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ORIGINAL ARTICLE

Socio-demographic and psychosocial factors are associated with features of the metabolic syndrome. The Women's Health in the Lund Area (WHILA) study

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Aim: The aim was to analyse any associations between socio-demographic and psychosocial factors and different features of the metabolic syndrome in a geographically well-defined population of middle-aged women.
Methods: A population of 10 766 Caucasian women aged 50–59 years was investigated regarding biological and socio-demographic conditions, physical activity, dietary habits, aspects of quality of life, and subjective physical and mental symptoms. The screening instrument was used to discriminate subjects as positive or negative on one or more of a total of eight variables considered to be linked to the metabolic syndrome. The cut-off values for positive screening were non-fasting capillary blood glucose ≥ 8.0 mmol/l and serum triglycerides ≥ 2.3 mmo/l, BMI ≥ 30 kg/m^2, WHR ≥ 0.90, blood pressure ≥ 160 and/or 95 mmHg, a family history of diabetes, and pharmacological treatment for hypertension or hyperlipidaemia.
Results: Altogether 6805 women (63.2%) participated: 3535 with positive and 3270 with negative screening. Multiple logistic regression analyses showed that comprehensive (OR 1.62, 95% CI 1.41–1.87) and upper secondary (1.40, 1.24–1.57) school, low physical quality of life (1.41, 1.23–1.61) and high sum of subjective physical symptoms (1.06, 1.04–1.08) were positively associated with one or more features of the metabolic syndrome, while high leisure-time exercise and healthy diet (0.84, 0.71–0.99), and low (≤ 83 g/week) (0.71, 0.63–0.81) and moderate (84–167 g/week) (0.78, 0.65–0.93) alcohol consumption were negatively associated.
Conclusions: To identify middle-aged women with cardiovascular risk factors and high risk for diabetes, it is important to consider not only biological, but also socio-demographic and psychosocial conditions.

Keywords: metabolic syndrome, middle-aged women, population screening, socio-demographic factors, psychosocial factors
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Introduction

The number of people suffering from diabetes is rapidly increasing, calling for actions from the health care system and society [1]. If the primary preventive work is to be successful, it is essential to analyse the total risk profile in the general population, meaning that we also must consider socio-demographic and psychosocial aspects, and not only biological factors. Obesity, hypertension, hyperlipidaemia and hyperglycaemia have convincingly been shown to increase the risk of

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development of diabetes and cardiovascular disease. A combination of these factors increases the risk and has been named the metabolic syndrome, as defined by WHO [2]. Finding features of the metabolic syndrome at an early stage gives the opportunity to act in a timely manner to prevent or postpone diabetes by changes in life style [3,4]. However, identifying factors other than biological factors linked to the metabolic syndrome is also of importance, but these aspects have been the topic in few reports only, especially concerning women.

The metabolic syndrome has been reported to be associated with low education [5], social inequality [6], social isolation [7] and psychosocial stress [8]. Dietary patterns [9], physical activity [10] and alcohol habits [10–12] have also been linked to the metabolic syndrome. Cigarette smokers of both sexes have an increased risk of developing type 2 diabetes [13–15]. Most studies, however, have been limited by numbers of study subjects or in their approach and variety of factors included. To our knowledge, no study has strived to perform a total analysis considering most aspects of daily life in a geographically defined population. Therefore, the main objective of the present study was to perform a comprehensive analysis of the socio-demographic, psychosocial and biological factors, and their possible association with features of the metabolic syndrome in a geographically well-defined population of middle-aged women.

Patients and Methods

Subjects

The Women's Health in the Lund Area Study (WHILA) invited all women (n = 10766; 96% being Caucasian) living in the Lund area of Southern Sweden by 1 December 1995, and who were born between 2 December 1935 and 1 December 1945, to a screening procedure taking place from 2 December 1995 until 3 February 2000. The screening programme included physical and laboratory examinations, and a questionnaire concerning physical activity, dietary habits, medical history, pharmacological treatment, family history (parents or siblings) of diabetes and hypertension, menopausal status, smoking and alcohol habits, education, household and working status, physical, social and mental well-being (Quality of life), and subjective physical and mental symptoms.

