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Effects of retirement on lifestyle in relation to changes in weight and waist circumference in Dutch men: a prospective study

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Abstract

Objective: To study changes in lifestyle in relation to changes in body weight and waist circumference associated with occupational retirement in men.

Design: A prospective cohort study with 5 years of follow-up. At baseline and at follow-up, questionnaires were completed and body weight and waist circumference were measured.

Setting: The Doetinchem Cohort Study, consisting of inhabitants of Doetinchem, a town in a rural area of The Netherlands.

Subjects: In total 288 healthy men aged 50–65 years at baseline, who either remained employed or retired over follow-up.

Results: The effect of retirement on changes in weight and waist circumference was dependent on type of former occupation. Increase in body weight and waist circumference was higher among men who retired from active jobs (0.42 kg year^{-1} and 0.77 cm year^{-1}, respectively) than among men who retired from sedentary jobs (0.08 kg year^{-1} and 0.23 cm year^{-1}, respectively). Weight gain and increase in waist circumference were associated with a decrease in fruit consumption and fibre density of the diet, with an increase in frequency of eating breakfast, and with a decrease in several physical activities, such as household activities, bicycling, walking and doing odd jobs.

Conclusion: Retirement was associated with an increase in weight and waist circumference among those with former active jobs, but not among those with former sedentary jobs. Retirement may bring opportunities for healthy changes in diet and physical activity, which could be used in health promotion programmes.

Keywords
Retirement
Middle age
Men
Body weight
Waist circumference
Diet
Physical activity

Occupational retirement is usually accompanied by substantial changes in lifestyle. If retiring persons do not replace their former work-related physical activity with other physical activities or do not diminish energy intake to a level that matches the new energy requirements, they are likely to gain weight and/or increase waist circumference. Alternatively, people who had sedentary occupations may, after retirement, have an increased opportunity to engage in physical activities.

People beyond the age of 50 years are likely to lose muscle mass[1], partly due to decreased physical activity, which is accompanied by a decrease in basal energy requirement[2]. They also, on average, accumulate more fat mass in the abdominal region[3,4]. Middle-aged people can experience a gain in abdominal fat mass, and thus increased waist circumference[4], without a change in body weight[5].

The prevalence of obesity is highest among subjects aged 50–65 years, then levels off and subsequently declines[6]. In addition, overweight and (particularly abdominal) obesity is associated with higher risks of several chronic diseases, such as type 2 diabetes and cardiovascular diseases[7,8].

Surprisingly little is known about the changes in lifestyle after retirement, and their effect on weight and waist circumference. Some studies have evaluated changes in lifestyle across retirement, but did not link them to changes in weight or waist circumference[9–12]. In another study, changes in body fat and muscle were evaluated in retiring men, but changes in lifestyle were not included[13]. Others[14] have studied the relationship between changes in lifestyle and increase in waist circumference, but did not analyse the impact of retirement.

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In the present study we evaluated the impact of retirement on diet, physical activity, body mass index (BMI) and waist circumference, over a 5-year follow-up period, in a population-based cohort. We hypothesised that a sudden reduction in work-related physical activity of moderate intensity may lead to unfavourable changes in energy balance and thereby lead to an increase in body weight and waist circumference.

Subjects and methods

Participants and study design

The Doetinchem Cohort Study is a prospective study carried out among inhabitants aged 20–59 years of Doetinchem, a town in a rural area of The Netherlands, who visited the municipal health centre between 1987 and 1991 ($n = 12\,404$)[15]. A total of 7768 of these participants were re-invited between 1993 and 1997[16], and 6582 participants were again invited between 1998 and 2002. Not all participants in the first examination were invited for the second examination due to logistic reasons. Participants in the first examination who died or emigrated during follow-up or who actively refused to participate in the second examination were not invited for the third examination. The participation rate was 62% for the first examination. Participation rates for the second and third examination were 79% and 75%, respectively, among subjects who participated in the first examination and were invited for the second and third examination respectively.

