Association of DASH Diet With Cardiovascular Risk Factors in Youth With Diabetes Mellitus
The SEARCH for Diabetes in Youth Study

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Background—We have shown that adherence to the Dietary Approaches to Stop Hypertension (DASH) diet is related to blood pressure in youth with type 1 and type 2 diabetes mellitus. We explored the impact of the DASH diet on other cardiovascular disease risk factors.

Methods and Results—Between 2001 and 2005, data on total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, triglycerides, low-density lipoprotein particle density, apolipoprotein B, body mass index, waist circumference, and adipocytokines were ascertained in 2130 youth aged 10 to 22 years with physician-diagnosed diabetes mellitus. Dietary intake was assessed by food frequency questionnaire, categorized into the DASH food groups, and assigned an adherence score. Among youth with type 1 diabetes mellitus, higher adherence to the DASH diet was significantly and inversely associated with low-density lipoprotein/high-density lipoprotein ratio and A1c in multivariable-adjusted models. Youth in the highest adherence tertile had an estimated 0.07 lower low-density lipoprotein/high-density lipoprotein ratio and 0.2 lower A1c levels than those in the lowest tertile adjusted for confounders. No significant associations were observed with triglycerides, low-density lipoprotein particle density, adipocytokines, apolipoprotein B, body mass index Z score, or waist circumference. Among youth with type 2 diabetes mellitus, associations were observed with low-density lipoprotein particle density and body mass index Z score.

Conclusions—The DASH dietary pattern may be beneficial in the prevention and management of cardiovascular disease risk in youth with diabetes mellitus. (Circulation. 2011;123:1410-1417.)

Key Words: diabetes mellitus ■ lipids ■ lipoproteins ■ nutrition ■ youth

Youth with diabetes mellitus are at high risk of cardiovascular disease (CVD) because of accelerated atherosclerosis that can lead to coronary artery disease in young adulthood. Comorbidities are very common; 14% of youth with type 1 diabetes mellitus (T1DM) and 92% of youth with type 2 diabetes mellitus (T2DM) have ≥2 CVD risk factors. Hypertension affects ∼30% of youth with diabetes mellitus aged >10 years, and lipid abnormalities are present in 19% of youth with T1DM and 33% of youth with T2DM. The American Heart Association recommends intense cardiovascular risk reduction in high-risk pediatric patients to improve long-term outcomes. Although aggressive medical treatment is the cornerstone of diabetes therapy and management of associated risk factors, management of dietary behavior is also an important part of medical nutritional therapy in persons with diabetes mellitus.

Clinical Perspective on p 1417
The National Heart, Lung, and Blood Institute–funded Dietary Approaches to Stop Hypertension (DASH) trial demonstrated the efficacy of a whole-diet approach on hypertension prevention and blood pressure reduction, and observational studies have confirmed that adherence to a DASH-style diet benefits cardiovascular health. We have shown previously that the DASH diet is associated with lower prevalence of hypertension in youth with T1DM. However, little is known about its impact on other CVD risk factors. The purpose of our study was to investigate the association of adherence to a DASH-like eating plan with blood lipid levels, lipoproteins, adipocytokines, and measures of adiposity and glycemic control in a large sample of youth with T1DM and T2DM.
Methods
The SEARCH for Diabetes in Youth Study is an ongoing multicenter study of physician-diagnosed diabetes mellitus in youth aged <20 years at diagnosis that began in 2001. The study was approved by the local institutional review boards at its 6 centers. Parents of participants aged <18 years provided written informed consent with participant assent; all participants aged ≥18 years provided written informed consent.

Study Participants
This analysis is restricted to youth attending the SEARCH clinic visit and whose diabetes mellitus was prevalent in 2001 or incident in 2002–2005 (n = 3354; 42% of 8031 ascertained by SEARCH surveillance system). We excluded those with (1) a missing food frequency questionnaire (n = 280); (2) provider-defined diabetes mellitus other than type 1 or type 2 (maturity-onset diabetes of the young, hybrid, secondary, unknown type, and missing type; n = 27); (3) diabetes duration < 6 months (n = 372); (4) fasting < 8 hours (n = 480); and (5) eating much more or much less than typical (n = 154), leaving 2130 youth (1810 T1DM, 320 T2DM) for descriptive analyses. For regression analyses, youth missing key analytical variables were excluded, and outcome-specific sample sizes are presented within the tables. The higher proportion of missing data for low-density lipoprotein (LDL) particle density and adipocytokines was due to the limited time period during which these measures were conducted.

Outcome Measures
Physical examinations at the study visits were conducted according to standardized protocols by trained and certified staff. Height and weight were measured to the nearest 0.1 cm and 0.1 kg, respectively. Body mass index (BMI) was calculated as weight (kg)/height squared (m²) and converted to BMI Z score. Waist circumference was measured just above the uppermost lateral border of the right ilium following National Health and Nutrition Examination Survey protocol. A fiberglass tape was used for youth with a waist circumference up to 150 cm, and a flexible steel tape was used otherwise.

Blood samples were obtained only if there was no episode of diabetic ketoacidosis within the prior month. Specimens were processed at the site and shipped within 24 hours to the Northwest Lipid Metabolism and Diabetes Research Laboratories in Seattle, WA. Measurements of plasma cholesterol, triglycerides, and high-density lipoprotein (HDL) cholesterol were performed on a Hitachi 917 analyzer (Boehringer Mannheim Diagnostics, Indianapolis, IN). LDL cholesterol was calculated by the Friedewald equation for individuals with triglyceride concentration < 400 mg/dL (4.52 mmol/L) and by the BetaQuantification procedure for those with triglyceride concentration ≥ 400 mg/dL. Assessment of lipoprotein cholesterol distribution was performed after density gradient ultracentrifugation and calculation of the LDL relative flotation rate for characterization of LDL particle density. Adiponectin and leptin were measured with a commercial radioimmunoassay procedure. Apolipoprotein B (apoB) was measured by a nephelometric system (BNI, Behring Diagnostics) calibrated with the World Health Organization international reference material for apoB. A1c was measured by a dedicated ion-exchange high-performance liquid chromatography instrument (TOSOH, Bioscience, Inc., San Francisco, CA).

Dietary Assessment and DASH Score
The SEARCH food frequency questionnaire has been described. It consisted of 85 food lines for which the participant indicated whether the item(s) was consumed in the past week (yes/no) and, if yes, for how many days and in what average portion. Food groups were created by either collapsing food lines on the basis of their major components or by disaggregating composite foods into constituent foods. The food frequency questionnaire was primarily self-administered after staff instruction.

Adherence to the DASH diet was assessed with an index variable (ie, a score) comprising 8 DASH food groups (grains, vegetables, fruits, dairy, meat, nuts/seed/legumes, fats/oils, and sweets), as described in detail. For each food group, a maximum score of 10 could be achieved when the intake met the recommendation, and lower intakes were scored proportionately. Reverse scoring was applied for meat, fats/oils, and sweets, and a score of 0 was applied to intakes ≥ 200% of the upper recommended level. The resulting 8 component scores were summed to create the overall DASH adherence score, which ranged from 0 to 80. Following the DASH eating plan guidelines, we assigned each individual the energy level closest to his or her estimated energy requirement on the basis of age, sex, and physical activity.

Covariates
Race and ethnicity were obtained through self-report with the standard census questions. Physical activity and sedentary behavior were assessed with questions identical to or slightly modified from those in the Youth Risk Behavior Surveillance System. Smoking, parental education, and family income were based on self-report.