The women were identified through a population register comprising all inhabitants. Informed consent was obtained from all participants, and the ethics committee at Lund University approved the study.

Features of the Metabolic Syndrome

The physical examination included measurements of body weight, height, minimal waist and maximal hip circumference (WHR). Body mass index (BMI) was calculated as kg/m^2. Blood pressure was measured twice in the right arm after 15 min rest in the seated position using a mercury sphygmomanometer with the cuff size adjusted to the circumference of the arm. Korotkoff phase V was taken as the diastolic blood pressure. The average of two recordings, measured to the nearest 2 mmHg, was the blood pressure used for statistical calculations. Random blood glucose and non-fasting serum levels of triglycerides were measured with a Cholestech LDX instrument (Cholestech Corporation, Hayward, CA, USA) on capillary whole blood. The reason for using non-fasting samples was to be able to perform the screening at any time of the day.

The cut-off values for positive screening were: capillary blood glucose ≥ 8.0 mmol/l, serum triglycerides ≥ 2.3 mmo/l, BMI $\geq 30\,kg/m^2$, WHR ≥ 0.90, and blood pressure ≥ 160 and/or 95 mmHg. Furthermore, pharmacological treatment for hypertension or hyperlipidaemia, or a family history of diabetes were included as screening variables. Subjects in the positive screening group fulfilled one or more of these eight criteria.

Bone Density

Wrist bone mineral density was measured by means of dual energy X-ray absorptiometry (Osteometer DTX 200; Medi-Tech A/S, Rodovre, Denmark) and expressed as standard deviations from young healthy women (T-score). A phantom was used for the daily calibration of the instrument. The WHO standard was used to define patients with osteopenia and osteoporosis [16].

Perimenopausal Status

Based on perimenopausal status, the population was divided in three groups; premenopausal (PM), postmenopausal with hormone replacement therapy (PMT) and postmenopausal without hormone replacement therapy (PM0). Menopause was defined as a bleed-free interval of at least 12 months.

Lifestyle Factors

Self-reported leisure-time exercise was assessed into five levels. The subjects summarized the duration, frequency and intensity of the activity performed per week during the last year, e.g. walking, jogging, running,

swimming, playing tennis, dancing, indoor workout, skiing, outdoor work, but also household work and gardening. The first level (n = 76, 1.1%) corresponded to having hardly any activity, the second (n = 315, 4.6%) to < 30 min/week of jogging and equivalent activities, the third (n = 3532, 51.9%) included 30–60 min/week, the fourth (n = 2605, 38.3%) > 60–120 min/week and the fifth level (n = 277, 4.1%) > 120 min/week of corresponding activities. The subjects were lastly divided into two groups whether they performed ≤ 60 min/week or > 60 min/week of leisure-time activities.

Dietary habits were based on four questions with three sub-levels from unhealthy to healthy pattern, regarding fat, fibres, fruits/vegetables and sweets/carbohydrates. Women with a healthy intake of fat had low total consumption of fat, especially animal fat, but relatively more vegetable oil, low-fat milk and meat, often fish, seldom sausages, bakeries and whipped cream. Healthy intake of fibres included high total consumption, often bread and cereal with a high percentage of fibres, potatoes and fruits. Healthy intake of fruits/vegetables meant high total daily consumption of both fruits and vegetables. Healthy pattern regarding sweets meant hardly ever using extra sugar, eating sweets, cookies and other bakeries. All subjects answered the four basic questions on diet and 40% of these were randomly selected to answer a validated detailed food questionnaire [17] that ensured that the basic questions discriminated between unhealthy and healthy diet. Women defined to have healthy dietary habits (n = 1596, 23.5%) were those indicating a healthy pattern on at least three out of the four basic questions and with none of the four questions indicating an unhealthy pattern.