Demographic characteristics and medical history of chronic diseases were collected using standardised questionnaires at baseline and at follow-up, including items regarding educational level, smoking status and working status. Educational level was assessed as the highest level reached and classified into three categories: low (intermediate secondary education or less), medium (intermediate vocational or higher secondary education) and high (higher vocational education or university). Smoking status was defined as persistent non-smoker (i.e. smoking less than one cigarette per month), persistent smoker, quitter or starter, based on a question about current cigarette smoking at baseline and at follow-up.

From 1994 onwards, identical questionnaires were used, allowing changes in dietary intake and physical activity to be studied in relation to changes in weight and waist circumference. From 632 men aged 50–65 years at the time of the examination between 1994 and 1997 (baseline), who visited the health centre again in 1999–2002 (follow-up), complete data on body weight and waist circumference were available. For the purpose of the present study we excluded men who suffered from cancer ($n = 37$), cardiovascular diseases ($n = 58$), diabetes ($n = 36$) and/or men who had a waist circumference below 79 cm at baseline ($n = 5$). From the remaining men ($n = 516$), we selected 288 men who reported to be employed at baseline and employed or retired at follow-up. These 288 men were divided into two groups of different employment status: 176 who were still working and 112 who had retired during the follow-up period.

Measurement of body weight and waist circumference

Body weight, height and waist circumference were measured at the municipal health centre at baseline and at the end of follow-up, with subjects wearing light indoor clothing with emptied pockets and without shoes. Height was measured to the nearest 0.5 cm, weight to the nearest 0.5 kg. To adjust for light indoor clothing, 1 kg was subtracted from the measured weight. BMI was calculated as weight divided by the square of height ($kg\,m^{-2}$). Waist circumference was measured to the nearest 0.5 cm, at the middle of the lowest rib and the iliac crest, with subjects in standing position and after breathing out gently.

Assessment of food intake

Food intake was assessed using the Dutch version of the EPIC (European Prospective Investigation into Cancer and Nutrition) Food Frequency Questionnaire, a validated semi-quantitative food-frequency questionnaire. In short, the questionnaire addressed habitual consumption of 178 food items during the previous year[17,18]. Energy intake was quantified by use of the 1996 computerised Dutch food consumption table[19]. For potatoes, pasta, rice, meat and vegetables, portion sizes were assessed by use of photographs. Portion sizes were expressed in numbers of standard amounts: 70 g per serving for potatoes, 45 g for pasta, 55 g for rice, 50 g for meat and 60 g for vegetables. Also, consumption frequencies of these foods, completed with fish, meat substitutes, fruits, snacks and drinks, were assessed. Further, issues such as eating dinner outside the home and eating breakfast were addressed.

Assessment of physical activity

Data on physical activity were collected by use of a validated questionnaire on physical activity[20], extended with questions on sports and other strenuous leisure-time activities. The questionnaire included questions on hours spent per week on leisure-time activities (walking, bicycling, doing odd jobs/do it yourself and gardening), household activities, sports and physical activities at the place of work, referring to the previous 12 months. The question on sports and other strenuous physical activities enabled the respondents to report on type, duration and number of weeks per year for three different activities. Average duration of leisure-time and household activities per week was calculated as the average of the summer and the winter season data. For sports and other strenuous activities, duration per week was weighted by the number of weeks per year that physical activities were performed. The number of stairs walked on a usual day was recorded also. Except for stair walking, all activities were converted

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into Ainsworth scores[21] expressed in metabolic equivalent (MET) values. Leisure-time physical activities included walking (3.5 MET), bicycling (5 MET), doing odd jobs (3 MET) and gardening (5 MET). Average intensity of leisure-time activities, including sports, was calculated by weighting intensities of the individual activities by their duration. For the purpose of the present study, occupational activity was dichotomised into sedentary ('sedentary occupation') or active ('standing occupation', 'manual work' or 'heavy manual work') jobs.