Statistical Analysis
Statistical analyses were conducted with the use of SAS (version 9.1, 2003; SAS Institute Inc, Cary, NC). Outcome variables with skewed distribution (eg, plasma triglycerides, adiponectin, leptin, and apoB) were log-transformed. We first evaluated a large number of potential confounders (age, gender, income, parental education, duration of diabetes mellitus, physical activity, sedentary behavior, missing doses of medication, type of diabetes treatment, study site, year of diabetes onset, lipid-lowering and antihypertensive treatment, family history of CVD and diabetes mellitus, smoking, and BMI Z score) and retained only those associated significantly (P < 0.05) with at least 1 of the outcomes. A series of multivariable linear regression models were fit, first adjusted for nonmodifiable confounders and subsequently adjusted for modifiable risk factors (physical activity, sedentary behavior, smoking, and, subsequently, BMI Z score). A1c was included in the final models as a potential mediator. P < 0.05 was considered significant. In addition, we estimated the level of the CVD risk factors using the least square means method at the median value of the lowest and highest tertiles of the DASH score and the differences between the tertile estimates. Back-transformations of log values were performed where applicable. We also investigated potential effect modification by race/ethnicity but found no evidence of this.

Results
Sample characteristics according to tertile of DASH adherence are summarized in Table 1. Higher levels of adherence to the DASH diet were significantly associated with race/ethnicity, higher income, not smoking, more vigorous physical activity, and less television watching, but not with age or gender, in T1DM youth. The DASH score was associated only with vigorous physical activity in T2DM youth.

In both T1DM and T2DM children, the average DASH diet scores were low, with the second tertile mean at 39.9 and 36.4, respectively, on an 80-point scale (Table 2). As expected, intake of food groups included in the DASH score differed significantly between tertiles (P < 0.05), shown per 1000 kilocalories because of the large differences in energy requirements across the age span. Youth in the highest tertiles consumed twice as many servings of fruit and low-fat dairy products and substantially more nuts and seeds than those in the lowest. A higher adherence to DASH was not related to total energy intake.

Mean levels of CVD risk factors according to diabetes type and DASH adherence tertile are shown in Table 3. With increasing DASH adherence, we observed decreasing levels of LDL cholesterol, LDL/HDL ratios, and A1c in T1DM,
decreasing levels of total cholesterol, apoB, and BMI Z score in T1DM and T2DM, and decreasing levels of triglycerides, HDL cholesterol, and waist circumference in T2DM.

Table 4 shows the association of the DASH diet score with CVD risk factors in youth with T1DM based on a prespecified, hierarchical series of analytical models. We observed significant associations of DASH diet score with LDL/HDL ratio and A1c. No association was observed with HDL cholesterol, triglycerides, LDL particle density, adiponectin, or leptin (data not shown for adipokines), BMI Z score, or waist circumference. The association with total cholesterol and LDL cholesterol was inconsistent. For most outcomes, adjustment for BMI Z score had very little impact on the association.

As shown in Table 5, in youth with T2DM, higher DASH diet adherence was associated significantly with LDL/HDL ratio and A1c. No association was observed with HDL cholesterol, triglycerides, LDL particle density, adiponectin, or leptin (data not shown for adipokines), BMI Z score, or waist circumference. The association with total cholesterol and LDL cholesterol was inconsistent. For most outcomes, adjustment for BMI Z score had very little impact on the association.

**Discussion**

Several observational studies in adults have shown that adherence to a DASH-like diet has positive effects on cardiovascular health, including reduced risk of hypertension, T2DM, heart failure, coronary heart disease, stroke, and overall mortality. However, few data exist on its effect on more proximal or intermediate risk factors, or for youth.

Our study found significant associations of adherence to DASH diet with LDL/HDL ratio in youth with T1DM and with LDL particle density in youth with T2DM. Our findings with total cholesterol were suggestive of an association, but require replication. To the best of our knowledge, the only large studies of the effect of the DASH diet on lipids are the DASH and PREMIER trials, in which it was shown that the DASH intervention group experienced significant and remarkably large reductions in total (13.7 mg/dL), LDL (10.7 mg/dL), and HDL (3.7 mg/dL) cholesterol compared with the control group but no changes in triglycerides or LDL/HDL ratio. The PREMIER trial reported similar findings with marked reductions in total and LDL cholesterol but no changes in triglycerides. A smaller intervention study in patients with metabolic syndrome has shown significant increases in HDL cholesterol and decreases in triglycerides but used a calorie-restricted version of the DASH diet.

One of the mechanisms by which a dietary pattern may affect cardiovascular risk factors may be via changes in energy intake, which in turn affect weight. In youth with T1DM, the initial inverse association of DASH diet with BMI Z score was explained by physical activity, sedentary behavior, and smoking. There was no association of DASH diet with waist circumference in this group. However, in T2DM youth, BMI Z score was strongly associated with DASH diet independent of lifestyle and other factors, whereas the association with waist circumference was inconsistent.
Similar to the findings of the national Youth Risk Behavior Surveillance System, we observed relatively high reports of vigorous physical activity. Compared with objective assessment methods, it has been suggested that self-report of vigorous activity with the use of the Youth Risk Behavior Surveillance System questions may lead to overreporting. It is conceivable that inaccuracies in measurement of physical activity impeded our ability to disentangle the mediating role of physical activity in the relationship of DASH diet and adiposity.

### Table 2. Mean Energy, Food Group, and Nutrient Intakes According to Diabetes Type and DASH Adherence Score

<table>
<thead>
<tr>
<th>Diet Characteristic</th>
<th>T1DM (n=1810)</th>
<th>T2DM (n=320)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DASH score, mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total grains</td>
<td>2.16 (0.75)</td>
<td>2.02 (0.78)</td>
</tr>
<tr>
<td>High-fiber grains</td>
<td>0.56 (0.5)</td>
<td>0.04 (0.1)</td>
</tr>
<tr>
<td>Vegetables</td>
<td>1.1 (0.8)</td>
<td>1.0 (0.8)</td>
</tr>
<tr>
<td>Total dairy</td>
<td>0.9 (0.6)</td>
<td>0.9 (0.6)</td>
</tr>
<tr>
<td>Low-fat dairy</td>
<td>0.4 (0.5)</td>
<td>0.4 (0.5)</td>
</tr>
<tr>
<td>Meat</td>
<td>1.0 (0.6)</td>
<td>1.0 (0.6)</td>
</tr>
<tr>
<td>Nuts and seeds</td>
<td>0.1 (0.3)</td>
<td>0.1 (0.3)</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>2.4 (1.5)</td>
<td>2.5 (1.5)</td>
</tr>
<tr>
<td>Sweets</td>
<td>1.1 (0.8)</td>
<td>1.1 (0.8)</td>
</tr>
<tr>
<td>Carbohydrates, g</td>
<td>114 (19)</td>
<td>114 (22)</td>
</tr>
<tr>
<td>Total fat, g</td>
<td>44 (6)</td>
<td>44 (8)</td>
</tr>
<tr>
<td>Saturated fat, g</td>
<td>16 (3)</td>
<td>16 (3)</td>
</tr>
<tr>
<td>Protein, g</td>
<td>40 (7)</td>
<td>39 (8)</td>
</tr>
<tr>
<td>Calcium, mg</td>
<td>539 (223)</td>
<td>378 (159)</td>
</tr>
<tr>
<td>Magnesium, mg</td>
<td>123 (27)</td>
<td>109 (24)</td>
</tr>
<tr>
<td>Potassium, mg</td>
<td>2332 (1168)</td>
<td>2077 (1225)</td>
</tr>
</tbody>
</table>

DASH indicates Dietary Approaches to Stop Hypertension; T1DM, type 1 diabetes mellitus; and T2DM, type 2 diabetes mellitus. DASH-recommended servings per 1000 kcal per day: 3 servings of grains; 2 servings of fruits; 2 servings of vegetables; 1 serving of dairy; 1 serving of lean meats, poultry, or fish; 0.3 servings of nuts, seeds, or legumes; 1.5 servings of fats and oils; 0.3 servings of sweets and added sugar.

