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# Cholesterol Levels and Cardiovascular Health Indicator Changes in a Holistic Health Treatment Program: An Archival Study

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A research report

by

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In collaboration with Bob Cruise, Ph.D.

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**Abstract**

Approximately 16.3% of the adult population in the United States maintains elevated levels of total cholesterol, and the components of the cholesterol profile—HDL, LDL, and triglyceride levels, among others—are particular determinants of cardiovascular disease risk. High levels of LDL in particular are associated with coronary atherosclerosis and cardiovascular disease. Conversely, high levels of HDL remove cholesterol from the blood and aid in metabolism. The HDL/LDL ratio is considered a marker of carotid plaque and is specifically used as an indicator for cardiovascular disease risk. Traditional cholesterol control treatment utilizes statin therapy and antihypertensive medication; however, recent trends toward alternative methods of treatment are making holistic cholesterol treatment programs more well-known. Using archival patient records at a holistic health cholesterol treatment program, this study investigates changes over the course of treatment in total cholesterol levels, the HDL/LDL ratio, and other cardiovascular health-related variables such as blood pressure, pulse rate, and weight. This study will provide a basis for future research investigating cardiovascular health from a holistic perspective, rather than examining these factors in isolation.

Cholesterol Levels and Cardiovascular Health Indicator Changes in a Holistic Health Treatment Program: An Archival Study

The Centers for Disease Control and Prevention estimates that 16.3% of the adult population in the United States has high total cholesterol—defined as total cholesterol 240 mg/dL and above (CDC, 2010). While the prevalence of high cholesterol in the adult demographic has been declining in recent decades (Schober, Carroll, Lacher, & Hirsch, 2007), this problem continues to be of significant economic and therapeutic concern; more than $300 billion is spent on cardiovascular care each year in the United States (HHS.gov, 2011), and 25.4% of deaths in 2007 were attributable to cardiovascular disease alone (CDC, 2007). Although the regulation of blood pressure levels may reduce the need for traditional cholesterol-controlling medications (Green et al., 2002), those who maintain high levels of cholesterol sustain approximately twice the risk of coronary heart disease (CHD) as those with optimal levels (CDC, 2010). Low-density lipoprotein (LDL) cholesterol in particular leads to accumulated coronary atherosclerosis (Scann, 1978 *in* Tian et al., 2011). Thus, the components of the cholesterol profile—HDL, LDL, and triglyceride levels, among others—are particularly crucial to note when determining cardiovascular disease (CVD) risk.

## Treatment of Cholesterol

Traditionally, elevated cholesterol levels have been treated with statin and antihypertensive regimens (Boden, 2003; Van der Harst & de Boer, 2010). However, current statin treatments focus on lowering LDL levels rather than on increasing HDL levels, and often produce undesireable side-effects (Anderson & Taylor, 2011; Rea, Durrant, & Boldy, 2002). While there has been demonstrated clinical improvement in cholesterol levels due to statin therapy, 60-70% of cardiovascular events are not prevented even with its use (Stroes, 2005).

Recently, there has been a trend towards a more holistic perspective of total body health, and holistic cholesterol treatment programs are becoming a viable alternative to traditional treatment (Guarneri, Mercado, & Suhar, 2009; Pratt, 2010). Holistic programs are extremely varied and differ from one program to another; however, focus is usually directed towards effecting lifestyle changes such as diet, exercise, and stress management rather than on the use of medications. The American Heart Association affirms that lifestyle changes such as these decrease cardiovascular disease morbidity and mortality risk (Artinian et al., 2010).

**Low-Density Lipoprotein**

Low-density lipoprotein cholesterol (LDL) is a combination protein-and-lipid whose composition is low in protein and high in cholesterol, and which transports cholesterol from the liver to the body tissues. High levels of LDL in the body are a direct cause of accumulated coronary atherosclerosis (Scann, 1978 *in* Tian et al., 2011). In the United States, 33.5% of adults maintain elevated levels of LDL; only 48.1% of these are receiving treatment (Morbidity and Mortality Weekly Report, 2011). High levels of non-HDL cholesterol have been linked to increased coronary heart disease-related mortality, and incidence of stroke (Li et al., 2011). In patients diagnosed with diabetes, high non-HDL levels (i.e. levels greater than 5.3 mmol/L) were associated with a 40% increased risk of death from CHD (Laasko, Lehto, Penttila, & Pyorala, 1993 *in* Li et al., 2011).

