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Maintenance of physical activity and body weight in relation to subsequent quality of life in postmenopausal breast cancer patients

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Abstract

Background We prospectively examined the association between physical activity, body weight and quality of life in Dutch postmenopausal early breast cancer patients treated with adjuvant endocrine therapy.

Methods In this side study of a large clinical trial, lifestyle and quality-of-life questionnaires were filled out 1 and 2 years after the start of endocrine therapy (T1 and T2, respectively) and included a pre-diagnosis lifestyle assessment (T0). A total of 435 breast cancer patients returned both questionnaires.

Results Individuals with a physical activity level above the median who maintained this level from T0 to T1 reported the best global quality of life and physical functioning and the least fatigue at T2, as compared with individuals with low levels of physical activity which further decreased after diagnosis (difference of +16, +14, and −22 points on a 0–100 quality-of-life scale, respectively; $p < 0.01$). Overweight or obese women who gained body weight after diagnosis reported worst quality of life and most fatigue as compared with women who maintained a stable body weight (difference of −8, −10 and +2 points, respectively; $p < 0.01$).

Conclusion Maintaining high pre-diagnosis physical activity levels and a healthy body weight is associated with better quality of life after breast cancer.

Introduction

Patients with early breast cancer are treated with local therapy with or without systemic therapy. Systemic therapy improves disease-free and overall survival but is associated with several side-effects, e.g. fatigue and menopausal complaints.[1,2] These can in turn affect the quality of life and cause functional limitations such as decreased levels of physical activity and weight gain.[3,4] Equally, decreased levels of physical activity and weight gain after a breast cancer diagnosis may sustain or even increase fatigue and other symptoms such as constipation, dyspnoea, and menopausal symptoms and may thereby negatively affect quality of life.

Several studies have shown physiological and psychological benefits of exercise interventions in cancer patients during and after their treatment.[5,6] However, many of these interventions are relatively short-term programmes and in a rehabilitation setting. Therefore, it remains unknown which beneficial effects on quality of life can be expected of normal daily physical activities and weight maintenance in breast cancer patients. Moreover, most of the studies on exercise in breast cancer patients have been conducted in the United States and Canada. The Netherlands is a country with a relatively low prevalence of obesity (i.e. 11% have a body mass index (BMI) of ≥30) and high levels of physical activity (i.e. 52% engage in moderate intensity physical activity for 30 min/day on at least 5 days/week).[7,8]

Cancer diagnosis has been described as a 'teachable moment', indicating that cancer patients may be highly motivated to make positive changes in diet, exercise and other health-related behaviours.[9,10] The American Cancer Society Guide for Informed Choices recommends at least 30 min of moderate-to-vigorous physical activity, above usual activities, on ≥5 days of the week.[11] However, it was shown that many cancer survivors do not meet these recommendations, which is associated with lower health-related quality of life.[12]

The purpose of the present study was to prospectively examine the association between physical activity, body weight and quality of life in Dutch postmenopausal early breast cancer patients treated with adjuvant endocrine therapy. We assessed whether maintenance or improvement of pre-diagnosis physical activity habits and normal body weight after breast cancer are associated with better subsequent quality of life and lower level of symptoms.

Patients and Methods

Study design and population

The current study is a side study of the Tamoxifen Exemestane Adjuvant Multicenter (TEAM) trial (Netherlands Trial Register NTR267). The TEAM trial is an international, open-label, randomised multicentre trial comparing 5 years of exemestane versus 2.5–3 years of tamoxifen followed by 2.5–2 years of exemestane as adjuvant endocrine treatment in postmenopausal women with hormone-sensitive breast cancer. The study design and population of the TEAM trial have been extensively described elsewhere.[13] From July 2001 to January 2006, a total of 2754 postmenopausal women with histologically/cytologically confirmed invasive hormone-positive early breast cancer were enrolled in the Dutch TEAM trial.