Finally, the group of women defined to have the healthiest life style (n = 775, 11.4%) were those who both performed > 60 min/week of intense leisure-time exercise and had healthy dietary habits.

Subjects unable to exercise as a result of illness or injury were identified.

Alcohol and Smoking Habits, Socio-demographic Factors and Subjective Health

Alcohol intake was defined as the weekly consumption of wine, beer and spirits converted into grams of alcohol. Twelve grams of alcohol equalized one drink. From the figures on total weekly grams of alcohol consumption, the women were divided in four categories: no consumption ≤ 83 grams/week, 84–167 grams/week, and ≥ 168 grams/week [18].

Smoking was categorized by the lifetime consumption of pack years. One pack year correspond to a consumption of 20 cigarettes per day for 1 year. The subjects were divided in three categories: never smokers (< 1 pack/year), past smokers and current smokers (≥ 1 pack/year for both). Past smokers were those who had stopped smoking ≥ 1 month prior to the study.

Household included women living single or with a partner.

Education was categorized into three levels: comprehensive school (in total 7 years), upper secondary school (in total 9 years) and university degree, according to the highest level of education stated by the respondent.

Working status referred to the subjects relation to the labour market: full time, part time, and a third group of subjects being unemployed, long-term sick listed or with a disability pension.

Physical activity at work during the last year was categorized into low, moderate and high physical intensity at work. Low referred to sedentary (white collar) work, moderate to mostly walking but not lifting heavily and high to work with a high degree of walking and lifting. Those without work during the last year were asked to categorize their work at home.

The Gothenburg Quality of Life instrument (GQL) was used to measure subjective health [19]. This instrument refers to the WHO definition of health, and divides the subjects perception of symptoms into social, physical and mental well-being. Altogether 19 topics on quality of life were estimated on a seven-step score from 'very bad' (1) to 'excellent, could not be better' (7). Also, 19 physical and 10 mental symptoms were listed to be answered with a yes or no, whether the woman had been troubled by any of the symptoms during the last 3 months or not. The different variables have been presented thoroughly elsewhere [20].

Statistics

Calculations were performed using SPSS 10.1. Values are given as median (range). The chi-square test was used to analyse differences in proportions regarding categorical variables. Differences between groups regarding continuous variables were analysed using the Kruskal–Wallis test and Mann–Whitney *U*-test, applying a Bonferroni correction for multiple comparisons. Socio-demographic and psychosocial variables that in bivariate analyses were associated with being positive screened for features of the metabolic syndrome on a < 0.1 significance level were entered into a multiple logistic regression model. A forward conditional procedure was performed, controlling for age, bone density, perimenopausal status, family history of hypertension (significant biological factors besides those included in

the screening criteria) and inability to exercise. P-values < 0.05 were considered statistically significant.

Results

Altogether 6805 (63.2%) women aged 56.1 years (50.1–64.1 years) fulfilled the screening procedure, 3535 with a positive and 3270 with a negative screening. Women in the positive screening group were older ($p < 0.001$) and bivariate analyses showed BMI, WHR, SBP and/or DBP, serum triglycerides, and blood glucose to be higher according to the inclusion criteria ($p < 0.001$ for all) (table 1). In this group, 19.2% had a family history of diabetes, 27.9% pharmacological treatment for hypertension and 3.4% for hyperlipidaemia. The positive screened women had higher bone density expressed as t-score ($p < 0.001$), fewer had osteoporosis ($p < 0.001$), more were postmenopausal without hormone replacement therapy (PM0) ($p < 0.001$) and more had a family history of hypertension ($p < 0.001$) (table 1).

Leisure-time physical activities and dietary habits differed, with more women having a healthy lifestyle in the group with negative screening outcome ($p < 0.001$) (table 2). In the positive screening group, there were more women unable to exercise ($p < 0.001$) and more non-drinkers, while in the negative screened group more were low consumers of alcohol ($p < 0.001$). No difference was seen in smoking habits and concerning household status. Among women with a positive screening, the educational level was lower ($p < 0.001$), fewer worked full time, more were unemployed or sick listed ($p < 0.001$) and more women had a work dominated by high physical activity, but fewer with moderate intensity ($p < 0.001$). Women with positive screening had lower physical quality of life and a higher sum of subjective physical symptoms ($p < 0.001$ for both) (table 2).