**High-Density Lipoprotein**

High-density Lipoprotein cholesterol (HDL) is comprised of a relatively large proportion of protein and little cholesterol. As HDL removes cholesterol from the blood, prevents the cellular uptake of LDL, and aids in metabolism of other lipoproteins, high levels of serum HDL are associated with a reduced risk of CHD (Wilson et al., 1998 *in* Tian et al., 2011). One study defined low levels of HDL as <40 mg/dL in men and <50 mg/dL in women (Ingelsson et al., 2009). Although the National Cholesterol Education Program has not set a specific goal value for raising HDL levels, the limited HDL level-raising properties of statin medication may be of particular concern for the one-third of patients with CVD who have normal serologic LDL levels but low HDL levels (Melnikova, 2005).

**HDL/LDL Ratio**

The HDL/LDL ratio is considered a marker of carotid plaque and cardiovascular health regardless of total cholesterol levels, and is used as a more accurate indicator for cardiovascular disease risk than LDL levels alone (Awano, 2010; Kannel, 2007, Millán et al., 2009). The HDL/LDL ratio is a strong predictor for subclinical atherosclerosis and carotid intima-media thickness progression (Enomoto et al., 2011). There is some evidence that the effectiveness of lipoprotein ratio profiles as an indicator of cardiovascular disease risk may differ by age (Paramsothy et al., 2010). While there is a growing trend towards using apolipoprotein levels as more accurate predictors of CVD risk than cholesterol levels, the HDL/LDL ratio is still considered a viable and standard method of assessing risk and cardiovascular health (Fernandez & Webb, 2008).

**The Program**

The holistic cholesterol and diabetes health program under study focuses on transforming lifestyle through dietary intake, exercise, moderation, outdoor activity, adequate rest, and trust in God. Patients are enrolled in an 18 day treatment program with individualized meal plans, an exercise regimen, physical therapy including water treatments and steam baths, and time for social interaction. Physical exams with a medical doctor are conducted throughout the program to assess changes over treatment.

Traditional treatment programs for cholesterol primarily utilize statin therapy and antihypertensive medication (Green, Kwok, & Durrington, 2002). However, there is growing evidence that balanced diets which include cereals, fruits, vegetables, and proteins improve cardiovascular health. Lifestyle factors such as diet have specifically been shown to have a measureable effect on plasma cholesterol levels (Howard et al., 2006). In one study, HDL improved more on a low–glycemic load diet (40% carbohydrate and 35% fat), and LDL concentration improved more on a low-fat diet (55% carbohydrate and 20% fat; Ebbeling et al., 2007). Evidence has suggested that CHD progression responses to diet differ by gender, age, and initial cholesterol levels (Lapointe, Balk, & Lichtenstein, 2006; Uranga & Keller, 2010; Schober et al., 2007). Dietary intake of soy protein has been shown to reduce LDL levels and lessen the need for cholesterol-lowering treatments such as statin medications (Grunwald, Hoie, & Stier, 2009). A diet rich in anti-oxidant vitamins, phytochemicals, folate, and dietary fiber provides “substantial additional benefits to diets low in saturated fatty acids” (Noakes, Clifton, & McMurchie, 1999, p. S3).

**The Study**

This study describes the outcomes of such a holistic program (name withheld for confidentiality), examines the relationships between cardiovascular health-related variables, and provides a basis for future research investigating these health markers from a holistic perspective, rather than in isolation. Specifically, this study evaluated the changes in total cholesterol levels and HDL/LDL ratios due to the holistic health treatment program, and identified demographic profiles and other cardiovascular health-related variables which are related to this change. This study examined the efficacy of alternative treatments, providing patients with elevated cholesterol a basis for choosing a holistic program.

## Materials and Methods

This is an archival analysis of patient records collected during pre- and post-treatment physical exams. All data were collected over six years (1998-2003) using standardized patient charting procedures. Cholesterol, triglycerides, HDL and LDL levels (mg/dL), pulse rate (bpm), blood pressure (mmHg), weight (lbs), amount of exercise (miles/day), age (years), and gender were included in the analysis. All statistical tests were performed using PASW SPSS Statistics Student Version 18. All records were kept confidential as per the American Psychological Association's *Ethical Principles of Psychologists and Code of Conduct* (APA.org, 2010).

