Physical Activity and the Metabolic Syndrome in Elderly German Men and Women

Results from the population-based KORA Survey

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OBJECTIVE — The purpose of this study is to determine the optimal duration and intensity of exercise for elderly people for the prevention of the metabolic syndrome.

RESEARCH DESIGN AND METHODS — The population-based Cooperative Research in the Region of Augsburg (KORA) S4 Survey with 1,653 participants aged 55–74 years was used to investigate the relationship between the metabolic syndrome and physical activity.

RESULTS — Fifty-seven percent of men and 48% of women showed clinical symptoms of the metabolic syndrome. Leisure activities were common (>80% walked >30 min/day). Sports activities performed regularly for ≤1 h per week reduced the odds of having the metabolic syndrome (odds ratio 0.70 [95% CI 0.49–1.02] for men and 0.74 [0.53–1.04] for women), and sports activities >2 h per week were even more effective (0.62 [0.42–0.92] for men and 0.59 [0.39–0.89] for women). In contrast, activities such as walking and cycling did not have an additional influence.

CONCLUSIONS — Intense physical activity by the elderly should be promoted in addition to leisure physical activity for the prevention of the metabolic syndrome.

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Obesity and a sedentary lifestyle are recognized as major risk factors for the development of the metabolic syndrome and type 2 diabetes (1–3). Increased physical activity has preventive effects (4–6), but data for the elderly are still scarce. Therefore, some controversy remains concerning the duration and the intensity of physical exercise required to prevent the metabolic syndrome in this age-group.

RESEARCH DESIGN AND METHODS

— Data have been collected during the population-based Cooperative Research in the Region of Augsburg (KORA) S4 Survey as described elsewhere (7–10). Briefly, in a sample of 1,653 individuals (842 men and 811 women) aged 55–74 years, body weight, waist circumference, blood pressure, fasting blood glucose, triglycerides, and HDL cholesterol were measured (7). In addition, physical activity was assessed by a structured personal interview. The regularity of sports activities was specified by categories: regularly >2 h/week, regularly ≤1 h/week, irregularly ≤1 h/week, and no (or almost no) activity. Intensity of sports activities was determined by asking each participant, "How intensively do you perform sports activities?" Possible responses were very intensive, intensive, not very intensive, not intensive, no sports activities at all, and don't know), of which the first two categories were combined to form the intensity category of "high," the next two to form "middle," and the last two to form "low." To assess the duration of walking and cycling (both in addition to sports activities), four groups were defined, each characterized by an average amount of time per day (including commute to work and retail locations): <15 min, 15–30 min, 30–60 min, and >60 min.

Statistical analysis

The metabolic syndrome was defined according to International Diabetes Federation (IDF) criteria (7). Statistical analyses were performed with SAS (SAS Institute, Cary, NC). Simple frequencies were used to describe the prevalence of the metabolic syndrome, and logistic regression models were used to analyze the associations adjusted for age and other variables.

RESULTS

— According to the IDF definition, 52.6% of the study population fulfilled the criteria for the metabolic syndrome (57% of men and 48% of women). Of the study population, 43.2% reported 0 h of sports activity, 15.3% ≤1 h irregularly , 24.5% ≤1 h regularly, and 17.0% >2 h regularly per week. Overall, intensity of sports activity was mostly moderate (45.2% vs. 25.2% low and 29.6% high). Leisurely walking was performed by 52.6% for >60 min/day, 29.2% for 30–60 min/day, 10.9% for 15–30 min/day, and 7.3% for <15 min/day.

Logistic regression analyses showed that regular sports activity ≥1 h per week

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Table 1—*Association between physical activity and the metabolic syndrome*

	Odds ratio (95% CI)*	
	Men	Women
Regularity		
No sports†	1.00	1.00
Irregular, ≤1 h per week	1.01 (0.67–1.52)	1.02 (0.66–1.59)
Regular, ≤1 h per week	0.70 (0.49–1.02)	0.74 (0.53–1.04)
Regular, >2 h per week	0.62 (0.42–0.92)	0.59 (0.39–0.89)
P‡	0.041	0.043
Intensity		
Low†	1.00	1.00
Medium	0.96 (0.69–1.35)	0.83 (0.59–1.16)
High	0.74 (0.50–1.09)	0.59 (0.41–0.85)
P‡	0.25	0.020
Duration of walking per day		
<15 min†	1.00	1.00
15–30 min	0.68 (0.35–1.28)	1.05 (0.53–2.08)
30–60 min	0.98 (0.56–1.72)	0.95 (0.52–1.72)
>60 min	0.94 (0.56–1.61)	1.03 (0.57–1.79)
P‡	0.47	0.97
Duration of cycling per day		
<15 min†	1.00	1.00
15–30 min	0.84 (0.69–1.72)	0.88 (0.58–1.35)
30–60 min	0.86 (0.59–1.23)	0.75 (0.53–1.09)
>60 min	0.97 (0.67–1.41)	0.95 (0.64–1.41)
P‡	0.80	0.49

*Controlled for age. †Comparison group. ‡*P* for trend.

diminished the risk of the metabolic syndrome in both sexes. High-intensity sports activities resulted in a significantly lower prevalence of the metabolic syndrome in women than in men (Table 1). In contrast, neither sports activity performed irregularly nor everyday activities like walking or cycling (even with durations exceeding 60 min/day) showed any significant association.