Statistical analyses

Demographic and anthropometric factors, and mean changes in weight, waist circumference, diet and physical activity between baseline and follow-up were compared between the groups of men with sedentary jobs and active jobs who remained working and those who retired during follow-up, based on analyses of covariance (PROC GLM in SAS version 8.2; SAS Institute, Cary, NC, USA), adjusting for age.

Associations between changes in behaviour and changes in weight and waist circumference were studied by use of linear regression analyses (PROC REG), adjusting for retirement (yes/no), type of occupational activity (sedentary or active), interaction between retirement and type of occupational activity, age, smoking and the base level (the average of baseline and follow-up) of the behavioural component.

Associations between retirement and changes in weight and waist circumference were studied, adjusting for age, and the changes in behaviour that were associated with changes in weight or waist circumference at $P < 0.10$, by analyses of covariance (PROC GLM).

Since the change in working hours was highly correlated with retirement ($r = 0.73$), change in working hours was not added to the models.

Results

Working men were on average younger than those who retired (Table 1). A total of 10.4% of the men were obese, and 33.7% had abdominal obesity at baseline.

Time spent on work decreased, by definition, significantly more among the men who retired than among the men who remained working (Table 2). Men who retired increased the time spent on household activities and on doing odd jobs, they increased the portion size of rice and the frequency of vegetable consumption, and they decreased the frequency of potato consumption in comparison to the men who remained working (Table 2). Men who retired from sedentary jobs also increased their alcohol consumption and decreased their energy intake

Table 1 Demographic and anthropometric characteristics* of the study population, at baseline and during follow-up, stratified for (change) in job status

	Working sedentary ($n = 90$)	Retired sedentary ($n = 66$)	Working active ($n = 86$)	Retired active ($n = 46$)
Baseline				
Age (years), mean (SD)	53.3[a] (2.6)	57.5[a] (2.7)	53.1[b] (2.2)	57.4[b] (2.3)
Weight (kg)	84.3	82.1	83.7	82.8
Height (cm)	178.5	177.9	177.5	176.8
BMI ($kg\,m^{-2}$)	26.4	26.0	26.6	26.5
WC (cm)	98.5	96.5	98.3	97.5
Normal weight ($BMI = 18.5–24.9\,kg\,m^{-2}$) (%)	33.0[a]	42.2	21.6[a]	28.1
Moderate overweight ($BMI = 25–29.9\,kg\,m^{-2}$) (%)	54.9[a]	48.9	69.2[a]	60.5
Obese ($BMI \geq 30\,kg\,m^{-2}$) (%)	12.1	8.9	9.3	11.4
WC = 79–93.9 cm (%)	28.3	41.5	29.3	30.4
WC = 94–101.9 cm (%)	37.4	30.5	33.4	35.7
WC ≥ 102 cm (%)	34.3	28.0	37.3	33.9
Low education level (%)	24.9[a,b]	41.2[a]	54.9[b]	54.8
Medium education level (%)	31.1[a]	13.2[a,b]	26.9	28.6[b]
High education level (%)	44.0	45.6[a]	18.3	16.7[a]
Follow-up				
Duration of follow-up (years), mean (SD)	5.0 (0.2)	5.0 (0.2)	5.0 (0.1)	5.0 (0.2)
Persistent non-smoker (%)	74.7	81.4	70.0	82.2
Persistent smoker (%)	20.0[a]	7.3[a]	23.3	11.3
Quitter (%)	2.4	9.2	5.9	5.9
Starter (%)	3.0	2.1	0.8	0.6

SD – standard deviation; BMI – body mass index; WC – waist circumference.
* Except for age and duration of follow-up period, all variables are adjusted for age.
Means or percentages with the same superscript letter within the same row are statistically different from each other at $P < 0.10$.
(Only relevant differences were tested: within workers, within retired men, within active jobs, and within sedentary jobs.)