Multiple Logistic Regression Analysis

In the model for multiple regression analysis, all socio-demographic and psychosocial factors from the bivariate analyses were entered, controlling for age, bone density, perimenopausal status, family history of hypertension and inability to exercise (table 3).

There was a positive association between comprehensive (OR 1.62, 95% CI 1.41–1.87) and upper secondary (1.40, 1.24–1.57) school, low physical quality of life (1.41; 1.23–1.61) and high sum of subjective physical symptoms (1.06; 1.04–1.08) and one or more of the eight features of the metabolic syndrome, while high leisure-time exercise and healthy diet (0.84, 0.71–0.99) and low (≤ 83 g/week) (0.71, 0.63–0.81) and moderate (84–167 g/week) (0.78, 0.65–0.93) alcohol consumption were negatively associated.

Table 1 Biological characteristics in middle-aged women with positive and negative screening for one or more features of the metabolic syndrome

	All subjects (n = 6805)	Positive screening (n = 3535)	Negative screening (n = 3270)	p-value
Age (year)	56.1 (50.1–64.1)	56.5 (50.1–64.1)	55.7 (50.1–63.9)	< 0.001
Body weight (kg)	67.5 (28.8–141.0)	71.0 (28.8–141.0)	64.9 (34.0–96.5)	< 0.001
BMI (kg/m^2)	24.8 (12.0–52.4)	26.3 (12.0–52.4)	23.7 (12.8–29.9)	< 0.001
WHR	0.78 (0.53–1.11)	0.80 (0.53–1.11)	0.75 (0.53–0.89)	< 0.001
SBP (mmHg)	130 (80–230)	135 (87–230)	125 (80–159)	< 0.001
DBP (mmHg)	85 (30–143)	90 (50–143)	80 (30–94))	< 0.001
S-triglycerides (mmol/l)	1.47 (0.51–7.34)	1.83 (0.51–7.34)	1.24 (0.51–2.29)	< 0.001
B-glucose (mmol/l)	5.87 (2.78–23.40)	6.04 (2.78–23.40)	5.73 (2.78–7.99)	< 0.001
Bone density (t-score)	−0.9 (−6.2 ± 3.9)	−0.8 (− 4.5 ± 3.5)	−1.1 (−6.2 ± 3.9)	< 0.001
Bone density (%)				< 0.001
Normal	50.8	55.3	46.0	
Osteopenia	42.6	39.0	46.5	
Osteoporosis	6.6	5.8	7.5	
Perimenopausal status (%)				< 0.001
PM	7.2	5.6	8.7	
PMT	41.0	39.0	42.7	
PM0	51.8	55.4	48.6	
Family history of hypertension (%)	29.4	35.5	22.7	< 0.001

Values are presented as median (range) and percentage. Serum triglycerides and blood glucose were taken in the non-fasting state. PM, premenopausal; PMT, postmenopausal with hormone replacement therapy; PM0, postmenopausal without hormone replacement therapy.

Table 2 Socio-demographic factors and psychosocial conditions in middle-aged women with positive and negative screening for one or more features of the metabolic syndrome