The study population was composed of 901 patients (549 women, 352 men) enrolled in the program. Mean age of the sample was 60.80 years ($SD = 15.26$). Initial cholesterol and cardiovascular health variable data are listed in Table 1. In quite a few cases, some data points were missing from the archive; however, data were complete for all variables in 502 cases. Three relationships were analyzed in this study: change evidenced due to treatment, the relationship between total cholesterol and additional cardiovascular health variables, and the relationship between the HDL/LDL ratio and additional cardiovascular health variables. Variables were tested and analyzed using the *t*-statistic for independent samples, the *t*-statistic for paired samples, the Pearson Product-Moment Correlation Coefficient, and linear regression as appropriate.

## Results

Significant differences between genders were seen for initial total cholesterol, HDL, LDL, the HDL/LDL ratio, and weight. Of these significant differences, men had higher triglyceride levels and initial weight than did women; however, women had higher total cholesterol, HDL, LDL, and HDL/LDL ratio values. For a summary of gender differences in cardiovascular health variables at admittance, see Table 2.

As the statistical results of this study are numerous and as analysis covers several topics, the results section of this report first details a summary of overall changes evidenced over the course of treatment. Following this, the relationships between cardiovascular-health related variables and (a) initial total cholesterol, (b) total cholesterol change, (c) initial HDL/LDL ratio, and (d) HDL/LDL ratio change are described. Total cholesterol levels are used as a reference marker and the HDL/LDL ratio is analyzed as an indicator of cardiovascular health and relative CVD risk.

**Overall Changes Evidenced**

Over the course of the 18 day treatment, there was a significant improvement in all major cardiovascular health variables except HDL levels. Total cholesterol improved from $M$ = 198.20 mg/dL ($SD$ = 46.58) to $M$ = 174.50 mg/dL ($SD$ = 42.21). Triglycerides dropped from $M$ = 182.53 mg/dL ($SD$ = 118.47; kurtosis = 23.73) to $M$ = 154.81 ($SD$ = 76.25; kurtosis = 12.30); both initial and discharge triglyceride levels exhibited an unusually large kurtosis value, which indicated a large spread of triglyceride scores around the mean. Mean LDL levels decreased from 114.42 mg/dL ($SD$ = 36.92) to 98.25 ($SD$ = 33.07). Contrary to expected trends, mean HDL levels also decreased from 47.94 mg/dL ($SD$ = 14.18) to 45.34 mg/dL ($SD$ = 13.25). However, the overall HDL/LDL ratio mean improved from 0.471 ($SD$ = 0.23) to 0.514 ($SD$ = 0.25). Upon regression analysis, this overall HDL/LDL ratio improvement and the concurrent decrease in both total cholesterol and in LDL levels explained 43% of the observed decline in HDL levels ($R^2$ = .430, $F$(3, 699) = 177.204, $SE$ = 5.749, $p$ < .001; for a summary of interactions, see Table 3).

Other cardiovascular health marker variables also improved over the course of treatment. Mean systolic blood pressure improved from 141.90 mmHg at admittance (*SD* = 24.50) to 127.50 mmHg at discharge (*SD* = 19.85). Similarly, diastolic blood pressure decreased from admittance (*M* = 80.17; *SD* = 14.61) to discharge (*M* = 73.19; *SD* = 10.80). The mean amount of exercise in which patients engaged rose from 0.85 miles/day (*SD* = 1.44) at the beginning of treatment to 3.53 miles/day (*SD* = 2.26) by the end of the program. Over the course of the 18 day treatment, mean patient weight decreased from 206.10 lbs at initial evaluation (*SD* = 61.86) to 200.33 lbs at discharge (*SD* = 59.06). All differences noted were statistically significant (see Table 4).

**Initial Total Cholesterol**

Upon deeper analysis of total cholesterol dynamics, several relationships were noted between initial cholesterol levels and other holistic cardiovascular health variables. Initial cholesterol levels were analyzed by gender and age categories to see whether there was a significant difference between groups at the beginning of treatment. A significant gender difference for total initial cholesterol was present ($t(837) = 4.988$, $p < .001$); men had lower initial cholesterol levels (*M* = 187.33 mg/dL, *SD* = 47.03) than did women (*M* = 203.90 mg/dL, *SD* = 46.57). Additionally, cholesterol levels were compared by age groups (defined as 10 year increments from 20 to 99 years of age). Patients age 40-49 had the highest mean admittance cholesterol levels of any age group (*n* = 119, *M* = 204.06, *SD* = 60.96), and the second highest age group, those 50-59, had mean cholesterol levels of 203.64 mg/dL (*n* = 194, *SD* = 47.91). Patients ages 90-99 evidenced the lowest mean initial cholesterol (*n* = 7, *M* = 176.14, *SD* = 56.07). For a summary of initial cholesterol age group differences see Figure 1.

