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

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OBJECTIVE — The aim of this secondary analysis of the Finnish Diabetes Prevention Study was to assess the effects of lifestyle intervention on metabolic syndrome and its components.

RESEARCH DESIGN AND METHODS — A total of 522 middle-aged overweight men and women with impaired glucose tolerance were randomized into an individualized lifestyle intervention group or a standard care control group. National Cholesterol Education Program criteria were used for the definition of 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 with the control group (odds ratio [OR] 0.62 [95% CI 0.40–0.95]) and in the prevalence of abdominal obesity (0.48 [0.28–0.81]).

CONCLUSIONS — The results suggest that lifestyle intervention may also reduce risk of cardiovascular disease in the long run.

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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 lifestyle intervention on metabolic syndrome and its components.

RESEARCH DESIGN AND METHODS

— The DPS design, subjects, and methods applied have previously been described (2,5,6). Altogether, 522 middle-aged (mean age 55 ± 7 years) and overweight (mean BMI 31.2 ± 4.6 kg/m^2) men (n = 172) and women (n = 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 2005 criteria (7) were used for the definition of metabolic syndrome. Data were analyzed using SPSS (version 11.5; SPSS, Chicago, IL). For those participants who developed diabetes according to the World Health Organization guidelines of 1985 (8) or who dropped out during the study, the measurements from the last observation were used as the final end value. Wilcoxon's nonparametric test was used to compare the prevalence of metabolic syndrome 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 metabolic syndrome and its components between the groups.

RESULTS

— The prevalence of metabolic syndrome 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 and control groups, respectively. At the end of the study, 62.6% of subjects in the intervention group and 71.2% of subjects in the control group (P = 0.025 for the change between the groups) had metabolic syndrome, which corresponds to an age- and sex-adjusted odds ratio (OR) of 0.62 (95% CI 0.40–0.95) in the intervention group compared with the control group.

The prevalence of different components of metabolic syndrome at year 1 and at the end of the study are shown in Table 1. During the first year, there was a significant decrease in all components except 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 observed in the intervention

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Abbreviations: DPS, Finnish Diabetes Prevention Study; IGT, impaired glucose tolerance.

Table 1—*Prevalence of metabolic syndrome and its components in the intervention group (IG) and in the control group (CG) at baseline, at year 1, and at the end of the DPS*

	Baseline			Year 1					End				
	IG	CG	*P* between groups*	IG	*P* in IG from baseline to year 1	CG	*P* in CG from baseline to year 1	*P* between groups†	IG	*P* in IG from baseline to end	CG	*P* in CG from baseline to end	*P* between groups†
n	265	257	—	256	—	250	—	—	265	—	257	—	—
Metabolic syndrome	74.0	73.9	0.913	58.0	<0.001	67.6	0.008	0.018	62.6	<0.001	71.2	0.297	0.025
Abdominal obesity	80.0	72.4	0.013	64.5	<0.001	70.0	0.209	0.002	67.9	<0.001	72.4	1.000	0.006
Elevated fasting glucose	74.7	77.4	0.411	64.8	0.001	74.8	0.336	0.023	78.8	0.174	80.9	0.225	0.744
Elevated blood pressure	80.0	80.1	0.937‡	69.5	<0.001	70.8	<0.001	0.770‡	73.2	0.004	75.8	0.096	0.470‡
Low HDL cholesterol	54.5	51.4	0.286§	48.6	0.036	52.4	0.662	0.111§	43.2	<0.001	45.5	0.047	0.277§
Elevated triglycerides	38.3	44.7	0.121§	34.8	0.241	44.4	0.705	0.156§	31.8	0.018	40.2	0.166	0.103§

Data are percent. 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, diastolic blood pressure ≥85 mmHg, and/or use of antihypertensive medication. Low HDL cholesterol: HDL cholesterol <40 mg/dl (<1.03 mmol/l) in men and <50 mg/dl (<1.3 mmol/l) in women. Elevated triglycerides: serum fasting triglycerides ≥150 mg/dl (≥1.7 mmol/l). *Adjusted for age and sex. †Adjusted for age, sex, and baseline value. ‡Adjusted for blood pressure medications. §Adjusted for lipid medications.

group, but only low HDL cholesterol was observed in the control group. At the end of the study, 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, a significant reduction in the prevalence of metabolic syndrome and abdominal obesity were observed in the intervention group compared with that in the control group. These data provide evidence of benefits associated with lifestyle intervention beyond the prevention of diabetes.

The prevalence of metabolic syndrome, abdominal obesity, and elevated blood glucose decreased significantly in the intervention group compared with 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 metabolic syndrome and abdominal obesity was still significantly lower in the intervention group. Abdominal obesity and insulin resistance are the main elements of metabolic syndrome (10–12). Uusitupa et al. (13) have shown earlier in a subgroup of DPS participants that a change in body weight strongly correlated with a change in insulin sensitivity. No increase in abdominal obesity was observed in the control group, indicating that the limited advice given to individuals in the control group was probably helpful in stopping progression of obesity. Our results were comparable with those of the U.S. Diabetes Prevention Program (DPP) study (9). In the DPP study, a significant increase in metabolic syndrome was observed in the control group; in our study, the prevalence of metabolic syndrome tended to be lower in the control group, indicating that the "mini-intervention" among control group participants had at least some effect on the occurrence of metabolic syndrome.

The significant decrease in elevated fasting glucose concentration observed after the first year deteriorated during the subsequent years. This is not surprising because all individuals had IGT at baseline. Furthermore, the recently updated cutoff point for elevated fasting plasma glucose criteria in metabolic syndrome is 5.6 mmol/l, while the mean fasting glu-

cose at baseline among DPS participants was 6.1 mmol/l. It would apparently be important to find and treat individuals with metabolic syndrome earlier, before IGT has developed.

In summary, compared with 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 metabolic syndrome in the long term. The occurrence of elevated fasting glucose, elevated blood pressure, low HDL cholesterol, and elevated triglycerides did not significantly differ between groups. Since metabolic syndrome is a major risk factor for type 2 diabetes and cardiovascular disease, these results suggest that lifestyle intervention may also reduce the risk of cardiovascular disease in the long run, but a longer follow-up is needed for confirmation.

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