	All subjects (n = 6805)	Positive screening (n = 3535)	Negative screening (n = 3270)	p-value
High leisure-time physical activity and healthy dietary habits (%)	11.4	9.9	12.7	< 0.001
Inability to exercise (%)	3.7	5.1	2.2	< 0.001
Alcohol consumption (%)				< 0.001
None	26.0	30.7	21.0	
Low (≤ 83 g/week)	57.4	53.9	61.1	
Moderate (84–167 g/week)	12.5	11.4	13.6	
High (≥ 168 g/week)	4.2	4.0	4.3	
Smoking habits (%)				0.309
Never	64.6	64.2	65.0	
Past	18.8	18.6	19.1	
Current	16.6	17.2	15.9	
Household (%)				0.902
Partner	78.0	78.0	77.9	
Single	22.0	22.0	22.1	
Education (%)				< 0.001
Comprehensive school	24.6	28.4	20.5	
Upper secondary school	40.6	42.0	39.2	
University	34.8	29.6	40.3	
Working status (%)				< 0.001
Full time	55.0	51.1	59.2	
Part time	30.3	31.2	29.3	
Unemployed, sick listed	14.7	17.7	11.5	
Physical activity at work (%)				< 0.001
Low	35.7	35.4	36.2	
Moderate	38.4	36.3	40.6	
High	25.8	28.3	23.3	
Quality of life				
Social well-being	5.9 (1–7)	5.9 (1–7)	5.8 (1.3–7)	0.963
Physical well-being	5.4 (1–7)	5.2 (1–7)	5.4 (1–7)	< 0.001
Mental well-being	5.4 (1–7)	5.4 (1–7)	5.4 (1–7)	0.123
Subjective symptoms				
Physical	4.0 (0–18)	4.0 (0–18)	4.0 (0–16)	< 0.001
Mental	4.0 (0–10)	4.0 (0–10)	4.0 (0–10)	0.267

Values are presented as median (range) and percentage.

If the group with positive screening was defined as having at least two features of the metabolic syndrome, the results in the multiple logistical regression analysis gave similar odds ratios for the different significant socio-demographic and psychosocial factors. The same results were achieved with an alternative criterion, obligating the simultaneous presence of positive screening for blood glucose, WHR and BMI (data not shown).

Discussion

The metabolic syndrome is closely related to diabetes, and this study contributes with new understandings by exploring several important associative socio-demographic and psychosocial factors among middle-aged women.

Weight gain is an increasing problem globally and continues although probably most people are aware of the health-related risks. Moreover, weight reduction and increased physical exercise have, at least in interventional studies, been confirmed to lower the diabetes incidence in subjects with impaired glucose tolerance [3,4]. In spite of this quite overwhelming knowledge, one must ask why people do not behave accordingly. One reason might be that the information and guidance is usually not adapted to the individuals' circumstances.

Table 3 Multiple logistic regression analyses showing associated factors in the group ($n = 3535$) with one or more of total of eight features of the metabolic syndrome, controlled for age, bone density, perimenopausal status, family history of hypertension and inability to exercise

Variable	OR (95% CI)	p-value
High leisure-time physical activity and healthy dietary habits	0.84 (0.71–0.99)	0.035
Alcohol consumption		
None	1.0	
Low	0.71 (0.63–0.81)	< 0.001
Moderate	0.78 (0.65–0.93)	0.006
High	NS	
Education		
Comprehensive school	1.62 (1.41–1.87)	< 0.001
Upper secondary school	1.40 (1.24–1.57)	< 0.001
University	1.0	
Working status		
Full time	1.0	
Part time	1.04 (0.92–1.17)	0.541
Unemployed, sick listed	1.23 (0.97–1.23)	0.089
Physical activity at work		
Low	1.0	
Moderate	0.91 (0.81–1.04)	0.163
High	1.06 (0.91–1.23)	0.444
Low physical well-being	1.41 (1.23–1.61)	< 0.001
Subjective physical symptoms	1.06 (1.04–1.08)	< 0.001

Therefore, may be only those already with qualifications near to ideal are able to further change their life style, leaving the vast majority of the population unaffected.

In this study, we found a lower risk of having features of the metabolic syndrome among women with a healthy life style, i.e. high intensity of leisure-time exercise and healthy dietary habits, which is in line with other studies [10,21]. Low consumption of alcohol has been reported to reduce cardiovascular risk factors [22–24], which is supported by this study in which subjects with an intake of ≤ 167 grams of alcohol per week had a lower risk of having components of the metabolic syndrome. Smoking, however, showed a non-significant pattern and seemed to contradict previous results, showing an increased risk of diabetes among cigarette smokers [13,14].