### Table 3. Mean Cardiovascular Disease Risk Factor Levels According to Diabetes Type and DASH Adherence Score

<table>
<thead>
<tr>
<th>Cardiovascular Disease Risk Factor</th>
<th>T1DM n=1810</th>
<th>T2DM n=320</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cholesterol, mg/dL</td>
<td>1615</td>
<td>313</td>
</tr>
<tr>
<td>LDL cholesterol, mg/dL</td>
<td>1615</td>
<td>313</td>
</tr>
<tr>
<td>HDL cholesterol, mg/dL</td>
<td>1616</td>
<td>313</td>
</tr>
<tr>
<td>LDL/HDL ratio</td>
<td>1615</td>
<td>313</td>
</tr>
<tr>
<td>Triglycerides, mg/dL</td>
<td>1615</td>
<td>254</td>
</tr>
<tr>
<td>LDL particle density, flotation rate</td>
<td>1302</td>
<td>182</td>
</tr>
<tr>
<td>Apolipoprotein B, mg/dL</td>
<td>1317</td>
<td>184</td>
</tr>
<tr>
<td>Body mass index Z score</td>
<td>1518</td>
<td>224</td>
</tr>
<tr>
<td>Waist circumference, cm</td>
<td>1578</td>
<td>254</td>
</tr>
<tr>
<td>A_{x} %</td>
<td>1518</td>
<td>224</td>
</tr>
</tbody>
</table>

Values are mean (SD). DASH indicates Dietary Approaches to Stop Hypertension; T1DM, type 1 diabetes mellitus; T2DM, type 2 diabetes mellitus; LDL, low-density lipoprotein; and HDL, high-density lipoprotein.
Table 4. Association of DASH Score With Cardiovascular Disease Risk Factors in Youth With Type 1 Diabetes Mellitus

<table>
<thead>
<tr>
<th>Cardiovascular Disease Risk Factor</th>
<th>β*</th>
<th>SE</th>
<th>P</th>
<th>Tertile 1†</th>
<th>Tertile 3†</th>
<th>Mean Difference (Tertile 3—Tertile 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cholesterol, mg/dL (n=1615)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>−2.05</td>
<td>0.92</td>
<td>0.026</td>
<td>171.1</td>
<td>167.4</td>
<td>−3.7</td>
</tr>
<tr>
<td>Model 2</td>
<td>−1.53</td>
<td>0.93</td>
<td>0.101</td>
<td>170.7</td>
<td>168</td>
<td>−2.7</td>
</tr>
<tr>
<td>Model 3</td>
<td>−2.37</td>
<td>0.97</td>
<td>0.014</td>
<td>171.6</td>
<td>167.4</td>
<td>−4.2</td>
</tr>
<tr>
<td>Model 4</td>
<td>−0.95</td>
<td>0.89</td>
<td>0.285</td>
<td>171.5</td>
<td>169.8</td>
<td>−1.7</td>
</tr>
<tr>
<td>LDL cholesterol, mg/dL (n=1615)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>−1.76</td>
<td>0.74</td>
<td>0.017</td>
<td>100.5</td>
<td>97.3</td>
<td>−3.2</td>
</tr>
<tr>
<td>Model 2</td>
<td>−1.42</td>
<td>0.75</td>
<td>0.060</td>
<td>100.2</td>
<td>97.7</td>
<td>−2.5</td>
</tr>
<tr>
<td>Model 3</td>
<td>−1.85</td>
<td>0.78</td>
<td>0.017</td>
<td>101.2</td>
<td>97.9</td>
<td>−3.3</td>
</tr>
<tr>
<td>Model 4</td>
<td>−1.00</td>
<td>0.72</td>
<td>0.166</td>
<td>100.9</td>
<td>99.1</td>
<td>−1.8</td>
</tr>
<tr>
<td>HDL cholesterol, mg/dL (n=1615)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>0.25</td>
<td>0.34</td>
<td>0.473</td>
<td>53.8</td>
<td>54.2</td>
<td>0.4</td>
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<tr>
<td>Model 2</td>
<td>0.17</td>
<td>0.35</td>
<td>0.625</td>
<td>53.8</td>
<td>54.1</td>
<td>0.3</td>
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<tr>
<td>Model 3</td>
<td>−0.14</td>
<td>0.35</td>
<td>0.689</td>
<td>53.4</td>
<td>53.2</td>
<td>−0.2</td>
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<td>Model 4</td>
<td>0.20</td>
<td>0.35</td>
<td>0.573</td>
<td>53.6</td>
<td>54</td>
<td>0.4</td>
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<tr>
<td>LDL/HDL ratio (n=1615)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>−0.05</td>
<td>0.02</td>
<td>0.008</td>
<td>1.97</td>
<td>1.88</td>
<td>−0.09</td>
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<tr>
<td>Model 2</td>
<td>−0.04</td>
<td>0.02</td>
<td>0.034</td>
<td>1.97</td>
<td>1.89</td>
<td>−0.08</td>
</tr>
<tr>
<td>Model 3</td>
<td>−0.04</td>
<td>0.02</td>
<td>0.050</td>
<td>2</td>
<td>1.93</td>
<td>−0.07</td>
</tr>
<tr>
<td>Model 4</td>
<td>−0.03</td>
<td>0.02</td>
<td>0.080</td>
<td>1.98</td>
<td>1.92</td>
<td>−0.06</td>
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<tr>
<td>Log triglycerides, mg/dL (n=1615)</td>
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<tr>
<td>Model 1</td>
<td>−0.022</td>
<td>0.014</td>
<td>0.117</td>
<td>71.8</td>
<td>69.1</td>
<td>−2.7</td>
</tr>
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<td>Model 2</td>
<td>−0.008</td>
<td>0.014</td>
<td>0.544</td>
<td>71.1</td>
<td>70</td>
<td>−1.1</td>
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<td>Model 3</td>
<td>−0.010</td>
<td>0.014</td>
<td>0.508</td>
<td>72.4</td>
<td>71.2</td>
<td>−1.2</td>
</tr>
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<td>Model 4</td>
<td>−0.001</td>
<td>0.013</td>
<td>0.923</td>
<td>72.5</td>
<td>72.4</td>
<td>−0.1</td>
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<td>LDL particle density, flotation rate (n=1302)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>0.0006</td>
<td>0.0006</td>
<td>0.336</td>
<td>0.28</td>
<td>0.28</td>
<td>0</td>
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<tr>
<td>Model 2</td>
<td>0.0002</td>
<td>0.0006</td>
<td>0.544</td>
<td>0.28</td>
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<td>Model 3</td>
<td>0.0003</td>
<td>0.0006</td>
<td>0.682</td>
<td>0.28</td>
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<td>0</td>
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<td>Model 4</td>
<td>−0.00002</td>
<td>0.0006</td>
<td>0.979</td>
<td>0.28</td>
<td>0.28</td>
<td>0</td>
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<tr>
<td>Log apolipoprotein B, mg/dL (n=1317)</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>−0.012</td>
<td>0.0081</td>
<td>0.037</td>
<td>74.7</td>
<td>72.5</td>
<td>−2.2</td>
</tr>
<tr>
<td>Model 2</td>
<td>−0.012</td>
<td>0.0082</td>
<td>0.149</td>
<td>74.5</td>
<td>72.9</td>
<td>−1.6</td>
</tr>
<tr>
<td>Model 3</td>
<td>−0.017</td>
<td>0.0085</td>
<td>0.051</td>
<td>75.2</td>
<td>73</td>
<td>−2.2</td>
</tr>
<tr>
<td>Model 4</td>
<td>−0.007</td>
<td>0.0077</td>
<td>0.361</td>
<td>74.9</td>
<td>74</td>
<td>−0.9</td>
</tr>
<tr>
<td>Body mass index Z score (n=1518)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1</td>
<td>−0.045</td>
<td>0.025</td>
<td>0.075</td>
<td>0.67</td>
<td>0.59</td>
<td>−0.08</td>
</tr>
<tr>
<td>Model 2</td>
<td>−0.039</td>
<td>0.026</td>
<td>0.128</td>
<td>0.66</td>
<td>0.59</td>
<td>−0.07</td>
</tr>
<tr>
<td>Model 3</td>
<td>−0.042</td>
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<td>0.102</td>
<td>0.9</td>
<td>0.83</td>
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<td>Waist circumference, cm (n=1578)</td>
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<td>0.014</td>
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</table>