Relationships with other cardiovascular health variables such as blood pressure, weight, and pulse rate were also analyzed to see whether any relationship existed between these variables and initial levels of cholesterol. These observed relationships describe the profile of those patients with higher admittance levels of cholesterol and evidence concurrent lower overall cardiovascular health markers as seen from a holistic perspective. Although positive relationships were noted between initial total cholesterol levels and several cardiovascular health markers, because of the large sample size and potential for exaggerated statistical significance only the most relevant effect size results are reported. The greatest effect sizes between initial cholesterol levels and cardiovascular health markers were seen for initial triglycerides ($r(842) = .446$, $r^2 = .199$, $p < .001$) and initial LDL levels ($r(793) = .884$, $r^2 = .781$, $p < .001$). These relationships indicated that initial cardiovascular levels explained 19.9% and 78.1% of observed initial triglyceride and LDL levels, respectively. Additionally, a negative relationship was observed between initial total cholesterol and the initial HDL/LDL ratio ($r(792) = -.433$, $r^2 = .187$, $p < .001$). Patients with higher initial levels of cholesterol experienced limited improvement in triglycerides ($r(761) = -.292$, $r^2 = .085$, $p < .001$) and LDL levels ($r(703) = -.370$, $r^2 = .137$, $p < .001$) when compared with those who had lower initial cholesterol levels. Relationships between initial total cholesterol and initial systolic blood pressure, initial weight, HDL change, pulse rate change, and systolic and diastolic blood pressure changes did not reach significance at the $\alpha = .01$ level. For a correlations matrix see Table 5.

**Total Cholesterol Change**

When determining the efficacy of a treatment program, the amount of total cholesterol change evidenced over the course of treatment is certainly important; however, when such a treatment program is viewed from a holistic perspective, an integrated analysis of the relationship between total cholesterol change and other cardiovascular health-related variable changes is even more crucial. Over the course of treatment, mean cholesterol levels dropped by 23.70 mg/dL (*SD* = 32.29) from 197.61 mg/dL at admittance (*SD* = 47.31) to 174.50 mg/dL at discharge (*SD* = 42.13). Patients ages 30-39 saw the greatest drop in cholesterol levels (*M* = -34.96, *SD* = 34.89) followed by patients ages 50-59 and 40-49. For a summary of total cholesterol change differences by age group see Figure 2. Improvement in cholesterol levels was significantly greater ($t(756) = 4.265$, $p < .001$) for men (*M* = -30.11, *SD* = 32.41) than for women (*M* = -19.93, *SD* = 31.52).

Although several statistically significant relationships between cholesterol change and cardiovascular health marker changes were observed, the greatest correlated effect sizes between cholesterol change and cardiovascular health-related variables were seen for triglyceride change ($r(761) = .472$, $r^2 = .223$, $p < .001$), and LDL change ($r(703) = .834$, $r^2 = .696$, $p < .001$). This analysis indicated that initial cardiovascular levels explained 22.3% of observed triglyceride changes, and 69.6% of observed LDL level changes. Interestingly, a negative relationship was observed between total cholesterol change and the HDL/LDL ratio change ($r(702) = -.469$, $r^2 = .220$, $p < .001$); as total cholesterol change was greater, the HDL/LDL ratio improvement was less marked. However, even with this relationship, mean HDL/LDL ratio improvement over the course of treatment was .047 (*SD* = .16) from *M* = .471 at admittance (*SD* = .23) to *M* = .514 at discharge (*SD* = .24).