The lifestyle side study (TEAM-L) protocol was activated after approval by the central medical ethical committee, and 45 of 76 TEAM centres participated in the study. Patients were recruited ~1 year after randomisation for the TEAM trial, from March 2004 to November 2005. Eligible TEAM participants received a letter to inform them about the TEAM-L, including the lifestyle and quality-of-life questionnaire (time point 1; T1). Patients who gave signed informed consent and returned the first questionnaire received a second questionnaire ~1 year after the first questionnaire (time point 2; T2).

Table 1 Baseline clinical subject characteristics.

		Total Dutch TEAM	Invited TEAM-L	TEAM-L T1	TEAM-L T2
Number of subjects	n	2754	742	543	454
Age[a] (mean ±SD)	yrs	65.4 ± 9.3	65.0 ± 9.3	64.0 ± 8.9	63.9 ± 8.9
Tumour characteristics n (%)					
Histological grade	G1	412 (15)	120 (16)	85 (16)	76 (17)
	G2	1202 (44)	333 (45)	243 (45)	197 (43)
	G3	928 (34)	241 (32)	179 (33)	150 (33)
	Gx	59 (2)	16 (2)	11 (2)	11 (2)
Tumour stage	T1	1222 (44)	356 (48)	267 (49)	220 (48)
	T2	1312 (48)	332 (45)	240 (44)	205 (45)
	T3	118 (4)	31 (4)	20 (4)	15 (3)
	T4	66 (2)	20 (3)	13 (2)	11 (2)
Nodal status	N0	829 (30)	215 (29)	150 (28)	122 (27)
	N+	1887(69)	543 (70)	391 (72)	330 (73)
Estrogen receptor	Pos	2673 (97)	729 (98)	532 (98)	447 (99)
	Neg	53 (2)	12 (2)	10 (2)	6 (1)
Progesterone receptor	Pos	1978 (72)	502 (68)	360 (66)	299 (66)
	Neg	589 (21)	167 (22)	128 (24)	106 (23)
Therapy characteristics n (%)					
Surgery	Mast	1504 (55)	404 (54)	279 (51)	228 (50)
	BCT	1207 (44)	334 (45)	261 (48)	223 (49)
Radiotherapy	Yes	1620 (59)	459 (62)	352 (65)	301 (66)
	No	1064 (39)	273 (37)	184 (34)	147 (32)
Chemotherapy	Yes	811 (29)	246 (33)	194 (36)	167 (37)
	No	1943 (71)	496 (67)	349 (64)	287 (63)
Endocrine therapy[b]	EXE	1374 (50)	369 (50)	273 (50)	227 (50)
	TAM	1380 (50)	373 (50)	270 (50)	227 (50)

[a]Age at randomisation for TEAM trial (1 year before invitation for TEAM-L).
[b]Endocrine therapy on the basis of randomisation arm.
BCT breast conserving therapy; *EXE* exemestane; *Gx* undetermined grade; *MAST* mastectomy; *SD* standard deviation; *TEAM* Tamoxifen Exemestane Adjuvant Multicenter; *TAM* tamoxifen.

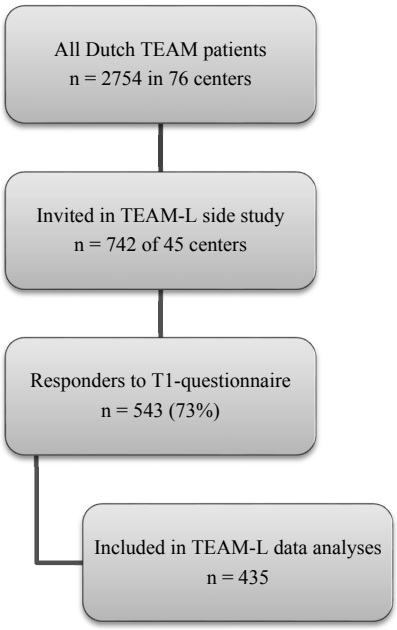

Figure 1 Flow chart of study population.