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Table 2 Changes in anthropometric characteristics, physical activity and diet* over the 5-year follow-up period in working and retired men with sedentary and active jobs

	Sedentary job				Active job			
	Working ($n = 90$)		Retired ($n = 66$)		Working ($n = 86$)		Retired ($n = 46$)	
	Mean change	95% CI	Mean change	95% CI	Mean change	95% CI	Mean change	95% CI
Anthropometric characteristics								
Body weight (kg year^{-1})	0.24	0.06, 0.41	0.08[a]	−0.13, 0.30	0.37	0.19, 0.55	0.42[a]	0.17, 0.67
WC (cm year^{-1})	0.31	0.09, 0.53	0.23[a]	−0.04, 0.50	0.54	0.31, 0.77	0.77[a]	0.46, 1.08
Physical activity								
Mean duration (hours per week)								
Work	−5.87[a]	−8.98, −2.76	−32.66[a]	−36.51, −28.82	−4.24[b]	−7.45, −1.02	−31.10[b]	−35.54, −26.65
Household	0.67[a]	−0.20, 1.54	2.16[a]	1.09, 3.24	0.23	−0.67, 1.13	1.50	0.26, 2.74
Sports	0.55	−0.22, 1.32	0.68	−0.28, 1.63	−0.02	−0.82, 0.78	0.15	−0.96, 1.25
Bicycling	0.37	−0.58, 1.32	0.86	−0.31, 2.04	−0.14	−1.12, 0.85	1.24	−0.12, 2.60
Walking	1.08	−1.33, 3.49	−0.62	−3.60, 2.36	−4.18	−6.67, −1.68	−5.14	−8.58, −1.70
Gardening	0.28	−0.44, 1.01	0.32	−0.58, 1.21	−0.19	−0.94, 0.56	0.47	−0.56, 1.51
Doing odd jobs	0.07	−0.92, 1.07	1.45	0.21, 2.68	−0.90[a]	−1.94, 0.13	3.01[a]	1.58, 4.43
Climbing stairs (no. per day)	−0.47	−2.54, 1.60	−3.09	−5.63, −0.55	−0.17	−2.31, 1.97	−2.13	−5.10, 0.85
Intensity (MET values)								
Leisure-time physical activity	0.04	−0.07, 0.15	0.00	−0.13, 0.13	0.08	−0.03, 0.19	0.09	−0.07, 0.24
Diet								
Portion size warm meal (no. of servings)								
Potatoes	−0.12	−0.28, 0.04	−0.04	−0.15, 0.24	−0.13	−0.29, 0.03	−0.24	−0.46, −0.02
Pasta	−0.54	−1.02, −0.06	−0.37	−0.97, 0.22	−0.20	−0.70, 0.29	−0.75	−1.44, −0.07
Rice	−0.39[a]	−0.67, −0.11	0.12[a]	−0.22, 0.47	−0.51[b]	−0.81, −0.22	0.04[b]	−0.39, 0.48
Meat	−0.02	−0.14, 0.09	−0.01	−0.15, 0.13	0.01	−0.11, 0.12	−0.14	−0.30, 0.02
Vegetables	−0.05	−0.14, 0.05	0.04	−0.08, 0.16	0.05	−0.05, 0.15	−0.01	−0.15, 0.13
Frequencies (times per week)								
Potatoes	−0.08[a]	−0.76, 0.60	−1.13[a]	−1.98, −0.29	−0.03[b]	−0.74, 0.68	−1.41[b]	−2.39, −0.43
Pasta	−0.02	−0.13, 0.08	0.05	−0.08, 0.18	0.01	−0.10, 0.12	0.02	−0.13, 0.17
Rice	−0.09	−0.21, 0.03	0.06	−0.09, 0.21	−0.07	−0.19, 0.06	−0.07	−0.24, 0.11
Meat	−0.20	−0.53, 0.13	−0.46	−0.87, −0.05	−0.16	−0.50, 0.18	−0.25	−0.72, 0.23
Fish	0.34	0.19, 0.50	0.18	−0.01, 0.37	0.19	0.03, 0.35	0.23	0.01, 0.45
Meat substitutes	0.02	−0.12, 0.16	0.06	−0.11, 0.23	−0.01	−0.16, 0.14	−0.01	−0.21, 0.19
Vegetables	−0.73[a]	−1.41, −0.05	0.58[a]	−0.26, 1.41	−0.13	−0.83, 0.57	0.01	−0.95, 0.98
Fruit	0.32	−1.20, 1.84	0.09	−1.81, 1.99	0.23	−1.35, 1.80	−2.16	−4.33, 0.02
Breakfast	−0.16	−0.47, 0.15	0.02	−0.36, 0.41	0.25	−0.07, 0.57	0.44	−0.00, 0.89
Eating out for dinner	0.14	0.02, 0.27	0.10	−0.06, 0.25	0.05	−0.08, 0.18	−0.02	−0.20, 0.16
Snacks (100 g per day)								
Sweet snacks	−0.04	−0.10, 0.02	0.03	−0.04, 0.10	0.01	−0.05, 0.07	−0.02	−0.10, 0.07
Savoury snacks	−0.08	−0.14, −0.02	−0.02	−0.10, 0.05	−0.04	−0.11, 0.02	−0.08	−0.17, 0.01
Drinks (glasses per day)								
Dairy drinks	−0.11	−0.40, 0.18	−0.40	−0.76, −0.04	0.06	−0.24, 0.36	−0.01	−0.43, 0.40
Sugared soft drinks	−0.08	−0.24, 0.08	0.02	−0.18, 0.22	0.07	−0.09, 0.23	0.09	−0.14, 0.32
Juice	0.02	−0.10, 0.14	0.09	−0.05, 0.23	0.07	−0.05, 0.19	0.23	0.06, 0.39
Alcoholic beverages	−0.11[a]	−0.36, 0.14	0.27[a]	−0.04, 0.57	−0.15	−0.40, 0.11	−0.04	−0.39, 0.32
Energy intake (MJ day^{-1})	−0.80	−1.22, −0.37	−0.50	−1.02, 0.02	−0.35[a]	−0.78, 0.09	−1.13[a]	−1.73, −0.52
Protein (% of energy)	0.19[a]	−0.21, 0.59	−0.60[a]	−1.09, −0.10	0.46	0.05, 0.87	0.29	−0.28, 0.85
Carbohydrate (% of energy)	−0.31	−1.26, 0.63	0.69	−0.49, 1.86	0.11	−0.87, 1.09	−0.85	−2.21, 0.50