**Initial HDL/LDL Ratio**

As a marker for cardiovascular health, the initial HDL/LDL ratio was examined in conjunction with demographic and other cardiovascular health-related variables in order to describe the medical profiles of patients at admittance. Initial mean HDL/LDL ratio values (*M* =

.471, *SD* = .23) indicated an approximate 1.00 mg/dL HDL : 2.12 mg/dL LDL concentration at admittance. HDL/LDL ratios were significantly ($t(786) = 3.516$, $p < .001$) worse in men ($M$ = .437, *SD* = .21) than in women ($M$ = .494, *SD* = .24) at admittance. There were no significant ratio differences between age groups ($F(7, 771) = 2.009$, $p = .052$). A relationship was observed between the initial HDL/LDL ratio and HDL levels at admittance ($r(792) = .623$, $r^2 = .388$, $p < .001$). A significant relationship was also noted between initial HDL/LDL ratio and LDL change over the course of treatment ($r(703) = .353$, $r^2 = .125$, $p < .001$). Those with higher initial HDL/LDL ratio values experienced greater improvements in LDL during treatment; however, mean change in LDL regardless of initial HDL/LDL profile was $M$ = -16.16 mg/dL (*SD* = 23.36), and decreased from 114.42 mg/dL at admittance (*SD* = 36.92) to 98.25 mg/dL at discharge (*SD* = 33.07). For a correlation matrix including variables with effect sizes less than 10% see Table 5.

**HDL/LDL Ratio Change**

As expected, the HDL/LDL ratio change was primarily related to both HDL change ($r(702) = .489$, $r^2 = .239$, $p < .001$) and LDL change over the course of treatment ($r(702) = -.602$, $r^2 = .362$, $p < .001$). Amount of HDL/LDL ratio improvement varied significantly ($t(696) = -3.434$, $p = .001$) by gender, however. Although men had poorer HDL/LDL ratios at admittance when compared to women, men improved more (M = .074, SD = .157) during treatment than did women (M = .031, SD = .161). Even with the more marked improvement, discharge HDL/LDL values were still lower for men (M = .501, SD = .243) than for women (M = .523, SD = .244); however, it is possible that with continued treatment the observed trend in men might eclipse the gender differences at the conclusion of treatment.

## Discussion

The positive effects of the 18 day holistic cholesterol treatment program are evident; every variable related to cardiovascular health (with the exception of HDL levels) evidenced improvement over the course of treatment. Although the nominal HDL levels decreased during treatment, the concurrent improvements in total cholesterol levels, LDL levels, and the HDL/LDL ratio help explain the observed phenomenon. A wide range of patients is represented in the sample yet improvements are seen, not just in the cholesterol profile, but also in blood pressure, weight, and pulse rate.

As markers for cardiovascular health and CVD risk, both total cholesterol levels and the HDL/LDL ratio were analyzed in conjunction with other cardiovascular health-related variables such as blood pressure, weight, and amount of exercise. Both total cholesterol and the HDL/LDL ratio were most strongly related to changes evidenced in various components of the cholesterol profile (triglyceride and LDL levels, for example). Gender differences in the cholesterol profile were also noted. Although initial values for total cholesterol and HDL/LDL ratio were poorer for men than for women, men saw greater improvement in both of these variables than did women.

The total cardiovascular health-related variable improvement during the treatment program, as well as the improvement in the cholesterol profile, provides evidence for a holistic perspective on cardiovascular treatment regimens. Because the population included in this study was quite large, only the greatest effect sizes were noted in this report; however, it is evident from an analysis of the data that a lifestyle program such as this has beneficial effects for a wide range of cardiovascular health-related variables. Even over the short duration of this program, mean cholesterol levels improved by 23.70 mg/dL, triglycerides by 27.72 mg/dL, and systolic blood pressure by 14.48 mmHg.

This study opens doors for future holistic research into alternative methods of cholesterol treatment. Notwithstanding, there are some limitations to the design of the study. First, because the data in this study are archival, the reasons for which patients sought treatment at the program are unknown, and the profile of patients treated may not be representative of the population seeking statin treatment. Additionally, in quite a few patients, at least one data point was missing from the record; although the statistical analysis was possible due to the large sample size, the missing data points may have restricted the holistic perspective of each patient's health changes. Patient data was also collected over a period of time and by various physicians. This may have introduced some error and variability into the data aggregated.

Future research possibilities include replication studies at other holistic cholesterol treatment centers, a mixed study design investigating both the psychological and physiological factors associated with holistic treatment programs, and an experimental study to control for the difference in environment at the treatment center versus implementing the same lifestyle changes in the patients' homes. While this study is by no means exhaustive, it aims to provide a basis for choosing a holistic treatment program as an alternative to traditional statin treatments, and works to establish a holistic understanding of cardiovascular health due to simple lifestyle changes.