DASH indicates Dietary Approaches to Stop Hypertension; LDL, low-density lipoprotein; and HDL, high-density lipoprotein.

Model 1 is adjusted for age, sex, race, site, diabetes mellitus duration, income; model 2, model 1 + television time, vigorous physical activity, smoking; model 3, model 2 + body mass index Z score; and model 4, model 3 + A1c.

*β for 10-unit DASH increase.
†Mean risk factor estimated at tertiles 1 and 3 of DASH score.
‡Tertile 1 and 3 estimates back-transformed to original units.
<table>
<thead>
<tr>
<th>Cardiovascular Disease Risk Factor</th>
<th>$\beta^*$</th>
<th>SE</th>
<th>P</th>
<th>Tertile 1†</th>
<th>Tertile 3†</th>
<th>Mean Difference (Tertile 3—Tertile 1)</th>
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<tr>
<td><strong>Total cholesterol, mg/dL (n=313)</strong></td>
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<tr>
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<td><strong>HDL cholesterol, mg/dL (n=313)</strong></td>
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<td><strong>LDL particle density, flotation rate (n=182)</strong></td>
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<td>0.009</td>
<td>2.1</td>
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<td><strong>Waist circumference, cm (n=254)</strong></td>
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<td><strong>A1c, % (n=224)</strong></td>
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<td>0.889</td>
<td>7.17</td>
<td>7.13</td>
<td>−0.04</td>
</tr>
</tbody>
</table>

DASH indicates Dietary Approaches to Stop Hypertension; LDL, low-density lipoprotein; and HDL, high-density lipoprotein.

Model 1 is adjusted for age, sex, race, site, diabetes duration, income; model 2, model 1 + television time, vigorous physical activity, smoking; model 3, model 2 + body mass index Z score; and model 4, model 3 + A1c.

* $\beta$ for 10-unit DASH increase.

†Mean risk factor estimated at tertiles 1 and 3 of DASH score.

‡Tertile 1 and 3 estimates back-transformed to original units.
We observed a marked association of adherence to DASH diet with A1c, in youth with T1DM, a finding that, to the best of our knowledge, has not been shown before. It is tempting to speculate that a higher-quality diet may affect glucose control physiologically via nutrient constituents such as fiber that slow digestion time. Alternatively, it is conceivable that both A1c and DASH scores reflect a latent construct related to general health behaviors and quality of diabetes care, but do not have a causal relation.

Previous cross-sectional and prospective studies have shown associations of A1c with lipid levels, and dense LDL. In the Diabetes Control and Complications Trial, intensive glucose control significantly reduced total and LDL cholesterol and triglycerides in patients with T1DM. Likewise, in the SEARCH population, glycemic control predicted short-term changes in lipid levels. We therefore presented data on the associations between DASH diet and lipids with and without adjustment for A1c. Our findings suggest that there may be multiple pathways linking dietary intake to lipid levels, some operating via concomitant changes in A1c and some operating independently.

Our study has several limitations. Because of the cross-sectional design, determinations of sequence of events and causal inferences were limited. Our sample of T2DM youth was still limited and might have influenced our ability to reach definitive conclusions. Assessment of dietary intake is prone to error, resulting in misclassification of exposure measurement; however, it is unlikely that such misclassification would be differential in relation to the outcomes considered. Sodium intake is generally not well assessed by food frequency questionnaire. The association magnitudes were of moderate clinical significance. Finally, we did not explicitly adjust for multiple comparisons. We fitted our models in a hierarchical sequence from simpler to more complex and thus used a systematic approach for examining whether associations were significant. However, given the large number of CVD risk factors studied, we cannot exclude the possibility that some of the observed associations with marginal P values may be due to chance and could become marginally nonsignificant if replicated.

We have previously shown that dietary intake in youth with diabetes mellitus falls markedly short of current recommendations, and the overall adherence score for the DASH diet is quite low. It has been suggested that very high DASH adherence levels like those in intervention settings may be needed to affect health outcomes. However, the low overall dietary quality in our population did not preclude us from finding associations. In T1DM, higher adherence to the DASH diet was significantly associated with LDL/HDL ratio and A1c. In youth with T2DM, DASH adherence was significantly associated with LDL particle density and BMI. In conclusion, the DASH dietary pattern may prove beneficial in the prevention and management of CVD risk in this vulnerable population of youth with diabetes mellitus, among whom there is clearly much room for improvement in the quality of dietary intake.

Acknowledgments
The SEARCH for Diabetes in Youth Study is indebted to the many youth and their families and their healthcare providers, whose participation made this study possible.

Sources of Funding
The authors wish to acknowledge the involvement of the General Clinical Research Centers at the Medical University of South Carolina (grant M01 RR01070); Seattle Children’s Hospital and the University of Washington School of Medicine (grants M01 RR00037 and M01RR001271); Colorado Pediatric General Clinical Research Center (grant M01 RR00069); and the Institutional Clinical and Translational Science Award, National Institutes of Health/National Center for Research Resources at the University of Cincinnati (grant 1UL1RR026314-01). The SEARCH for Diabetes in Youth Study is funded by the Centers for Disease Control and Prevention (PA No. 00097 and DP-05-069) and supported by the National Institute of Diabetes and Kidney Diseases. Site contract numbers are as follows: Kaiser Permanente Southern California (U01 DP000246), University of Colorado Health Sciences Center (U01 DP000247), Pacific Health Research Institute (U01 DP000245), Children’s Hospital Medical Center (Cincinnati) (U01 DP000248), University of North Carolina at Chapel Hill (U01 DP000254), University of Washington School of Medicine (U01 DP000244), and Wake Forest University School of Medicine (U01 DP000250). The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention and the National Institute of Diabetes and Digestive and Kidney Diseases.

Disclosures
None.