Table 2. *Continued*

	Sedentary job				Active job			
	Working ($n=90$)		Retired ($n=66$)		Working ($n=86$)		Retired ($n=46$)	
	Mean change	95% CI	Mean change	95% CI	Mean change	95% CI	Mean change	95% CI
Fat (% of energy)	0.10	−0.83, 1.02	−1.09	−2.24, 0.05	−0.32	−1.28, 0.64	0.19	−1.13, 1.51
Alcohol (% of energy)	0.03	−0.66, 0.71	1.00	0.15, 1.85	−0.25	−0.96, 0.46	0.37	−0.60, 1.35
Fibre density ($g\,MJ^{-1}$)	0.05	−0.06, 0.16	0.02	−0.12, 0.15	0.06[a]	−0.05, 0.18	−0.18[a]	−0.34, −0.02

CI – confidence interval; WC, waist circumference; MET – metabolic equivalent.
*Adjusted for age.
Means with the same superscript letter within the same row are statistically different from each other at $P < 0.10$.
(For changes in behaviour, only relevant differences are shown: between men with (former) sedentary jobs, and between men with (former) active jobs.)

from protein, while men who retired from active jobs decreased their total energy intake and fibre density of the diet compared with their peers who remained working (Table 2).

Men who retired from sedentary jobs tended to gain less weight and to increase less in waist circumference in comparison to their peers remaining at work. Men who retired from active jobs tended to gain more weight and to increase more in waist circumference compared with the men who maintained working in active jobs (Table 2). Men who retired from active jobs gained significantly more weight and increased more in waist circumference than the men who retired from sedentary jobs (Table 2). Working men with an active job gained more weight and increased more in waist circumference in comparison with working men with a sedentary job, but these differences were not statistically significant.