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Table 1

*Summary of Patient Record Data at Admittance*

| Variable | *M* | *SD* | # Valid cases |
|---|---|---|---|
| Total cholesterol (mg/dL) | 197.61 | 47.31 | 844 |
| Triglycerides (mg/dL) | 180.60 | 116.06 | 843 |
| HDL (mg/dL) | 47.90 | 14.29 | 842 |
| LDL (mg/dL) | 113.83 | 36.57 | 794 |
| HDL/LDL ratio | 0.47 | 0.23 | 793 |
| Systolic blood pressure (mmHg) | 141.22 | 24.79 | 888 |
| Diastolic blood pressure (mmHg) | 79.98 | 14.44 | 892 |
| Pulse rate (beats/minute) | 76.15 | 12.22 | 889 |
| Weight (lbs) | 204.70 | 62.55 | 893 |
| Exercise (miles/day) | .825 | 1.41 | 739 |

Table 2

*Summary of Gender Differences in Cardiovascular Health Variables at Admittance*

| | | | Means | |
|---|---|---|---|---|
| Variable | *t*-statistic | *p*-value | Men (*SD*) | Women (*SD*) |
| Total cholesterol (mg/dL) | 4.988 | .000 | 187.33 (*47.03*) | 203.90 (*46.57*) |
| Triglycerides (mg/dL) | -1.658 | *n.s.* | 189.12 (*123.15*) | 175.41 (*111.81*) |
| HDL (mg/dL) | 11.492 | .000 | 41.53 (*11.38*) | 51.85 (*14.43*) |
| LDL (mg/dL) | 3.678 | .000 | 107.66 (*35.59*) | 117.49 (*36.81*) |
| HDL/LDL ratio | 3.516 | .000 | 0.435 (*0.209*) | 0.494 (*0.241*) |
| Systolic blood pressure (mmHg) | 1.165 | *n.s.* | 139.93 (*24.40*) | 141.93 (*25.05*) |
| Diastolic blood pressure (mmHg) | -1.042 | *n.s.* | 80.62 (*16.23*) | 79.54 (*13.20*) |
| Pulse rate (beats/minute) | 1.509 | *n.s.* | 75.42 (*12.73*) | 76.69 (*11.89*) |
| Weight (lbs) | -6.962 | .000 | 222.98 (*65.18*) | 193.07 (*57.85*) |
| Exercise (miles/day) | -.958 | *n.s.* | 0.89 (*1.40*) | 0.79 (*1.42*) |

Table 3

*Interactions between Cholesterol, LDL, and HDL/LDL Ratio Changes when Predicting HDL Change*

| | Unstandardized Coefficients | | | | |
|---|---|---|---|---|---|
| Variable | *B* | *SE* | β | *t*-statistic | *p*-value |
| (Constant) | -1.649 | .274 | | -6.011 | .000 |
| Cholesterol change | .045 | .014 | .172 | 3.312 | .001 |
| LDL change | .127 | .019 | .389 | 6.785 | .000 |
| HDL/LDL ratio change | 38.197 | 1.702 | .803 | 22.441 | .000 |

Table 4

*Mean Change Scores in Cardiovascular Health Variables over the Course of Treatment*

| Variable | Mean change (discharge – admittance) | *SD* | *t*-statistic | *p*-value |
|---|---|---|---|---|
| Total cholesterol (mg/dL) | -23.695 | 32.289 | -20.270 | .000 |
| Triglycerides (mg/dL) | -27.723 | 80.923 | -9.457 | .000 |
| HDL (mg/dL) | -2.596 | 8.318 | -8.622 | .000 |
| LDL (mg/dL) | -16.165 | 23.356 | -18.363 | .000 |
| HDL/LDL ratio | 0.047 | 0.160 | 7.793 | .000 |
| Systolic blood pressure (mmHg) | -14.484 | 19.196 | -21.580 | .000 |
| Diastolic blood pressure (mmHg) | -6.979 | 12.008 | -16.653 | .000 |
| Pulse rate (beats/minute) | -4.484 | 10.904 | -11.624 | .000 |
| Weight (lbs) | -5.771 | 9.722 | -17.121 | .000 |
| Exercise (miles/day) | 2.680 | 2.155 | 31.976 | .000 |