References
DASH Diet and CVD Risk Factors in Diabetes

Since the publication of the landmark findings of the Dietary Approaches to Stop Hypertension (DASH) trial, the DASH diet has become well known as an effective whole-diet approach to hypertension prevention and blood pressure reduction. However, little is known about its impact on other cardiovascular disease risk factors, especially in youth with type 1 and type 2 diabetes mellitus. In this cross-sectional study, we explored the association of DASH diet with blood lipid levels, lipoproteins, adipocytokines, and measures of adiposity and glycemic control in 2130 youth aged 10 to 22 years with type 1 diabetes mellitus, among whom there is clearly much room for improvement in the quality of dietary intake.


CLINICAL PERSPECTIVE

Since the publication of the landmark findings of the Dietary Approaches to Stop Hypertension (DASH) trial, the DASH diet has become well known as an effective whole-diet approach to hypertension prevention and blood pressure reduction. However, little is known about its impact on other cardiovascular disease risk factors, especially in youth with type 1 and type 2 diabetes mellitus. In this cross-sectional study, we explored the association of DASH diet with blood lipid levels, lipoproteins, adipocytokines, and measures of adiposity and glycemic control in 2130 youth aged 10 to 22 years with physician-diagnosed diabetes mellitus. Dietary intake was assessed by food frequency questionnaire, categorized into the DASH food groups, and assigned an adherence score. In both type 1 and type 2 diabetes mellitus youth, the average DASH diet scores were low, suggesting very poor dietary intake quality in this population. Of the various cardiovascular disease risk factors evaluated, we found that among youth with type 1 diabetes mellitus, higher adherence to the DASH diet was significantly associated with lower levels of low-density lipoprotein/high-density lipoprotein ratio and A1c. In youth with type 2 diabetes mellitus, higher adherence to the DASH diet was significantly associated with higher low-density lipoprotein particle density and lower body mass index Z score. In conclusion, the DASH dietary pattern may prove beneficial in the prevention and management of cardiovascular disease risk in this vulnerable population of youth with diabetes mellitus, among whom there is clearly much room for improvement in the quality of dietary intake.
Association of DASH Diet With Cardiovascular Risk Factors in Youth With Diabetes Mellitus: The SEARCH for Diabetes in Youth Study
Angela D. Liese, Andrey Bortsov, Anke L.B. Günther, Dana Dabelea, Kristi Reynolds, Debra A. Standiford, Lenna Liu, Desmond E. Williams, Elizabeth J. Mayer-Davis, Ralph B. D'Agostino, Jr, Ronny Bell and Santica Marcovina

_Circulation_. 2011;123:1410-1417; originally published online March 21, 2011; doi: 10.1161/CIRCULATIONAHA.110.955922

_Circulation_ is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

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A DASH-diéta cardiovascularis kockázati tényezőkkel való összefüggése fiatal cukorbetegből

A fiatalkorúakban a cukorbetegség kutatását célzó tanulmány

Angela D. Liese, PhD; Andrey Bortsov, MD; Debra A. Standiford, MSN; Lenna Liu, MD; Desmond E. Williams, MD, PhD; Elizabeth J. Mayer-Davis, PhD; Ralph B. D’Agostino, Jr, PhD; Ronny Bell, PhD; Santica Marcovina, ScD, PhD

Hátter – Kimutattuk, hogy a magas vérnyomás kezelésére kidolgozott diéta tartása (Dietary Approaches to Stop Hypertension, DASH-étrend) összefüggésekben áll az 1-es és 2-es típusú cukorbetegségben szenvedő fiatalok vérnyomásának alakulásával. Megvizsgáltuk a DASH-diéta egyéb cardiovascularis körképek kockázati tényezőire gyakorolt hatását.


Kulcsszavak: cukorbetegség ■ lipidek ■ lipoproteinek ■ táplálkozás ■ fiatalkor

A diabéteszes fiatalok cardiovascularis betegségei (CVB) kialakulásának szempontjából nagyságát alakítottuk a felgyorsult atherosclerosis folyamat miatt, amely a fiatal felnőttkorban idős termékeny betegséghez vezethet.A A betegségek gyakori előfordulása nyugon gyakori; az 1-es típusú diabéteszben (T1DM) szenvedő fiatalok 14%-a, a 2-es típusú diabéteszben (T2DM) 92%-a rendelkezik ≥2 cardiovascularis kockázattal bíró gyermek-diabéteszesek (T1DM) és fiatal cukorbetegek (T2DM) rizikószintjében 0,07-dal alacsonyabb LDL/HDL-arányt és 0,2-del alacsonyabb A 1c-szinteket találtunk, mint a legalacsonyabb testtömegindex és lipoproteinreszecskéssűrűséggel, adipocitokinként, valamint testtömegindex és derékkörfogat mértékek rögzítve a diétás kezelés hatékonyságát, a magas vérnyomás és cukorbetegség megelőzése és kezelése szempontjából. A DASH-étrendi táplálkozás elsősorban az összefüggésben áll az első és második cardiovascularis kockázattal bíró gyermek-diabéteszesek (T1DM) és fiatal cukorbetegek (T2DM) rizikószintjében 0,07-dal alacsonyabb LDL/HDL-arányt és 0,2-del alacsonyabb A 1c-szinteket találtunk, mint a legalacsonyabb testtömegindex és lipoproteinreszecskéssűrűséggel, adipocitokinként, valamint testtömegindex és derékkörfogat mértékek rögzítve a diétás kezelés hatékonyságát, a magas vérnyomás és cukorbetegség megelőzése és kezelése szempontjából.

Kulcsszavak: cukorbetegség ■ lipidek ■ lipoproteinek ■ táplálkozás ■ fiatalkor

Stop Hypertension (A magas vérnyomás kezelésének diéta megközelítését vizsgáló, DASH) elnevezésű tanulmánya iga-
A vizsgálat részletei

Az elemzést a biofaktorok korlátozásához, az adott élelmiszer elemekhez tartozó ioncserélő, nagy teljesítményű feladatkamra, kevert típus, másolósárga, ismeretlen típus, és azoknál nem megtörténhet a cukorbetegség típusa. A kezdeti elemzés alapján a táplálkozók gyakorlati működésében és életmódban hajlamosabbak a csontvastagság és a felnőtt diabetikus csoportok eltérő energiaszükségletével volt magyarázható.

A kezelés eredményével kapcsolatos mérések

A tanulmány rendszeres kontrollja során a fizikális vizsgálatot egy szerint kiejtett és hitelesített személyzet végezte. A magasság, valamint a súly mérése során a legközelebbi 0,1 cm, illetve a 0,1 kg-nyi beosztás felé kerekítettük. A testméretek megjelenésére 2010. május-eugeniát és testmagasság négyszögét (m²) alapján számoltuk, majd TTI-Pontszorban konvertáltuk. 14 A derékkörfogatot közvetlenül a jobb csőcsípőcsont lateralis, legmagasabb szintje felett mértük a National Health and Nutrition Examination Survey (Américai egészségügy és táplálkozási vizsgálat) protokollja alapján.15 A 150 cm, illetve ez alatti testsúly (kg)/testmagasság négyzete (m²) alapján meghatározott adagokat a TTI-Pontszorban rögzített 8031 személy 42%-ával megfelelő tömegértékre lenyomtuk (n=154). Ennek az elemzésének eredményeként végül 2130 fiatalkorú (1810 T1DM-es és 320 T2DM-es) becslét bizonyított alkalmazásnak a lelki elemzésekhez. A regressziós elemzésekkel kizárólag a fiatalokat, aki alapvetően fontosodott az elemzésekhez, a kimenetelispecifikus minták méretét a tablázatokban szemléltettük. Az alacsony diagnosztizált lipozónia (LDL) részesesedésről és az adipocitokinek hiányzó adataiaknak nagy arányta a mérésünkhez rendelkezésünkre állt korlátozott időtartammal volt magyarázható.