Low education was a risk indicator for features of the metabolic syndrome in this study and confirms the results previously presented by Wamala *et al.* [5] in 300 women aged 30–65 years living in Stockholm, Sweden, but that performed analysis was not able to present significance in multiple comparisons. Low education per se will not cause diabetes, but may influence the attitude towards life style changes and possibly contributes to obesity, which may explain low physical quality of life and the high sum of subjective physical symptoms. There is obviously no direct link between physical and mental problems in these cases. It can only be speculated upon that mental symptoms were not affected in women with as yet no distinct signs of diabetes. Other studies have suggested that repeated activation of central nervous stress centres, through hypothalamic activation and elevated cortisol, may be involved in the pathogenesis of abdominal obesity and metabolic abnormalities [25,26]. To better validate the results on physical, social and mental aspects in the present population, longitudinal studies will follow.

Neither working status nor physical activity at work was associated with features of the metabolic syndrome in the multiple regression analysis. One could have expected that women being unemployed, sick listed or with disability pension would, on account of physical inactivity or concurrent diseases, have an increased risk. The same with working status, knowing that women with high physical intensity at work had lower degree of educational level (data not shown). In the latter case, the results indicate that the level of education is a more important discriminating factor than the physical intensity at work.

Taken together, the implication of the results brings new questions. Can some of the associations with the metabolic syndrome be explained by personality traits? Is it that certain characteristics of personality, or a lack of talent, results in lower education and a person who will be more vulnerable to develop diabetes and other related diseases? If that is a contributory factor, the focus on health prevention must change somewhat.

There are some important limitations of the study. First, this is a cross-sectional study, only providing information about associations but not causality between some of the variables presented. Furthermore, we did not use the strict definition of the metabolic syndrome by the WHO [2], but a screening procedure previously shown to be effective in disclosing diabetes [27]. Finally, the life-style variables must be considered sufficient to explore women with healthy behaviours, although based on somewhat limited figures on dietary intake or physical achievement.

In summary, this study showed an increased risk of features of the metabolic syndrome among middle-aged women with low education, low physical quality of life and a high sum of physical symptoms, while healthy life style, and low and moderate alcohol consumption were associated with a lower risk. The results indicate that the primary prevention should not only consider biological risk factors, but must also take socio-demographic and psychosocial conditions into consideration in order to identify persons at high risk for diabetes and cardiovascular disease.