Data collection

Patient, tumour and treatment characteristics were collected through the main TEAM Datacenter. Information on demographic and reproductive factors, lifestyle, and quality-of-life was collected through mailed self-report questionnaires at time point 1 (T1) and time point 2 (T2). The first questionnaire consisted of questions on current (T1) and pre-diagnosis (T0) characteristics, i.e. parity, occupational status, body weight and height, leisure time physical activity, smoking and alcohol intake, use of oral contraceptives, hormone replacement therapy and dietary supplements, use of complementary and alternative therapies and quality of life. The second questionnaire (at T2) was essentially the same, excluding the retrospective assessment of pre-diagnosis lifestyle factors.

Physical activity measures

To assess physical activity, we used the following question derived from the validated European Prospective Investigation into Cancer Physical Activity Questionnaire: how much time did you approximately spend on the following activities (average number of hours per week)—walking, bicycling, gardening, housekeeping, sports (i.e. three separate sports could be specified).[14] The mean of the number of hours of physical activities per week in summer and winter was calculated. To include an estimate of intensity, metabolic equivalent intensity values (MET value) were assigned to each activity: 3.5 for walking, 8 for bicycling, 4 for gardening, 3.5 for housekeeping and for each sport, the MET value was derived from the compendium of physical activities.[15] Level of recreational physical activity was assessed as time engaged in walking, bicycling, gardening, and sports times the MET value of each activity, resulting in MET hours/week. The level of total physical activity was calculated by summing the MET hours/week of all activities, including housekeeping.

Quality-of-life measures

Quality of life was assessed using a 54-item questionnaire, including the validated European Organisation for Research and Treatment of Cancer quality-of-life questionnaire (EORTC QLQ-C30) and the EORTC breast cancer module questionnaire (EORTC QLQ-BR23), both translated in Dutch.[16,17] The EORTC QLQ-C30 contains 30 items resulting in five functional scales (physical, role, cognitive, emotional, and social functioning), three symptom scales (fatigue, pain, and nausea/vomiting), a global health status/quality-of-life scale, and six single symptom items (dyspnoea, appetite loss, sleep disturbance, constipation, diarrhoea and financial impact). The EORTC QLQ-BR23 is a validated tool especially designed for patients with breast cancer who vary in disease stage and treatment modality. It contains 23 items assessing disease symptoms, side-effects of treatment, body image, sexual functioning, and future perspective. Items assessing chemotherapy side-effects (n = 5) were not found to be applicable for this study and were therefore not included in the TEAM-L questionnaire. The Functional Assessment of Cancer Therapy—Endocrine Subscale questionnaire originally consists of 18 items.[18] Of these 18 items, 13 are included in the TEAM-L questionnaire (i.e. 7 items are already included in the EORTC QLQ-C30 or QLQ-BR23 questionnaires, 6 items were added), resulting in three endocrine symptom scales (menopausal complaints, weight complaints, and vaginal complaints).

Each of the 54 items in the TEAM-L quality-of-life questionnaire has four answer categories. Answers were transformed into scales or single items with

Table 2 Descriptive statistics and scale reliability of the Quality of Life questionnaires

		T1 (n=543)			T2 (n=454)			
	No. of Items	Mean score[a]	SD	Cronbach's alpha[b]	Mean score[a]	SD	Cronbach's alpha[b]	
Functional scales								
Physical	5	78.8	18.0	0.74	79.3	18.4	0.74	
Role	2	79.2	26.4	0.90	81.9	25.4	0.88	
Cognitive	2	81.1	22.8	0.72	83.8	20.5	0.64	[c]
Emotional	4	77.2	22.1	0.86	81.8	20.6	0.86	[c]
Social	2	86.4	19.7	0.70	88.9	19.3	0.73	[c]
Global quality of life	2	76.0	18.6	0.92	76.9	17.9	0.91	
Symptom scales/items								
Fatigue	3	32.2	25.8	0.87	27.4	23.0	0.82	[c]
Nausea and Vomiting	2	6.0	15.9	0.69	4.1	12.4	0.66	[c]
Pain	2	20.3	24.6	0.82	19.4	24.2	0.84	
Dyspnea	1	17.3	25.2		15.8	24.7		
Insomnia	1	32.2	33.0		30.7	30.4		
Appetite loss	1	8.7	21.3		5.6	15.2		[c]
Constipation	1	12.0	23.7		11.7	22.6		
Diarrhea	1	5.0	15.6		4.0	14.2		
Financial difficulties	1	6.5	17.5		7.4	19.1		
Breast cancer functional scales								
Body image	4	82.9	24.6	0.90	85.6	22.9	0.91	[c]
Sexual functioning	2	18.6	20.1	0.88	19.5	19.4	0.85	
Sexual enjoyment	1	31.4	29.9		32.5	29.0		
Future perspective	1	64.8	27.8		70.6	25.4		[c]
Breast cancer symptom scales								
Breast symptoms	4	20.9	21.6	0.80	14.3	16.7	0.75	[c]
Arm symptoms	3	20.2	21.8	0.72	16.6	19.7	0.72	[c]
Endocrine symptom scales								
Menopausal complaints	4	25.7	21.2	0.70	24.8	21.5	0.70	
Weight complaints	2	15.5	20.1	0.50	14.1	18.9	0.52	
Vaginal complaints	2	19.9	27.9	0.79	22.9	28.2	0.81	