A DASH-diéta és statisztikai elemzés

Az elemzés azokra vonatkozott, aki részt vettek a SEARCH体力と検討した。従来の検討では、体格と体重は死因予防の指標になることが示唆されている。この結果を踏まえて、同一の集団について、検討を進めることが望ましい。
1. táblázat. A vizsgálati mintában szereplő 2130 fiatal jellemzői a cukorbetegség típusa és a DASH-diéta betartásának pontoszámá alapján

<table>
<thead>
<tr>
<th></th>
<th>T1DM (n=1810) DASH-pontszám tercilei</th>
<th>T2DM (n=320) DASH-pontszám tercilei</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 (Legmagasabb)</td>
<td>2 (Középső)</td>
<td>3 (Legmagasabb)</td>
</tr>
<tr>
<td>DASH-pontszám, átlagérték (SD)</td>
<td>30,0 (4,6)</td>
<td>39,9 (2,4)</td>
<td>49,9 (4,7)</td>
</tr>
<tr>
<td>Életkor, átlagév</td>
<td>15,0 (3,0)</td>
<td>14,7 (3,1)</td>
<td>14,9 (3,1)</td>
</tr>
<tr>
<td>Nő, %</td>
<td>52,6</td>
<td>46,8</td>
<td>47,1</td>
</tr>
<tr>
<td>Szárazmázsíz- és nemzetiségi, %</td>
<td>&lt;0,0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nem spanyol ajkú, felnőtt</td>
<td>72,3</td>
<td>79,3</td>
<td>81,9</td>
</tr>
<tr>
<td>Fekete bőrű</td>
<td>12,1</td>
<td>5,9</td>
<td>4,6</td>
</tr>
<tr>
<td>Spanyol ajkú</td>
<td>10,9</td>
<td>9,9</td>
<td>9,9</td>
</tr>
<tr>
<td>Egyéb</td>
<td>4,6</td>
<td>4,8</td>
<td>3,5</td>
</tr>
<tr>
<td>Családi bevétel, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$25000</td>
<td>15,2</td>
<td>12,7</td>
<td>8,6</td>
</tr>
<tr>
<td>$25000-$74999</td>
<td>47,7</td>
<td>44,8</td>
<td>40,1</td>
</tr>
<tr>
<td>≥$75000</td>
<td>37,0</td>
<td>42,4</td>
<td>51,2</td>
</tr>
<tr>
<td>Életkor, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;18</td>
<td>4,2</td>
<td>3,5</td>
<td>3,3</td>
</tr>
<tr>
<td>18-24</td>
<td>60,6</td>
<td>55,6</td>
<td>48,3</td>
</tr>
<tr>
<td>≥25</td>
<td>35,2</td>
<td>27,9</td>
<td>28,4</td>
</tr>
<tr>
<td>Dohányzás, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nem</td>
<td>12,1</td>
<td>7,4</td>
<td>4,6</td>
</tr>
</tbody>
</table>

DASH: A magas vérnyomás kezelése módszerrel; T1DM: 1-es típusú diabetes mellitus; T2DM: 2-es típusú diabetes mellitus
* P ANOVA vagy χ²-próba.

Liese és mtsai

A DASH-diéta kardiovaskuláris kockázati tényezőkkel való összefüggése

A legmagasabb tercilebe tartozó gyerekek később annyi gyümölcsöt és alacsony zsírtartalmú tejterméket, valamint lényegen több diétát és magyarázatot fogysztoztattak, mint a legalacsonyabb tercilebe tartozó társaik. A DASH-diétához való erősabb ragaszkodás nem mutattott összefüggést a teljes energiabevétellel.

A CVB rizikóterületeknek a diabétesz típusától, valamint a DASH-diétahoz való ragaszkodás tercileiből függő középpontokat ábrázoltunk az analitikai modellek egy előre megállapított, hierarchikus sorban. Az analízis során jól megértettünk a diabétesz típus és a DASH-diétahoz való ragaszkodás közötti kapcsolatot, de az LDL/HDL-arány és az A₁c-szint alacsonyabb értékeit a 3. táblázatban ábrázoltuk. A DASH-diéta szigorúbb DASH-etrendhez való ragaszkodás tercileiből függő közepeseket ábrázoltuk az analitikai modellek egy előre megállapított, hierarchikus során.

A CVB rizikóterületeknek a diabétesz típusától, valamint a DASH-diétahoz való ragaszkodás tercileiből függő középpontokat ábrázoltunk az analitikai modellek egy előre megállapított, hierarchikus sorban.

Az összkoleszterinszintre vonatkozó eredményeink alapján a T1DM-es és a T2DM-es gyermekekben az összkoleszterin-, valamint a trigliceridszint, a derékkörfogat, az A₁c-, az adiponektin- és leptin-szintek (az adatokat nem tüntettük fel) között áll vényhöz az adatokat nem tüntettük fel) esetén nem észleltünk ilyen kapcsolatot. A koleszterinszintet és a derékkörfogat vonatkozásában a trigliceridek, a HDL-koleszterinin és a derékkörfogat csökkenésének kapcsolatát tapasztaltunk.

A 4. táblázatban a T1DM-es gyerekeken a DASH-diéta pontoszama és a CVB kockázati tényezői közötti összefüggéseket ábrázoltuk az analitikai modellel egy előre megállapított, hierarchikus során. Eredő kapcsolatot figyeltünk meg a DASH-diéta pontoszama, valamint az LDL/HDL-arány, illetve az A₁c-értékek között. Nem találtunk összefüggést a HDL-koleszterin-, a trigliceridek-, az adrézseckeszedésnél, az adiponektin vagy leptin (az adipokitinak adatait nem ábrázoltuk), a TTI-Z-pont, illetve a derékkörfogat kapcsolódásban. Az összkoleszterin- és az LDL-koleszterin tercileiben a DASH-diéta pontoszama a felnőtt tercileben volt, 0,01-dal magasabb LDL-részecskesűrűséget és 0,03-dal alacsonyabb A₁c-szintet találtunk, mint azokban, akiknek a DASH-diéta és a DASH-pontszama a legalacsonyabb tercilebe esett, függetlenül a zavaró tényezőktől. Emellett értékelünk a DASH-pontrendszer és a lipidszintek között lévő kapcsolatban az A₁c, mint lehetőséges közvetítő tényező szerepét. Az A₁c-hez történt korrigálás következtében minden, a lipidszintekkel kapcsolatosan megfigyelt összefüggést gyengült vagy megszűnt.

Ahogyan azt a 5. táblázatban is bemutattuk, a T2DM-es fiatalokban a DASH-diéta pontoszama a felnőtt tercilebe esett, 0,01-dal magasabb LDL-részecskesűrűséget és 0,03-dal alacsonyabb A₁c-szintet találtunk, mint azokban, akiknek a DASH-diéta és a DASH-pontszama a legalacsonyabb tercilebe esett. Függetlenül a DASH-diéta és a DASH-pontszama a legalacsonyabb tercilebe esett, függetlenül a zavaró tényezőktől.

Megbeszélés

Számosságos, a felnőttek közötti megfigyelésen alapuló vizsgálat azt mutatja, hogy a DASH-jellegű diéta betartása pozitív hatással van a cardiovascularis rendszerre; s e hatáson a diéta nél a magas vérnyomás, a T2DM, a szívleágótnás, a stroke és az összmortalitás rizikóját csökkentő hatását értjük. A CVB rizikóterületeknek a diabétesz típusától, valamint a DASH-diétahoz való ragaszkodás közötti kapcsolatot függetlenül a zavaró tényezőktől.

