Blood Lipid and Percent Body Fat Levels in Down Syndrome Versus Non-DS Persons With Mental Retardation

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Little data exist on the comparison of blood lipids and percent body fat between Down Syndrome and non-DS adults with mental retardation (MR). The following study was undertaken to determine if there were physiological and biochemical differences between these two groups. Subjects included 294 non-DS adults with MR (162 males and 132 females) and 31 adults with Down Syndrome (21 males and 10 females). Level of mental retardation was similar for both groups (males/females, Down vs. non-DS). A two-factor ANOVA with a regression approach was used to analyze the data. Results of the study found that there were no significant differences between the Down Syndrome and non-DS subjects on total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, or percent body fat. The present study suggests that the composition of lipoproteins and storage of body fat are similar in Down Syndrome and non-DS adults with mental retardation, and that the risk for developing coronary heart disease appears to be the same for both groups.

Coronary heart disease is the major cause of death in the United States (Working Group, 1991). Every year more than 1.5 million people will sustain a heart attack and more than half a million will die of this disease. Several research studies have confirmed that elevated levels of total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG), and low levels of high-density lipoprotein cholesterol (HDL-C) are related strongly, independently, and directly to the development of CHD (Grundy, 1990; Johnson & Greenland, 1990; U.S. Department of Health and Human Services, 1990).

Given the growing emphasis in the U.S. on maintaining cholesterol to within safe levels and reducing the incidence of obesity, there is a need to determine whether a subset of the population, adults with mental retardation (MR), are at risk for developing coronary heart disease. Although a plethora of

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research has been published on the blood cholesterol and percent body fat levels of nonretarded populations, very little research has focused on persons with MR (Rimmer, 1990). More specifically, only three recent studies have compared blood lipid and percent body fat levels between adults with Down Syndrome and adults with MR who do not have Down Syndrome (Dorner, Gaethke, Tolksdorf, Schumann, & Gustmann, 1984; Lacko, Hayes, McConathy, Lacko, & Redheendran, 1983; Nishida, Akaoka, Nishizawa, Maruki, & Maruki, 1977).

The study by Dorner et al. (1984) found that HDL-C was significantly lower in a population of adults with Down Syndrome, thereby making this group more susceptible to morbidity and mortality associated with coronary heart disease. Nishida et al. (1977) concluded that persons with Down Syndrome had significantly higher plasma triglyceride levels than a population of adults with mental retardation who did not have Down Syndrome. Lacko et al. (1983) did not find significant differences in TC, HDL-C, LDL-C, and TG between a population with mental retardation who did or did not have Down Syndrome. These conflicting findings call for more research in this area.

In a recent study that investigated the total cholesterol levels of adults with MR, Rimmer and Kelly (1990) found that a large percentage of their sample (59% of males and 68% of females) were classified in the moderate to high-risk category for coronary heart disease (TC >200 mg/dl). However, the investigators did not isolate adults with Down Syndrome, and so the question remains as to whether this group has a higher or lower risk for developing CHD. Since a number of biochemical abnormalities have been reported in persons with Down Syndrome, some of which are related to lipid metabolism such as elevated triglycerides and very low-density lipoproteins (Nishida et al., 1977; Salo, Solakivi-Jaakkola, Kivimaki, & Nikkari, 1979), the present study was initiated to compare the serum lipid levels and percent body fat of a group of adults with DS versus a population of adults with MR who did not have DS.

Method

Subjects

Ambulatory subjects (183 males and 142 females) were recruited from four residential settings (developmental center, intermediate care facility, group home, or residing with family members) in a large midwestern state. All subjects had a diagnosis of mild to severe mental retardation and ranged in age from 17 to 72 years. They were selected on a volunteer basis. Names of subjects were solicited from agencies that were responsible for the clients’ social services. Level of mental retardation and age were similar for both the Down Syndrome and non-DS groups.

Apparatus

Total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were determined with an Abbott Vision System analyzer (Abbott Laboratories, N. Chicago). This method involves a typical “wet” chemistry reaction. Through several intermediate chemical reactions, a colored compound is liberated that is then measured by spectrophotometry (Burke & Fischer, 1988).
The TC and TG values were obtained directly by pipetting two to three drops of serum into a well in the specific reagent test pack. For HDL-C analysis, however, a preliminary step was performed that involved placing .5 ml of serum in a tube that contained dextran-sulfate magnesium. The tube was then centrifuged at 2,300 rpm for 10 minutes to precipitate out the very low-density lipoprotein cholesterol (VLDL), low-density lipoprotein cholesterol (LDL-C), and TG, leaving only the HDL-C supernate. Two to three drops of supernatant were then drawn off the top and placed in the HDL-C cartridge for analysis. TC, HDL-C, and TG were run as a lipid panel on the Abbott Vision system. Three panels were run at one time. LDL-C was calculated on the Abbott Vision system using the standard Friedewald equation (Friedewald, Levy, & Fredrickson, 1972). All of the samples were measured by a trained technician.