Weight gain was statistically significantly associated with a decrease in fruit consumption, an increase in frequency of eating breakfast, an increase in consumption of sugar-sweetened soft drinks, a decrease in fibre density of the diet, and with a decrease in time spent bicycling (Table 3). Independent of other changes in behaviour, a decrease in fruit consumption remained associated with

Table 3 Changes in behaviour over follow-up in relation to change in body weight

	Total group of men ($n=288$)			
	Univariate models		Multivariate model	
	β*	P	β†	P
Control variables				
Age (years)			−0.00	0.82
Retirement (vs. working)			0.08	0.64
Type of job (sedentary vs. active)			−0.02	0.88
Interaction retirement × sedentary job			−0.25	0.17
Smoker (vs. non-smoker)			0.11	0.39
Ex-smoker (vs. non-smoker)			1.00	<0.01
Starter (vs. non-smoker)			−0.19	0.58
Physical activity				
Mean duration (hours per week)				
Bicycling	−0.03	<0.01	−0.02	0.13
Doing odd jobs	−0.02	0.06	−0.01	0.21
Diet				
Frequencies (times per week)				
Potatoes	0.04	0.05	0.02	0.17
Fruit	−0.02	<0.01	−0.02	0.03
Breakfast	0.07	0.03	0.04	0.21
Sugared soft drinks (glasses per day)	0.20	<0.01	0.12	0.05
Fibre density ($g\,MJ^{-1}$)	−0.31	<0.01	−0.17	0.10

* β refers to the change in body weight ($kg\,year^{-1}$) per unit change in the behaviour, adjusted for retirement (yes/no), type of job (sedentary or active), interaction between retirement and type of job, age, smoking and the base level of the behaviour.
† β refers to the change in body weight ($kg\,year^{-1}$) per unit change in the behaviour, adjusted for retirement, type of job, interaction between retirement and type of job, age, smoking, the base level of the behaviour, and all other behaviours in the table.
(Only associations with P-value <0.10 in the univariate models are shown.)

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weight gain. The total multivariate model explained 22% of variance in changes in body weight in the study population.

Increase in waist circumference was associated with an increase in frequency of pasta consumption, a decrease in fruit consumption, an increase in frequency of eating breakfast, an increase in the consumption of sugar-sweetened soft drinks, a decrease in fibre density of the diet, and with a decrease in time spent on walking or on doing odd jobs (Table 4). Independent of other changes in behaviour, an increase in frequency of pasta consumption, a decrease in fruit consumption and an increase in frequency of eating breakfast remained associated with increase in waist circumference. The total multivariate model explained 27% of variance in changes in waist circumference among the study population.

When the associations between retirement and changes in weight and waist circumference were adjusted for changes in behaviours that were associated (at $P < 0.10$) with changes in weight or waist circumference, the average gains in body weight and waist circumference for the groups of men who remained working in sedentary or active jobs became equal. The differences in weight gain and in increase in waist circumference between the men who retired from sedentary versus active jobs were maintained (Figs 1 and 2).

Table 4 Changes in behaviour over follow-up in relation to change in waist circumference

	Total group of men ($n = 288$)			
	Univariate models		Multivariate models	
	β*	*P*	β†	*P*
Control variables				
Age (years)			−0.03	0.13
Retirement (vs. working)			0.31	0.13
Type of job (sedentary vs. active)			−0.02	0.91
Interaction retirement × sedentary job			−0.47	0.04
Smoker (vs. non-smoker)			0.16	0.30
Ex-smoker (vs. non-smoker)			1.05	<0.01
Starter (vs. non-smoker)			0.38	0.37
Physical activity				
Mean duration (hours per week)				
Household	−0.02	0.09	−0.03	0.07
Bicycling	−0.02	0.07	−0.01	0.59
Walking	−0.01	0.02	−0.01	0.12
Doing odd jobs	−0.03	0.04	−0.02	0.08
Diet				
Frequencies (times per week)				
Pasta	0.29	0.02	0.26	0.03
Fruit	−0.03	<0.01	−0.03	<0.01
Breakfast	0.13	<0.01	0.10	0.01
Sugared soft drinks (glasses per day)	0.16	0.04	0.06	0.47
Alcoholic beverages (glasses per day)	0.09	0.09	0.09	0.09
Energy intake (MJ day^{-1})	0.05	0.08	X	X
Carbohydrate (% of energy)	−0.02	0.07	X	X
Fibre density (g MJ^{-1})	−0.32	<0.01	−0.08	0.55