A CVB rizikóterületeknek a diabétesz típusától, valamint a DASH-diétahoz való ragaszkodás közötti kapcsolatot függetlenül a zavaró tényezőktől.
2. táblázat. Átlagos energia- és tápanyagbevitél, táplálékcsotartások a cukorbetegség típusának és a DASH-diéta betartásának pontoszama alapján

<table>
<thead>
<tr>
<th>Diéta jellemzői</th>
<th>T1DM (n=1810) DASH-pontszám tercilei</th>
<th>T2DM (n=320) DASH-pontszám tercilei</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 (Legmagasabb)</td>
<td>2 (Középső)</td>
</tr>
<tr>
<td>DASH-pontszám, átlagérték (SD)</td>
<td>30 (4,6)</td>
<td>39,9 (2,4)</td>
</tr>
<tr>
<td>Energia, átlagérték (SD), kcal/nap</td>
<td>1987 (906)</td>
<td>1944 (1019)</td>
</tr>
<tr>
<td>Teljes kőrülözött testtömeg</td>
<td>2,16 (0,75)</td>
<td>2,25 (0,77)</td>
</tr>
<tr>
<td>Magas réztesttömeg</td>
<td>0,04 (0,1)</td>
<td>0,05 (0,1)</td>
</tr>
<tr>
<td>Zöldségek</td>
<td>1,1 (0,8)</td>
<td>1,1 (0,8)</td>
</tr>
<tr>
<td>Gyúmölcs</td>
<td>0,7 (0,6)</td>
<td>1,0 (0,8)</td>
</tr>
<tr>
<td>Normális zsírtartalmú tejettermékek</td>
<td>0,9 (0,6)</td>
<td>1,0 (0,6)</td>
</tr>
<tr>
<td>Csakkiértelmezett zsírtartalmú tejettermékek</td>
<td>0,4 (0,5)</td>
<td>0,6 (0,5)</td>
</tr>
<tr>
<td>Húrok</td>
<td>1,6 (0,6)</td>
<td>1,3 (0,6)</td>
</tr>
<tr>
<td>Diófélék és magvak</td>
<td>0,1 (0,3)</td>
<td>0,4 (0,5)</td>
</tr>
<tr>
<td>Zöldségek és olajok</td>
<td>2,4 (1,5)</td>
<td>2,1 (1,5)</td>
</tr>
<tr>
<td>Édességek</td>
<td>1,1 (0,8)</td>
<td>0,9 (0,6)</td>
</tr>
<tr>
<td>Tápanyagok, átlagérték (SD), 1000 kcal-ánként</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Szénhidrátok, g</td>
<td>114 (19)</td>
<td>118 (18)</td>
</tr>
<tr>
<td>Állati eredetű zsír, g</td>
<td>44 (6)</td>
<td>42 (6)</td>
</tr>
<tr>
<td>Telített zsír, g</td>
<td>16 (3)</td>
<td>15 (2)</td>
</tr>
<tr>
<td>Fehérje, g</td>
<td>40 (7)</td>
<td>39 (5)</td>
</tr>
<tr>
<td>Rost, g</td>
<td>6 (2)</td>
<td>7 (2)</td>
</tr>
<tr>
<td>Kalciump, mg</td>
<td>539 (223)</td>
<td>610 (242)</td>
</tr>
<tr>
<td>Magnezium, mg</td>
<td>123 (27)</td>
<td>138 (27)</td>
</tr>
<tr>
<td>Kalium, mg</td>
<td>2332 (1168)</td>
<td>2524 (1303)</td>
</tr>
</tbody>
</table>

DASH: A magas vérnyomás kezelése diétás módszere; T1DM: 1-es típusú diabetes mellitus; T2DM: 2-es típusú diabetes mellitus

DASH-ajánlás szerinti adagok 1000 kcal-ánként naponta: ≥3 adag gabonaféle; ≥1 adag protein; HDL: magas denzitású lipoprotein.

*DASH-pontszám tercilei

<table>
<thead>
<tr>
<th>Cardiovaskuláris betegség rizikófaktorai</th>
<th>n</th>
<th>1 (Legmagasabb)</th>
<th>2 (Középső)</th>
<th>3 (Legmagasabb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Összeszervesztet, mg/dl</td>
<td>1615</td>
<td>171,4 (32,8)</td>
<td>169,4 (33,4)</td>
<td>166,6 (34,1)</td>
</tr>
<tr>
<td>LDL-szervesztet, mg/dl</td>
<td>1615</td>
<td>100,4 (25,6)</td>
<td>99,2 (27,8)</td>
<td>96,8 (26,2)</td>
</tr>
<tr>
<td>HDL-szervesztet, mg/dl</td>
<td>1616</td>
<td>54,4 (13,5)</td>
<td>53,9 (12)</td>
<td>54,3 (12,2)</td>
</tr>
<tr>
<td>LDL/HDL arány</td>
<td>1615</td>
<td>1,95 (0,68)</td>
<td>1,94 (0,75)</td>
<td>1,86 (0,63)</td>
</tr>
<tr>
<td>Trigliceridek, mg/dl</td>
<td>1615</td>
<td>84,7 (82,6)</td>
<td>86,2 (133,3)</td>
<td>78,1 (56)</td>
</tr>
<tr>
<td>LDL-részecskesírozás, flotációs arány</td>
<td>1302</td>
<td>0,28 (0,02)</td>
<td>0,28 (0,02)</td>
<td>0,28 (0,02)</td>
</tr>
<tr>
<td>Apolipoprotein B, mg/dl</td>
<td>1317</td>
<td>77,7 (21,7)</td>
<td>76,3 (22,4)</td>
<td>74,9 (20,9)</td>
</tr>
<tr>
<td>Testőrindex-2-pont</td>
<td>1518</td>
<td>0,64 (0,86)</td>
<td>0,66 (0,87)</td>
<td>0,57 (0,89)</td>
</tr>
<tr>
<td>Derékkörtőfogat, cm</td>
<td>1578</td>
<td>78,7 (11,8)</td>
<td>78,8 (11,8)</td>
<td>78,5 (11,2)</td>
</tr>
<tr>
<td>%</td>
<td>1518</td>
<td>8,57 (1,69)</td>
<td>8,33 (1,66)</td>
<td>8,16 (1,47)</td>
</tr>
</tbody>
</table>

A számok átlagértékeket jelentenek (SD).

DASH: A magas vérnyomás kezelése diétás módszere; T1DM: 1-es típusú diabetes mellitus; T2DM: 2-es típusú diabetes mellitus; LDL: alacsony denzitású lipoprotein; HDL: magas denzitású lipoprotein.
## 4. táblázat

A DASH-pontok cardiovascular betegségek rizikófaktoraival való összefüggései az 1-es típusú cukorbetegségben szerepdő gyermekeken

<table>
<thead>
<tr>
<th>Cardiovascularis betegségek rizikófaktorai</th>
<th>β*</th>
<th>SE</th>
<th>P</th>
<th>1. tercilis</th>
<th>3. tercilis†</th>
<th>Állagérték-különbség (3 tercilis–1 tercilis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Összkoleszterin, mg/dl (n=1615)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. modell</td>
<td>−2,05</td>
<td>0,92</td>
<td>0,026</td>
<td>171,1</td>
<td>167,4</td>
<td>−3,7</td>
</tr>
<tr>
<td>2. modell</td>
<td>−1,53</td>
<td>0,93</td>
<td>0,101</td>
<td>170,7</td>
<td>168</td>
<td>−2,7</td>
</tr>
<tr>
<td>3. modell</td>
<td>−2,37</td>
<td>0,97</td>
<td>0,014</td>
<td>171,6</td>
<td>167,4</td>
<td>−4,2</td>
</tr>
<tr>
<td>4. modell</td>
<td>−0,95</td>
<td>0,89</td>
<td>0,285</td>
<td>171,5</td>
<td>169,8</td>
<td>−1,7</td>
</tr>
<tr>
<td>LDL-koleszterin, mg/dl (n=1615)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. modell</td>
<td>−1,76</td>
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DASH: A magas vérnyomás kezelése diétás módszereit; LDL: alacsony denzitású lipoprotein; HDL: magas denzitású lipoprotein.