Validity of the Abbott Vision system was completed prior to data collection. Thirty-two cholesterol samples were analyzed on the instrument and then frozen and transported to the State Laboratory of Hygiene at the University of Wisconsin Center for Health Sciences (Madison), one of eight referenced laboratories in the U.S. that is certified by the Centers for Disease Control, for further analysis using the gold standard Abell-Kendall reference cholesterol method (Myers, Cooper, Winn, & Smith, 1989).

Results indicated that the Abbott system was within the recommended 3% accuracy criteria established by the National Cholesterol Education Program Laboratory Standardization Panel (r=0.99, SE_{w}=5.37). Intraclass test-retest reliability coefficients were also calculated for TC and HDL-C. TC measurements were taken on 20 randomly selected samples before and after a 5-day interval. The resulting intraclass correlation was r=0.99. For HDL-C, 30 randomly selected samples resulted in a correlation coefficient of r=0.98. The precision data during control runs produced coefficients of variation (CV) between 2.6% and 4.8%.

Procedure

All data collection took place at the site where the subjects resided or worked. Consent forms were signed by a parent or guardian, and whenever possible, the client, before any data collection was performed. A certified medical technologist or registered nurse accompanied the principal investigator and an assistant to the testing sites. Venipuncture blood samples (approximately 15 ml) were collected into volume serum separator tubes (SST, Becton-Dickinson Vacutainer Systems, Rutherford, NJ), placed in a cooler, and transported to the Human Performance Laboratory for analysis. Controls were run each testing day to assure that the Abbott Vision system was calibrated.

Skinfolds were taken by a trained investigator with a Lange skinfold caliper. Tricep, bicep, suprailliac, and subscapular skinfolds were used for the males, and the tricep, suprailliac, and thigh skinfolds were used for the females. These measurements were taken according to the procedures of Behnke and Wilmore (1974). Three measurements were taken at each skinfold site and the mean value was used as the actual measurement. Percent body fat was determined by using the formulas of Dumin and Womersley (1974) for males, and Jackson, Pollock, and Ward (1980) for females. These equations were validated on a population of adults with mental retardation in a previous investigation (Rimmer, Kelly, & Rosentswieg, 1987).
Results

Thirty-one adults with Down Syndrome (21 men and 10 women) were tested on blood cholesterol and percent body fat and compared to a non-DS population of adults with mental retardation (162 men and 132 women). The physical characteristics of the subjects are presented in Table 1. Both the males and females in the non-DS group were taller and heavier than the subjects with Down Syndrome.

Table 2 illustrates the blood lipid and percent body fat data on the non-DS and Down Syndrome groups. A two-factor ANOVA (Gender x DS/NDS)

**Table 1**

Physical Characteristics of the Subjects

<table>
<thead>
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<th>Variable</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NDS (N = 162)</td>
<td>DS (N = 21)</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>35.9 ± 11.2</td>
<td>35.5 ± 10.3</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>170.7 ± 11.2</td>
<td>157.0 ± 8.4</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>71.4 ± 13.4</td>
<td>65.0 ± 10.7</td>
</tr>
</tbody>
</table>

NDS = non-Down Syndrome subjects; DS = subjects with Down Syndrome.

**Table 2**

Blood Lipids and Percent Body Values

<table>
<thead>
<tr>
<th>Variable</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NDS (N = 162)</td>
<td>DS (N = 21)</td>
</tr>
<tr>
<td>Body fat (%)</td>
<td>21.0 ± 6.0</td>
<td>21.0 ± 6.0</td>
</tr>
<tr>
<td>TC (mg/dl)</td>
<td>192.2 ± 39.2</td>
<td>193.5 ± 34.1</td>
</tr>
<tr>
<td>HDL-C (mg/dl)</td>
<td>44.6 ± 11.5</td>
<td>40.4 ± 8.2</td>
</tr>
<tr>
<td>LDL-C (mg/dl)</td>
<td>127.7 ± 34.0</td>
<td>134.0 ± 29.3</td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>99.3 ± 47.9</td>
<td>119.3 ± 54.5</td>
</tr>
</tbody>
</table>