[a]Scores range from 0 to 100 (higher score is higher level of functioning, higher score is greater degree of symptoms).
[b]Alpha values ‡0.70 indicate adequate scale reliability, only available for multi-item scales.
[c]$p < 0.01$ (Wilcoxon signed-rank test) for difference between T1 and T2.
SD standard deviation.

scores from 0 to 100 according to the EORTC manual. A higher global quality-of-life score and higher functional scores correspond with better quality of life. For scales or single items evaluating symptoms, higher scores indicate worse symptoms, i.e. worse quality of life.

Statistical analysis

A descriptive analysis of changes in lifestyle characteristics and quality of life between T0, T1, and T2 was carried out. Paired sample *t*-tests were used for continuous variables and McNemar tests for categorical data. To test changes in quality-of-life scales between T1 and T2, Wilcoxon signed-rank test was conducted. Cronbach's alpha was calculated as a measure of subscale reliability. For the prospective analysis of physical activity and body weight (at T0 and T1) in relation to quality of life (at T2), we excluded women diagnosed with recurrent breast cancer or a new primary tumour before T2, women who reported unlikely high levels of physical activity, i.e. ≥40 h/week of either leisure time walking or bicycling, and nonresponders to the second questionnaire. We then evaluat-

ed whether T0 levels of physical activity and body weight, and changes therein (from T0 to T1), were associated with subsequent quality-of-life outcomes (T2) using linear multivariable regression analyses and analyses of covariance models. All models were adjusted for age, occupational status, adjuvant chemotherapy, randomisation arm (tamoxifen or exemestane), TNM (tumour–node–metastasis) stage, and smoking status. BMI and physical activity were mutually adjusted for. To control for multiple statistical testing, a statistically significant difference or change was defined as a p value < 0.01. All analyses were carried out using SPSS software, SPSS for Windows, version 15.0.

Results

A total of 742 TEAM participants were invited to TEAM-L, of which 73% (n = 543) signed informed consent and returned the first questionnaire (Figure 1). Reasons for nonresponse were deceased or moved to unknown address (n = 13), declined (n = 90), and no response at all (n = 96). Response to the second questionnaire was 84% (n = 454).

The clinical characteristics of the participants of the Dutch TEAM trial (n = 2754), the TEAM participants who received an invitation for the TEAM-L (n = 742), and the respondents to the T1 and T2 questionnaires (n = 543 and 454, respectively) are listed in Table 1. Mean age of the patients participating in TEAM-L was 64 ± 9 years (mean ± standard deviation (SD)). About one-third of the study population was treated with adjuvant chemotherapy before endocrine therapy. No differences in clinical characteristics were observed between patients in the TEAM trial and the subgroup of TEAM-L respondents at T1 and T2. Table 2 shows quality-of-life characteristics of the TEAM-L respondents. Minor improvements in cognitive, emotional, and social functioning and future perspective were observed between T1 and T2 (p < 0.01). Several symptoms slightly decreased at T2 as compared with T1, i.e. fatigue, appetite loss, breast symptoms, and arm symptoms (p < 0.01).