† b 10 egységről DASH-növekedés esetén.
† A keckázati tényezők átlagértékét a DASH-pontok 1. és 3. terciliisére beszünték.
†† A 1. és 3. terciliisék beszüntett értékeit eredeti mértékegységükbe alakítottuk vissza.
5. táblázat. A DASH-pontok cardiovascularis betegségek rizikófaktoraira való összefüggései a 2-es típusú cukorbetegségben szenvedő gyermekben

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<th>3. tERCill</th>
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<td>3. modell</td>
<td>-1.16</td>
<td>1.08</td>
<td>0.286</td>
<td>74.3</td>
<td>72.3</td>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>4. modell</td>
<td>-3.03</td>
<td>1.58</td>
<td>0.056</td>
<td>113.5</td>
<td>107.8</td>
<td>-5.7</td>
<td></td>
</tr>
<tr>
<td>Aτv, % (n=224)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. modell</td>
<td>-0.007</td>
<td>0.16</td>
<td>0.965</td>
<td>7.67</td>
<td>7.66</td>
<td>-0.01</td>
<td></td>
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<tr>
<td>2. modell</td>
<td>-0.029</td>
<td>0.16</td>
<td>0.859</td>
<td>6.63</td>
<td>6.68</td>
<td>0.05</td>
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</tr>
<tr>
<td>3. modell</td>
<td>-0.023</td>
<td>0.17</td>
<td>0.889</td>
<td>7.17</td>
<td>7.13</td>
<td>-0.04</td>
<td></td>
</tr>
<tr>
<td>4. modell</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*DASH: A magas vérnyomás kezelése diétás módszere; LDL: alacsony denzitású lipoproteín; HDL: magas denzitású lipoproteín.

Az 1. modellt az életkorra, nemre, származásra, lakhelyre, a cukorbetegség fennállásának időtartamára, a családi jövedelemre korrigáltuk; a 2. modell esetén 1. modell+televíziós időtartama, erőteljes fizikai aktivitás, dohányzás; 3. modell esetén 2. modell+testfőmegindex-Z-pont és a 4. modell esetén 3. modell+Aτv korrigálást végeztünk.

* β 10 egyeségnyi DASH-növekedés esetén.
† A keckázati tényezők átlagértékét a DASH-pontok 1. és 3. tercileire beszüntük.
‡ Az 1. és 3. tercilek beszünt értékeit eredeti mértékegységekbe alakítottuk vissza.
nak szintjétől, azonban nincs közöttük közvetlen ok-okozati számoltak be erőteljes fizikai aktivitásról.31 Amennyiben ezt nem volt egyértelmű.

álpozitív eredményekhez vezet.32 Elképzelhető, hogy a fizikai észleltünk, amely független volt az életstílustól és egyéb té-
arány vonatkozásában.6 A PREMIER tanulmányban hasonló móddal és a dohányzással volt magyarázható. Ebben a cso-
hoz tartozik a DASH-diéta és a kövérség közötti összefüggés adatait az ARCH vizsgálat részvételein a glykaemiás kontroll előre elejleste a rövid ideig tartó lipidzintváltozásokat.6 Emiatt a DASH-diáta és a lipidszintek közötti összefüggések adatait az A₁c-vel történő korrigálással és a nélkül is bemutattuk. Ered-
ményeink arra engednek következtetni, hogy a diétás táplálkozás előnyös lehet a cukorbeteg fiatal korúak betegség-
kezelése szempontjából. Nyilvánvaló, hogy az egészségi állapotra hatással legyen. Azonban a mi vizsgált
工作岗位ának számos korlátozó tényezője van. Vízsg-
gátoltak meg bennünket abban, hogy összefüggéseket tájékozódhatunk a DASH-diáta és a lipidszintek közötti összefüggésben, de az erőteljes fizikai aktivitás kérdésének pontatlanságai megakadályozzák, hogy fékezett, vagy csupán felvételét és a lipidszintek közötti kapcsolatot számos úton le-
keresztülnézést vizsgáltunk, nem tudjuk ki-
zárni annak a lehetőségét, hogy néhány általunk megfigyelt összefüggés, amely esetén a P-érték a szignifikáns tartomány határában volt, csak véletlencént kapott eredmény lenne, és amennyi-nyiben azt megismételnénk, már a nem szignifikáns csoport-
sorolódna át.

Már korábban bemutattuk, hogy a fiatalok diétás táplálék-
úton átesett betegeknél és néhány ettől független úton fejtik ki hatását. A DASH-diáta tartásának nagyon magas szintje – mint például a T2DM-es fiatalokat tartalmazó mintánk szintén korlátozott volt és ez

Korábbi keresztmetszeti és prospektív tanulmányok azt mutatták, hogy összefüggés van az A₁c-vel, valamint a lipidszint-
kezést nem gátoltak meg bennünket abban, hogy összefüggéseket vizsgáljunk a diabetes mellitus mellékhatásainak megelőzése, valamint kezelése szempontjából. Az A₁c-vel történő korrigálással és a nélkül is bemutattuk a DASH-diáta és a lipidszintek közötti összefüggéseket. Ezen felül, hogy az egészségi állapotra hatással legyen. Azonban a mi vizsgált

A 1-es típusú diabéteszesekben a DASH-etrendhez való nagyobb mértékű ragaszkodás jelentős összefüggést mutatott az LDL-kihasználással és az A₁c-vel, mint amennyiben a cukorbetegség gondozásában végzett tehát kezdetben a jobb tudománszerű megközelítés lehetőségét, hogy végleges összefüg-

Keretek közé tartozik azonok, akik hozzájárulásukkal lehetővé téthetik a vizsgálat elkészítését.

Anyagi háttér

A szerzők szeretnének köszönetet mondani a Dél-karolinai Orvostudomá-
nyi Egyetem General Clinical Research Centernek (ösztöndíj M01)

ARCH vizsgálat résztvevőiben a gyakorlati kontroll előre jelezte a rövid ideig tartó lipidzintváltozásokat. Emiatt a DASH-diáta és a lipidszintek közötti összefüggések adatait az A₁c-vel történő korrigálással és a nélkül is bemutattuk. Ered-
ményeink arra engednek következtetni, hogy a diétás táplál-

Közönségtíltsás

A SEARCH for Diabetes in Youth Study (Fiatalokban a cukorbetegség

A szerzők szeretnének köszönetet mondani a Dél-karolinai Orvostudomá-
nyi Egyetem General Clinical Research Centernek (ösztöndíj M01)
Érdekeltségek

A szerzők nem számláltak be érdekeltségről.

Irodalom


Fordította: dr. Eszlári-Kucsa Katalin

**KLINIKAI TÁVLATOK**