Effect of Lifestyle Intervention on the Occurrence of Metabolic Syndrome and its Components in the Finnish Diabetes Prevention Study

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Running Title: Lifestyle intervention and MetS

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ABSTRACT

Objective: The aim of this secondary analysis of the Finnish Diabetes Prevention Study (DPS) was to assess the effects of a lifestyle intervention on metabolic syndrome and its components.

Research Design and Methods: 522 middle-aged overweight men and women with impaired glucose tolerance were randomized into an individualized lifestyle intervention group or into a standard care control group in the DPS. The National Cholesterol Education Program criteria were used for the definition of the metabolic syndrome.

Results: At the end of the study with a mean follow-up of 3.9 years we found a significant reduction in the prevalence of metabolic syndrome in the intervention group compared to the control group (OR of 0.62; 95% CI 0.40–0.95) as well in the prevalence of abdominal obesity (OR 0.48; 95% CI 0.28–0.81).

Conclusions: The results suggest that lifestyle intervention may also reduce risk of cardiovascular diseases in long run.

ClinicalTrials.gov ID: NCT00518167

ABBREVIATIONS. CVD, cardiovascular disease; DPP, Diabetes Prevention Program Study; DPS, Finnish Diabetes Prevention Study; IGT, impaired glucose tolerance; MetS, metabolic syndrome; NCEP, National Cholesterol Education Program; WHO, World Health Organization; OR, odds ratio
Recent studies (1-4) have shown that lifestyle intervention reduces the risk of progression from impaired glucose tolerance (IGT) to manifest type 2 diabetes. The aim of this secondary analysis of the Finnish Diabetes Prevention Study (DPS) was to assess the effects of a lifestyle intervention on metabolic syndrome (MetS) and its components.

**RESEARCH DESIGN AND METHODS**

A detailed description of the DPS study design, subjects and methods applied has been reported previously (2; 5; 6). Altogether 522 middle-aged (mean age 55±7 years) and overweight (mean BMI 31.2±4.6 kg/m²) men (172) and women (350) with IGT were randomized into either an intensive lifestyle intervention group or a standard care control group. Blood samples were collected and an oral glucose tolerance test was performed at baseline and at each annual visit. Updated National Cholesterol Education Program (NCEP) 2005 criteria (7) were used for the definition of MetS. The data were analyzed using SPSS statistical software (version 11.5, SPSS Inc, Chicago, IL, USA). For those participants who developed diabetes according to WHO 1985 (8) or who dropped out during the study the measurements from the last observation were used as the final end value. The Wilcoxon non-parametric test was used to compare the prevalence of MetS and its components within the groups. Regression analyses adjusted for sex, age, blood pressure and cholesterol medications and baseline status were applied to compare the prevalence of MetS and its components between the groups.

**RESULTS**

The prevalence of MetS decreased during the first year from 74.0% to 58.0% vs. from 74.0% to 67.7% (p=0.018 for the change between the groups) in the intervention group and control group, respectively. At the end of the study 62.6% in the intervention group and 71.2% in the control group (p=0.025 for the change between the groups) had MetS. It corresponds to an age and sex adjusted odds ratio (OR) of 0.62 (95% CI 0.40–0.95) in the intervention group compared to the control group.

The prevalence of different components of MetS at year one and at the end are shown in Table 1. During the first year there was a significant decrease in all components but elevated triglycerides in the intervention group, while the control group showed a significant decrease only in the prevalence of elevated blood pressure. From baseline to the end of the study a significant decrease in the prevalence of abdominal obesity, elevated blood pressure, low HDL-cholesterol and elevated triglycerides was seen in the intervention group, but only in low HDL cholesterol in the control group.

At the end of the study, the between group comparisons showed that lifestyle intervention reduced abdominal obesity (OR 0.48; 95% CI 0.28–0.81, adjusted for age, sex and baseline value).

**CONCLUSIONS**

In this secondary analysis of DPS data we found that after a mean follow up of 3.9 years significant reduction in the prevalence of Mets and abdominal obesity were observed in the intervention group compared to the control group. These data provide evidence of benefits associated with a lifestyle intervention beyond the prevention of diabetes.