To assess the relation between physical activity and body weight (at T0 and T1) and quality of life (at T2), we excluded 26 women diagnosed with recurrent breast cancer or a new primary tumour before T2, 5 women who reported unlikely levels of physical activity, and 89 nonresponders to T2, resulting in n = 435 participants for further analyses (Figure 1). Mean body weight, BMI, and prevalence of obesity did not change over time (Table 3). Relatively high levels of pre-diagnosis (T0) recreational physical activity were observed (mean ± SD: 10.5 ± 8.1 h/week), with ~1 h/day spent on walking or bicycling. A statistically significant decrease in all subtypes of physical activity was observed from T0 to T1 (p < 0.01). The overall level of recreational physical activity decreased to 8.7 ± 7.3 h/week at T1 and was restored to a large extent at T2 (mean ± SD: 9.8 ± 7.4 h/week; p < 0.01 for T0 versus T1 and T1 versus T2). Housekeeping was the only type of physical activity which was not restored from T1 to T2. Figures 2A and 2B show that changes in physical activity and body weight differ according to pre-diagnosis level (T0), with the strongest decrease in physical activity observed in women in the highest quartile for pre-diagnosis physical activity (p < 0.01) and an increase in body weight in women with normal weight before diagnosis as compared with a decrease in body weight in obese women (p < 0.01).

The combined effects of pre-diagnosis (T0) physical activity and BMI and change in physical activity and body weight from T0 to T1 on subsequent quality of life at T2 are presented in Figures 3A and 3B. Individuals with a physical activity level above the median who managed to maintain this level from T0 to T1 (i.e. <3.5 MET h/week increase or decrease) reported the most optimal quality of life at T2, as compared with individuals with low levels of physical activity which further decreased after diagnosis (global quality of life and physical functioning; difference of 14 and 16 points, respectively, p < 0.01) (Figure 3A). Similarly, this group of patients also reported the lowest level of fatigue (difference of 22 points; p < 0.01). Individuals who increase their level of physical activity from T0 to T1 do not report better quality of life or less fatigue than those who maintain their pre-diagnosis level of physical activity. However, it should be noted that the number of women who report an increase of ≥3.5 MET h/week is rather small. The above results did not markedly differ when analyses were stratified by randomisation arm (i.e. exemestane or tamoxifen) or adjuvant chemotherapy (yes or no) (data not shown).

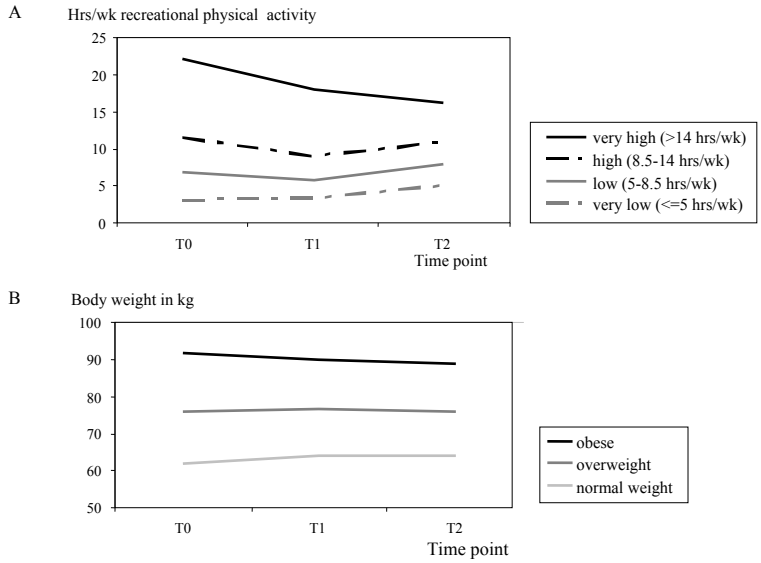

Figure 2 Change in recreational physical activity (A) and body weight (B) from pre-diagnosis (T0) to 1 year (T1) and 2 years (T2) after start of endocrine therapy, for quartiles of T0 physical activity (A) and categories of T0 BMI (normal weight, BMI < 25; overweight, BMI 25–30; obese, BMI ≥ 30) (B).
BMI body mass index.