NDS = non-Down Syndrome subjects; DS = subjects with Down Syndrome.
employing a regression approach was used to analyze the data. The results of the study found that there were no significant differences between the subjects with and without Down Syndrome on TC, HDL-C, LDL-C, TG, or percent body fat. However, there were significant gender differences between groups on three of the five variables measured. The female subjects had significantly higher levels of HDL-C, $F(1,331) = 6.60, p<.011$, and lower levels of LDL-C, $F(1,331) = 4.04, p<.045$ than their male counterparts. The females also had significantly higher levels of percent body fat, $F(1,324) = 55.12, p<.001$. There were no significant differences between males and females on TC and TG.

**Discussion**

From a strictly observational standpoint, individuals with Down Syndrome appear to be more obese than their non-DS counterparts. This may be due in part to their short stature, since many adults with Down Syndrome will not reach 5 feet in height (Thelander & Pryor, 1966). Block (1991) has also noted in an extensive review of the literature that several research studies have confirmed a high incidence of obesity among persons with Down Syndrome. Since obesity is linked to higher cholesterol levels and lower levels of HDL-C (Kissebah, Freedman, & Peiris, 1989), it was hypothesized that individuals with Down Syndrome would have higher levels of body fat and poorer cholesterol profiles. The present study did not support this hypothesis. Percent body fat and blood lipid levels for adults with Down Syndrome were no different from those for adults with MR who did not have Down Syndrome. In fact, percent body fat values were identical for each group, as shown in Table 2.

Three recent studies that have looked at the cholesterol levels of adults with Down Syndrome had conflicting findings. Dorner and co-workers (1984) concluded that HDL-C levels were significantly lower in subjects with Down Syndrome; Nishida et al. (1977) found significantly higher levels of TG in a population of adults with Down Syndrome; and Lacko and co-workers (1983) reported that there were no differences in any of the blood cholesterol parameters—TC, HDL-C, LDL-C, TG—between subjects with and without Down Syndrome. Our findings support the work of this latter investigation.

A closer look at the subjects' blood lipid profiles (Table 2) revealed that TC values were almost identical, while HDL-C was slightly higher in the non-DS group and LDL-C was slightly higher in males with Down Syndrome and females who did not have Down Syndrome. TG values were also higher in the group with Down Syndrome. However, none of these values reached statistical significance.

The present study suggests that the composition of lipoproteins is similar in adults with mental retardation regardless of Down Syndrome, and that the risk for developing coronary heart disease associated with abnormal lipid profiles and high levels of obesity appears to be the same for both groups. The findings of this study also confirmed that female subjects with and without Down Syndrome had better lipid profiles than their male counterparts and appear to have a lower risk of CHD as a result of higher HDL-C and lower LDL-C values. It is important to note, however, that this finding is consistent with the literature on nonretarded populations (Burke et al., 1991).

A final analysis of the data revealed the incidence of obesity and hypercho-
lesterololemia (high blood cholesterol) among adults with MR. Since there were no differences between subjects with and without Down Syndrome, the group data were collapsed and compared to the recent guidelines established by the National Cholesterol Education Program for high blood cholesterol (Expert Panel, 1988). This organization has stated that individuals with a total cholesterol value >200 mg/dl are in a moderate to high risk category for developing coronary heart disease and should therefore receive dietary education and be encouraged to exercise (National Heart, Lung, and Blood Institute, 1991).

When comparing our data to the guidelines established by the National Cholesterol Education Program, it was found that 32% of the female subjects and 54% of the male subjects had cholesterol levels greater than 200 mg/dl. Using the criteria for obesity of greater than 20% body fat for males and greater than 30% body fat for females (McArdle, Katch, & Katch, 1991), it was also determined that 42% of the male subjects and 61% of the female subjects were classified as obese.

It is clear from this investigation that a significant percentage of individuals with mental retardation—with and without Down Syndrome—could benefit from an exercise program and appropriate counseling on diet and nutrition. Given the large proportion of subjects who had cholesterol levels greater than 200 mg/dl and were classified as obese, professionals who work with this group (e.g., adapted physical educators, therapeutic recreation specialists, nutritionists and dietitians) should make every effort to include cardiovascular exercise and nutrition counseling in their clients’ programs.

References


Blood Lipid and Percent Body Fat Levels