* β refers to the change in waist circumference (cm year^{-1}) per unit change in the behaviour, adjusted for retirement (yes/no), type of job (sedentary or active), interaction between retirement and type of job, age, smoking and the base level of the behaviour.
† β refers to the change in waist circumference (cm year^{-1}) per unit change in the behaviour, adjusted for retirement, type of job, interaction between retirement and type of job, age, smoking, the base level of the behaviour, and all other behaviours in the table.
(Only associations with *P*-value <0.10 in the univariate models are shown.)

Discussion

To our knowledge, this is the first study that has analysed the association between retirement and changes in dietary behaviour and physical activities in relation to changes in body weight and waist circumference. Retirement was associated with an increase in weight and waist circumference among those with former active jobs, but not among those with former sedentary jobs. Weight gain and increase in waist circumference were associated with a decrease in fruit consumption and fibre density of the diet, with an increase in eating breakfast and in the consumption of sugar-sweetened soft drinks, and with a decrease in several leisure-time physical activities.

There are several methodological issues that warrant discussion. First, men who retired were on average 4 years older than those who did not. Both changes in behaviour and changes in weight may be related to age (e.g. older

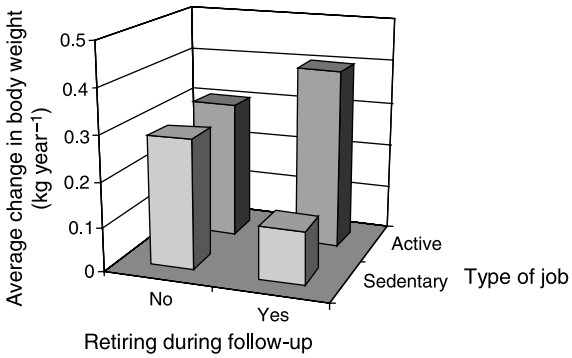

Fig. 1 Changes in body weight among working and retiring men with sedentary or active jobs, adjusted for age, smoking and changes in behaviour as stated in Table 3

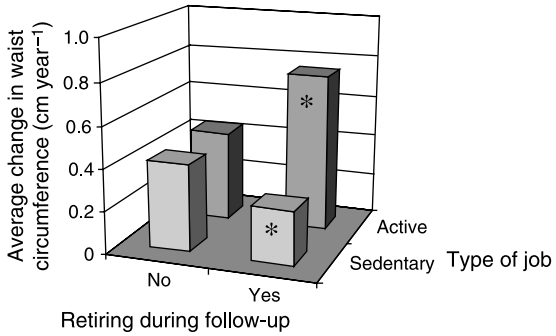

Fig. 2 Changes in waist circumference among working and retiring men with sedentary or active jobs, adjusted for age, smoking and changes in behaviour as stated in Table 4. Bars with * are statistically different from each other at $P < 0.05$