Table 5

*Correlations Matrix for Total Cholesterol, HDL/LDL Ratio, and Additional Cardiovascular Health-related Variables*

| | Cholesterol at admittance | Cholesterol change | HDL/LDL at admittance | HDL/LDL change |
|---|---|---|---|---|
| 1. Cholesterol at admittance | — | | | |
| 2. Cholesterol change | -.476* | — | | |
| 3. HDL/LDL at admittance | -.433* | .273* | — | |
| 4. HDL/LDL change | .034 | -.469* | -.255* | — |
| 5. Triglycerides at admittance | .446* | -.292* | -.294* | .036 |
| 6. Triglyceride change | -.292* | .472* | .121* | -.213* |
| 7. HDL at admittance | .190* | .06 | .623* | -.196* |
| 8. HDL change | -.063 | .011 | -.239* | .489* |
| 9. LDL at admittance | .884* | -.371* | -.630* | .075 |
| 10. LDL change | -.370* | .834* | .353* | -.602* |
| 11. Systolic BP at admittance | .074 | -.030 | -.080 | .005 |
| 12. Systolic BP change | -.006 | .047 | .011 | .003 |
| 13. Diastolic BP at admittance | .136* | -.094 | -.159* | .030 |
| 14. Diastolic BP change | -.051 | .064 | .084 | -.035 |
| 15. Pulse rate at admittance | .113* | -.081 | .064 | .044 |
| 16. Pulse change | -.049 | .077 | -.044 | -.059 |
| 17. Weight at admittance | .047 | -.161* | -.246* | .070 |
| 18. Weight change | -.007 | .085 | .099* | -.030 |
| 19. Exercise at admittance | -.114* | .029 | .041 | .037 |
| 20. Exercise change | .080 | -.149* | -.087 | .069 |

*Note: * = Correlation is significant at the .01 level (2-tailed).*

Figure 1

*Initial Total Cholesterol Means by Age Group*

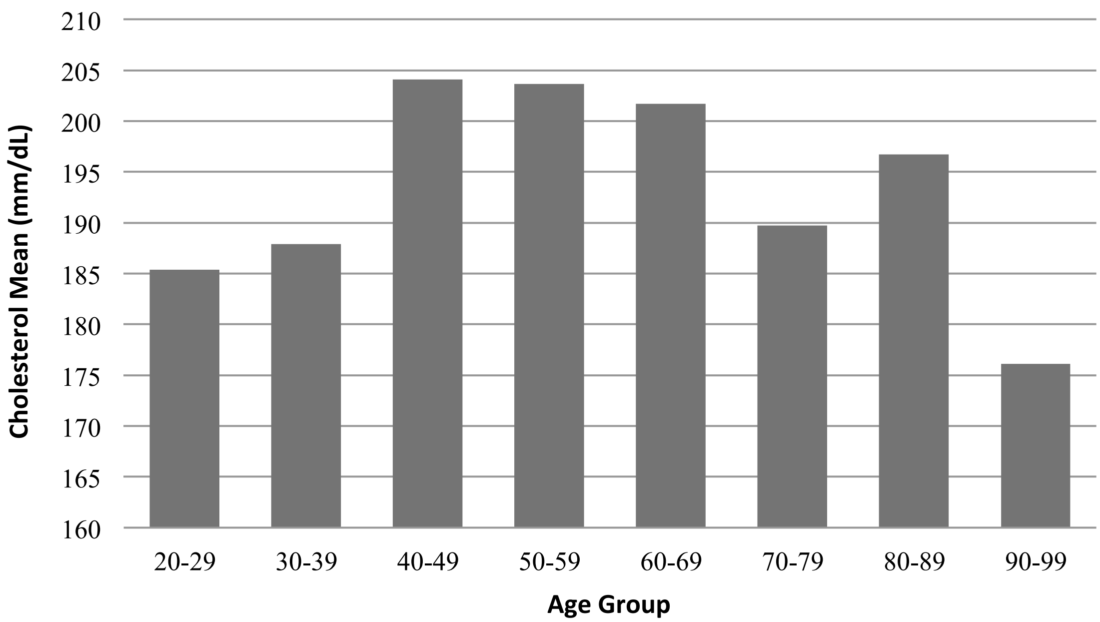

Figure 2

*Total Cholesterol Mean Changes by Age Group*