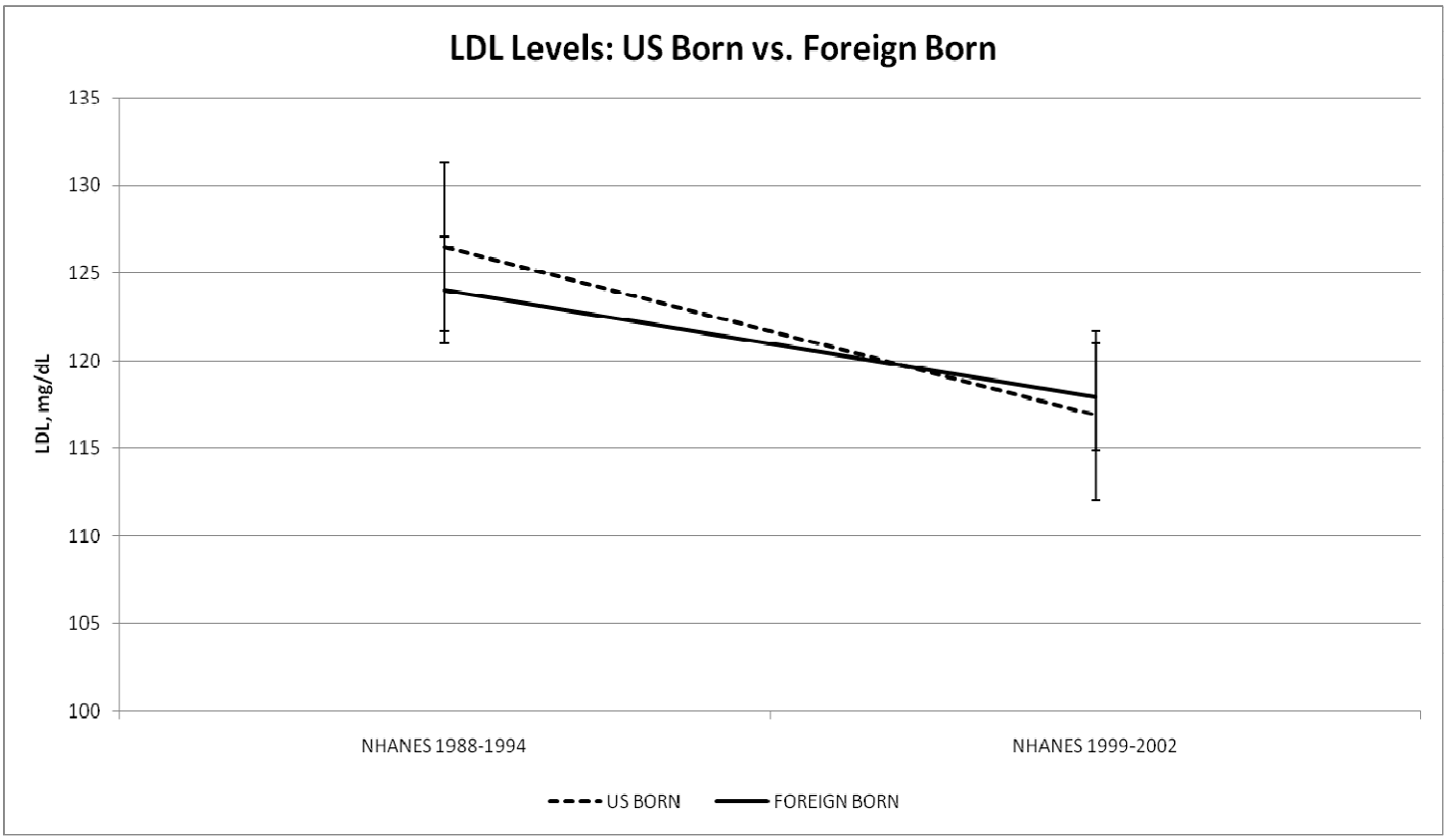
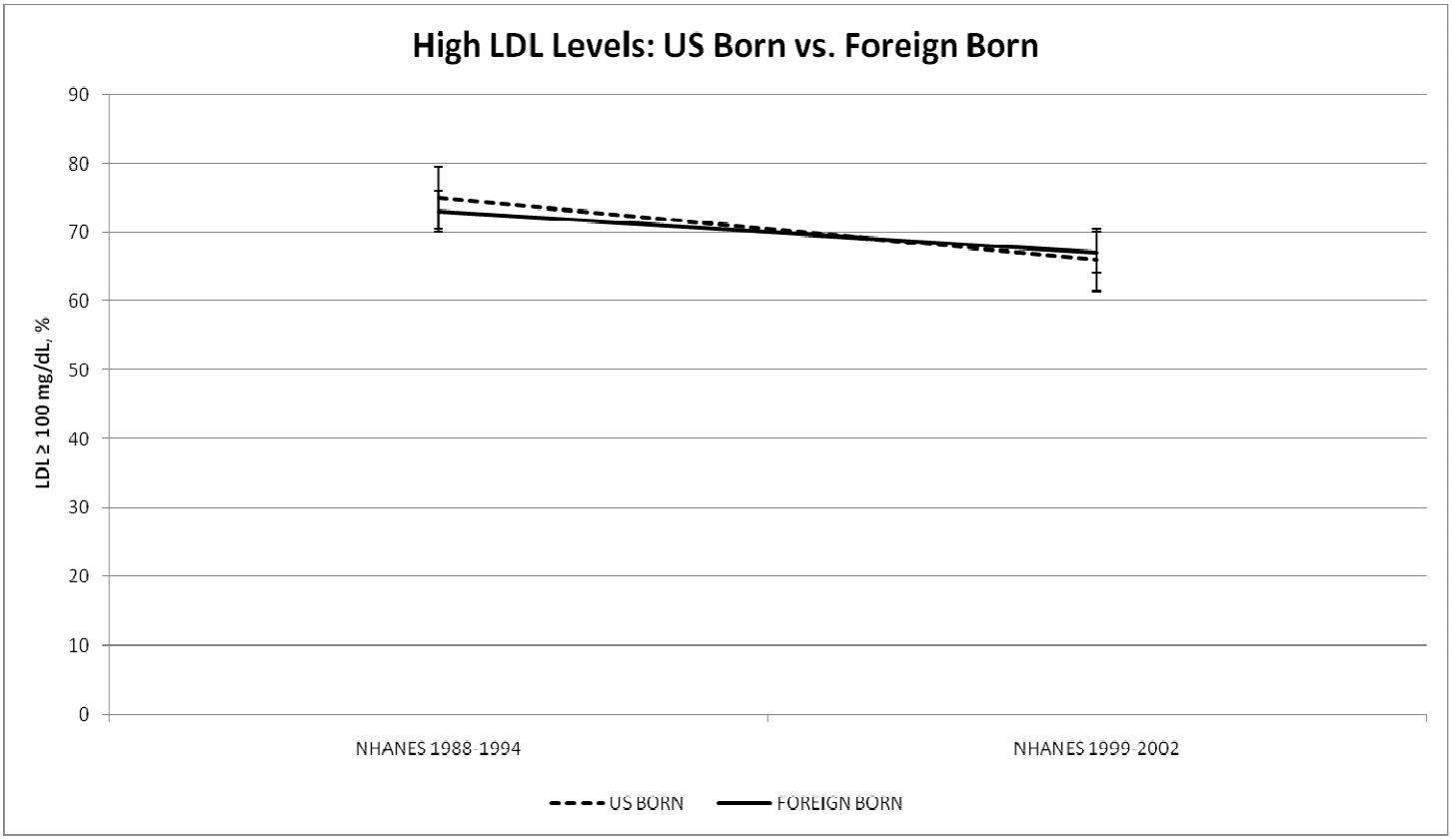

LDL Levels: US Born vs. Foreign Born
135
130
125
120
115
110
105
100
LDL, mg/dL
NHANES 1988-1994
NHANES 1999-2002
US BORN
FOREIGN BORN

Figure 8.


High LDL Levels: US Born vs. Foreign Born
LDL ≥ 100 mg/dL, %
90
80
70
60
50
40
30
20
10
0
NHANES 1988-1994
NHANES 1999-2002
US BORN
FOREIGN BORN