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men gaining less weight than younger men). In The Netherlands, voluntary or mandatory early retirement is relatively common and, in principle, unrelated to health status. People who have to stop working before age 65 due to health status receive disablement insurance benefits and were not included in the present study. Most people retire between the ages 55 and 65 years with a pension or some other kind of early retirement payment. Most of them retire around 60 years of age[22]. Therefore, there was sufficient overlap in the age ranges between the groups of men who remained working and who retired during follow-up, and we were able to study effects of retirement on body weight and waist circumference, independent of age. Second, the use of questionnaires to assess food intake and physical activity is susceptible to misreporting[23–25]. However, by studying changes in behaviour, it could be argued that a possible distorting effect of misreporting on the studied associations was eliminated when the extent of misreporting was similar within participants in both examinations. Third, one may argue that educational level should have been included in the multivariate analyses, since body weight and waist circumference are associated with level of education. However, these associations are mediated by lifestyle. Therefore we chose to present results of the multivariate analyses on changes in lifestyle in relation to changes in body weight or waist circumference, unadjusted for educational level. Conclusions did not change when educational level was included in the analyses. Another point is that we do not know the exact date of retirement, only that men did or did not retire during follow-up. Under the assumption that changes in body weight and waist circumference do not differ between the group of men remaining at work and the last years of employment for the retiring men, the effects of retirement on change in body weight and waist circumference may have been underestimated in this study. Finally, the results in the present study are based on a subpopulation of all men in the study. However, we included all healthy men in the cohort who fulfilled the inclusion criteria to be 50–65 years of age and working at baseline and working or retired at follow-up. We have no reason to believe that the associations between retirement and weight gain are different in the total Dutch population. Since the findings in the present study are to a large extent based on the reduction of work-related physical activity coupled with occupational retirement, we assume that the findings of the present study are also applicable to all men who are about to retire in other countries.

Evenson *et al.* reported that retirement was associated with increases in sport and exercise participation[9]. In a prospective study among men aged 40–75 years, decreased consumption of fibre and a decrease in total physical activity were associated with an increase in waist circumference over a 9-year follow-up[14]. Another study group reported heavy alcohol intake to contribute directly to weight gain in middle-aged men[26]. In a study among middle-aged and old men, increased physical activity was associated with weight loss[27]. These results are largely in line with the findings in the present study. Two studies evaluated the relationship between retirement and weight gain. Morris *et al.* reported that retiring men were more likely to gain over 10% body weight in comparison with men who remained employed[28], while Patrick *et al.* reported an increase in fat mass in the first year of retirement but a decline in body mass and its components between the first and fifth year after retirement[13]. Unfortunately we were not able to make such a distinction.

To prevent an increase in body weight and waist circumference after retirement, energy intake should be changed to a level that matches the new energy requirements or physical activities should replace the former work-related physical activities. In our study population, men who retired from active jobs lowered their total energy intake and they increased doing odd jobs over time, but not enough to prevent weight gain and an increase in waist circumference. However, without these changes in behaviour, even larger increases in weight and waist circumference would have been expected.

Most changes in diet and physical activity were related to both changes in body weight and changes in waist circumference in a similar way. However, some components (e.g. frequency of pasta consumption, drinking alcoholic beverages, walking) were clearly related to change in waist circumference, and not to change in body weight. Apparently, changes in these behaviours have more effect on fat distribution than they have on total fat storage. Since waist circumference has shown to be a better predictor of all-cause mortality among the elderly[29], it seems better to focus on the determinants of increases in waist circumference than on determinants of weight gain only, in order to prevent the negative effects of overweight and obesity among middle-aged men.

The differences in weight gain and increase in waist circumference between the groups of working men in sedentary and active jobs could be explained by differences in changes in lifestyle over the follow-up. The differences in weight gain and increase in waist circumference between the groups of men who retired from active versus sedentary jobs, which remained after adjusting for changes in behaviours, can be attributed to the cessation of work-related physical activity. Apparently, men with former active jobs become overall less active after retirement than they were before retirement, while men with former sedentary jobs become overall more active after retirement in comparison with their working years. This is not surprising, since men with former sedentary jobs can almost not become less active after retirement compared with their activities during former working hours. For men with former active jobs, however, greater adaptations are required to create a new energy balance.

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In conclusion, men who retired from physically active jobs were more prone to gain weight and increase in waist circumference than men who retired from sedentary jobs. Since retirement may bring opportunities for healthy changes in diet and physical activity, it seems warranted to develop health promotion programmes aimed at prevention of overweight in men who are eligible for retirement, particularly in those who have physically demanding jobs.

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