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References

1 Zimmet P, Alberti KGMM, Shaw J. Global and societal implications of the diabetic epidemic. Nature 2001; **414:** 782–787.
2 Alberti KGMM, Zimmet PZ, for the WHO Consultation. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus: provisional report of a WHO consultation. Diabet Med 1998; **15:** 539–553.
3 Tuomilehto J, Lindström J, Eriksson JG *et al.* Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. N Engl J Med 2001; **344:** 1343–1350.
4 The Diabetes Prevention Programme Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med 2002; **346:** 393–403.
5 Wamala SP, Lynch J, Horsten M, Mittleman MA, Schenck-Gustafsson K, Orth-Gomér K. Education and the metabolic syndrome in women. Diabetes Care 1999; **22:** 1999–2003.
6 Brunner EJ, Marmot MG, Nanchahal K *et al.* Social inequality in coronary risk: central obesity and the metabolic syndrome. Evidence from the Whitehall II study. Diabetologia 1997; **40:** 1341–1349.
7 Horsten M, Mittleman MA, Wamala SP, Schenck-Gustafsson K, Orth-Gomér K. Social relations and the metabolic syndrome in middle-aged Swedish women. J Cardiovasc Risk 1999; **6:** 391–397.
8 Raikkonen K, Keltikangas-Jarvinen L, Adlercreutz H, Hautanen A. Psychosocial stress and the insulin resistance syndrome. Metabolism 1996; **45:** 1533–1538.
9 Williams DE, Prevost AT, Whichelow MJ, Cox BD, Day NE, Wareh NJ. A cross-sectional study of dietary patterns with glucose intolerance and other features of the metabolic syndrome. Br J Nutr 2000; **83:** 257–266.
10 Godslands IF, Leyva F, Walton C, Worthington M, Stevenson JC. Associations of smoking, alcohol and physical activity with risk factors for coronary heart disease and diabetes in the first follow-up cohort of the Heart Disease and Diabetes Risk Indicators Screened Cohort study (HDDRISC-1). J Intern Med 1998; **244:** 33–41.
11 Kiechl S, Willeit J, Poewe W *et al.* Insulin sensitivity and regular alcohol consumption: large, prospective, cross-sectional population study (Bruneck study). BMJ 1996; **313:** 1040–1044.
12 Goude D, Fagerberg B, Hulthe J, for the AIR study group. Alcohol consumption, the metabolic syndrome and insulin resistance in 58-year-old clinically healthy men (AIR study). Clin Sci 2002; **102:** 345–352.
13 Rimm EB, Manson JE, Stampfer MJ *et al.* Cigarette smoking and the risk of diabetes in women. Am J Public Health 1993; **83:** 211–214.
14 Manson JE, Ajani UA, Liu S, Nathan DM, Hennekens CH. A prospective study of cigarette smoking and the incidence of diabetes mellitus among US male physicians. Am J Med 2000; **109:** 538–542.
15 Uchimoto S, Tsumura K, Hayashi T *et al.* Impact of cigarette smoking on the incidence of Type 2 diabetes mellitus in middle-aged Japanese men: the Osaka Health Survey. Diabet Med 1999; **16:** 951–955.
16 WHO. Assessment of fracture risk and its application to screening to postmenopausal osteoporosis. WHO Technical Report Series 843. Geneva, World Health Organisation. 1994.
17 Asp NG, Isaksson Å, Johansson U *et al.* Dietary habits among adults in Olofström: a baseline study. Scand J Nutr 1992; **36:** 106–114.
18 National Institute on Alcohol Abuse and Alcoholism. Health risks and benefits of alcohol consumption. Tenth Special Report US Cong Alcohol Health 2000; **1:** 5–11.
19 Tibblin G, Tibblin B, Peciva S, Kullman S, Svardsudd K. 'The Goteborg quality of life instrument': an assessment of well-being and symptoms among men born 1913 and 1923. Meth Validity Scand J Prim Health Care 1990; **1:** 33–38.
20 Lidfeldt J, Nyberg P, Nerbrand C *et al.* Biolgical factors are more important than socio-demographic and psychosocial conditions in relation to hypertension in middle-aged women. The Women's Health In the Lund Area (WHILA) study. Blood Press 2002; **11:** 270–278.
21 Simonsick EM, Latterty ME, Phillips CL *et al.* Risk due to inactivity in physically capable older adults. Am J Public Health 1993; **83:** 1443–1450.
22 Steinberg D, Pearson TA, Kuller LH. Alcohol and atherosclerosis. Ann Intern Med 1991; **114:** 967–976.
23 Sillanaukee P, Koivula T, Jokela T, Pitkajarvi T, Seppa K. Alcohol consumption and its relation to lipid-based cardiovascular risk factors among middle-aged women: the role of HDL(3) cholesterol. Atherosclerosis 2000; **152:** 503–510.
24 Nanchahal K, Ashton WD, Wood DA. Alcohol consumption, metabolic cardiovascular risk factors and hypertension in women. Int J Epidemiol 2000; **29:** 57–64.
25 Björntorp P. Behaviour and the metabolic disease. Int J Behav Med 1996; **3:** 285–302.
26 Bjorntorp P. Do stress reactions cause abdominal obesity and comorbidities? Obes Rev 2001; **2:** 73–86.
27 Lidfeldt J, Nerbrand C, Samsioe G, Scherstén B, Agardh C-D. A screening procedure detecting high-yield candidates for OGTT. The Women's Health In the Lund Area (WHILA) Study: a population based study of middle-aged Swedish women. Eur J Epidemiol 2001; **17:** 943–951.