The prevalence of MetS, abdominal obesity and elevated blood glucose decreased significantly in the intervention group compared to the control group during the first year, when the intervention was at its most intense. During the subsequent years there were some relapses, as expected. Nevertheless, by the end of the study, the proportion of subjects with MetS and abdominal obesity was still significantly lower in the intervention group. Abdominal obesity and insulin resistance are the main elements in MetS (10-12). Uusitupa et al.
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have shown earlier in a subgroup of DPS participants that a change in body weight strongly correlated with a change in insulin sensitivity (13). No increase in abdominal obesity was seen in the control group, indicating that the limited advice given to individuals in the control group was probably helpful in stopping the progression of obesity. Our results were comparable with those of the US Diabetes Prevention Program (DPP) (9). In DPP a significant increase in MetS was observed in the control group, while in our study the prevalence of MetS tended to be lower also in the control group, indicating that the “mini-intervention” among control group participants had at least some effect on the occurrence of MetS.

The significant decrease in elevated fasting glucose concentration observed after the first year deteriorated during the subsequent years. This is not surprising, since all individuals had IGT at baseline. Furthermore, the recently updated cutoff point for elevated fasting plasma glucose criteria in MetS is 5.6 mmol/l, while the mean fasting glucose at baseline among DPS participants was 6.1 mmol/l. It would apparently be important to find and treat the people with MetS earlier, before IGT has developed.

In summary, compared to the standard care offered to the control group the intensive and individualized lifestyle intervention in the DPS reduced the occurrence of abdominal obesity and the overall prevalence of MetS in long term. The occurrence of elevated fasting glucose, elevated blood pressure, low HDL cholesterol and elevated triglycerides were not significantly affected between the groups. Since MetS is a major risk factor for type 2 diabetes and cardiovascular diseases (CVD), these results suggest that lifestyle intervention may also reduce the risk of CVD in the long run, but to be confirmed a longer follow-up is needed.

ACKNOWLEDGEMENTS

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REFERENCES


**TABLE 1.** Prevalence of MetS and its components in the intervention group (IG) and in the control group (CG) at baseline, at year one and at the end of the Finnish Diabetes Prevention study

<table>
<thead>
<tr>
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<th>Baseline</th>
<th>Year one</th>
<th>End</th>
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<tr>
<td></td>
<td>IG</td>
<td>CG</td>
<td>p†</td>
</tr>
<tr>
<td></td>
<td>n=265</td>
<td>n=257</td>
<td>between groups</td>
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<tr>
<td>MetS (%)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>74.0</td>
<td>73.9</td>
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<td></td>
<td>58.0</td>
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<td></td>
<td>62.6</td>
<td>71.2</td>
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<td>Abdominal obesity (%)</td>
<td>80.0</td>
<td>72.4</td>
<td>0.013</td>
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<tr>
<td></td>
<td>64.5</td>
<td>70.0</td>
<td>&lt;0.001</td>
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<tr>
<td></td>
<td>67.9</td>
<td>72.4</td>
<td>&lt;0.001</td>
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<td>Elevated fasting glucose (%)</td>
<td>74.7</td>
<td>77.4</td>
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<td></td>
<td>64.8</td>
<td>74.8</td>
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<td></td>
<td>78.8</td>
<td>80.9</td>
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<td>Elevated blood pressure (%)</td>
<td>80.0</td>
<td>80.1</td>
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<td>69.5</td>
<td>70.8</td>
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<td>73.2</td>
<td>75.8</td>
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<td>Low HDL-cholesterol (%)</td>
<td>54.5</td>
<td>51.4</td>
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<td>48.6</td>
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<td>43.2</td>
<td>45.5</td>
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<td>Elevated triglycerides (%)</td>
<td>38.3</td>
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<td>34.8</td>
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<td>31.8</td>
<td>40.2</td>
<td>0.166</td>
</tr>
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</table>

* Adjusted for age and sex
† Adjusted for age, sex, baseline value
‡ Adjusted for blood pressure medications
§ Adjusted for lipid medications

Abdominal obesity; waist circumference ≥102 cm in men and ≥88 cm in women
Elevated fasting glucose; fasting plasma glucose ≥5.6 mmol/l
Elevated blood pressure; systolic blood pressure ≥130 mmHg and/or diastolic blood pressure ≥85 mmHg and/or use of antihypertensive medication
Low HDL-cholesterol; HDL cholesterol <40 mg/dL i.e. 1.03 mmol/l in men and <50 mg/dL i.e. 1.3 mmol/l in women
Elevated triglycerides; Serum fasting triglycerides ≥150 mg/dL i.e. 1.7 mmol/l