Slight differences between the prevalence of the metabolic syndrome in the present analysis and that in a prior analysis of the KORA data are due to different statistical methods. In the previous analyses, prevalences were adjusted for sample design (7).

CONCLUSIONS — The present analysis reveals an inverse association between both the regularity and intensity of physical activity and the prevalence of the metabolic syndrome. The lowest prevalence can be seen in those elderly individuals performing sports activity with high intensity and regularity (i.e., >2 h weekly). These findings suggest that higher exercise levels confer greater physiological benefits. In addition, our analyses indicate that physical activity performed at regular intervals is more effective than irregular exercise, as the subgroup performing 1 h of regular sports activity per week already showed reduced prevalence of the metabolic syndrome (as compared with the subgroup performing 1 h of irregular sports activity). Moreover, everyday activities like walking and cycling may not be as effective at reducing the prevalence of the metabolic syndrome in this age-group.

Thus, our findings are not quite in line with previous studies showing that moderate activities also have preventive effects on the development of the metabolic syndrome in middle-aged and elderly people. In a French study population (aged 50–69 years), moderate and vigorous physical activity decreased the likelihood of the metabolic syndrome by one-third and two-thirds, respectively (6). Likewise, in the London Whitehall II study population (aged 45–68 years), vigorous activity including cycling and swimming and moderate activity including walking and gardening reduced the risk for the metabolic syndrome by approximately one-half and one-fourth, respectively (4). Because of a dose-response association between physical activity, energy expenditure (taking into account all types and intensities of activity performed in daily life), and the metabolic syndrome in a study with middle-aged British individuals (mean age 53.3 years), everyday physical activities were also suggested to be important in the primary prevention of the metabolic syndrome (5). In addition, intervention studies in middle-aged obese individuals also indicate that regular brisk walking seems sufficient to reduce the conversion from impaired glucose tolerance to clinical manifestation of type 2 diabetes (2,3).

The discrepancy between these findings may be explained by the fact that the population examined was rather active (>80% walked >30 min/day), such that differences between lower activity levels are not easily differentiated. Also, some limitations of the study design need to be considered, including the cross-sectional nature of the survey, the evaluation of physical activity by self-report only, and missing differentiation between types of physical activity (e.g., endurance or strength training as well as exercise intensity by metabolically equivalent tasks).

Despite these limitations, it can be concluded that in a population of which >80% engaged in substantial leisure physical activity, sports activity provided greater benefit than leisure activity alone in reducing the risk of the metabolic syndrome. Larger interventional studies in the elderly are needed to confirm these cross-sectional findings and permit accurate advice for preventive strategies in this age-group.

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References

1. Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, Keinanen-Kiukaanniemi S, Laakso M, Louheranta A, Rastas M, Salminen V, Uusitupa M: Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* 344:1343–1350, 2001
2. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM: Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 346:393–403, 2002
3. Lindstrom J, Ilanne-Parikka P, Peltonen M, Aunola S, Eriksson JG, Hemio K, Hamalainen H, Harkonen P, Keinanen-Kiukaanniemi S, Laakso M, Louheranta A, Mannelin M, Paturi M, Sundvall J, Valle TT, Uusitupa M, Tuomilehto J: Sustained

reduction in the incidence of type 2 diabetes by lifestyle intervention: follow-up of the Finnish Diabetes Prevention Study. *Lancet* 368:1673–1679, 2006
4. Rennie KL, McCarthy N, Yazdgerdi S, Marmot M, Brunner E: Association of the metabolic syndrome with both vigorous and moderate physical activity. *Int J Epidemiol* 32:600–606, 2003
5. Ekelund U, Brage S, Franks PW, Hennings S, Emms S, Wareham NJ: Physical activity energy expenditure predicts progression toward the metabolic syndrome independently of aerobic fitness in middle-aged healthy Caucasians: the Medical Research Council Ely Study. *Diabetes Care* 28:1195–1200, 2005
6. Bertrais S, Beyeme-Ondoua JP, Czernichow S, Galan P, Hercberg S, Oppert JM: Sedentary behaviors, physical activity, and metabolic syndrome in middle-aged French subjects. *Obes Res* 13:936–944, 2005
7. Rathmann W, Haastert B, Icks A, Giani G, Holle R, Koenig W, Löwel H, Meisinger C: Prevalence of the metabolic syndrome in the elderly population according to IDF, WHO, and NCEP definitions and associations with C-reactive protein: the KORA Survey 2000. *Diabetes Care* 29: 461, 2006
8. Rathmann W, Haastert B, Icks A, Lowel H, Meisinger C, Holle R, Giani G: High prevalence of undiagnosed diabetes mellitus in Southern Germany: target populations for efficient screening: the KORA survey 2000. *Diabetologia* 46:182–189, 2003
9. Rathmann W, Haastert B, Icks A, Giani G, Holle R, Meisinger C, Mielck A: Sex differences in the associations of socioeconomic status with undiagnosed diabetes mellitus and impaired glucose tolerance in the elderly population: the KORA Survey 2000. *Eur J Public Health* 15:627–633, 2005
10. Icks A, Haastert B, Gandjour A, John J, Löwel H, Holle R, Giani G, Rathmann W: Cost-effectiveness analysis of different screening procedures for type 2 diabetes: the KORA Survey 2000. *Diabetes Care* 27: 2120–2128, 2004