Table 3 Lifestyle factors at pre-diagnosis (T0) and 1 year (T1) and 2 years (T2) after start of endocrine therapy/randomisation (n = 435)[a]

	T0	T1	T2	*p****
Anthropometry				
Weight (kg)	73.3 ± 13.6	73.9 ± 13.0	73.6 ± 13.0	
Height (cm)	166 ± 6			
BMI (kg/m^2)	26.6 ± 4.7	26.8 ± 4.5	26.7 ± 4.4	
Obesity				
Normal weight (BMI<25)	41	37	39	
Overweight (BMI 25-30)	41	44	43	
Obese (BMI ≥30)	18	19	18	
Physical activity**				
Walking (h/week)	4.6 ± 4.7	3.9 ± 3.9	4.3 ± 4.0	1
Cycling (h/week)	2.9 ± 3.4	2.5 ± 3.3	2.8 ± 3.4	1
Gardening (h/week)	1.6 ± 2.4	1.1 ± 1.7	1.3 ± 2.1	1,2
Housekeeping (h/week)	17.9 ± 12.8	15.3 ± 11.4	14.6 ± 11.1	1,3
Sports (h/week)	1.5 ± 2.7	1.3 ± 2.5	1.4 ± 2.4	1
Total physical activity (h/week)	28.2 ± 15.8	23.7 ± 14.2	24.2 ± 14.7	1,3
Recreational activity (h/week)	10.5 ± 8.1	8.7 ± 7.3	9.8 ± 7.4	1,2
Total physical activity (MET h/week)	114 ± 65	96 ± 59	99 ± 61	1,3
Recreational activity (MET h/week)	52 ± 43	43 ± 40	49 ± 40	1,2

[a]Excluding cases with extremely high frequency (≥40 h/week) of walking or cycling (n = 5), recurrences (n = 26) and non-responders to T2 (n = 89).
[b]Paired sample t-test (marginal homogeneity test for categorical data); 1 = $p < 0.01$ for T0 versus T1, 2 = $p < 0.01$ for T1 versus T2, 3 = $p < 0.01$ for T0 versus T2.
[c]Total physical activity is the sum of walking, cycling, gardening, housekeeping and sports; recreational activity excludes housekeeping; MET is sum of MET h/week (i.e. MET h/week is h/week times MET value).
BMI body mass index; *MET* metabolic equivalent intensity.

Overweight or obese women who gained body weight after diagnosis (i.e. ≥5% increase) reported lower subsequent quality of life and more fatigue, as compared with women who maintained a stable body weight irrespective of whether they were overweight/obese or normal weight at T0 (global quality of life, physical functioning, and fatigue; difference of 8, 10, and 12–14 points, respectively; $p < 0.01$) (Figure 3B). Similarly, results did not markedly change after stratification by randomisation arm or adjuvant chemotherapy (data not shown).

Discussion

In this study among Dutch postmenopausal women with hormone-sensitive early breast cancer, the level of physical activity decreased from pre-diagnosis to 1 year after randomisation. Subsequent quality of life was markedly better in women who managed to maintain their pre-diagnosis levels of physical activity and in women who maintained a healthy body weight.

Our study has several strengths and limitations. The repeated questionnaires allowed us to prospectively assess the associations between lifestyle and subsequent quality of life. Recreational physical activity was assessed by addressing specific activities, with respect to duration as well as intensity, on the basis of a validated questionnaire.[14] We rely on retrospectively assessed pre-diagnosis physical activity and body weight. However, the relatively high pre-diagnosis levels of physical activity in our study are comparable with previously reported levels of recreational activity in Dutch women, i.e. 10 h/week at age 60–69 years spent on walking, bicycling, gardening, and sports.[19] In The Netherlands, 76% of women between 55 and 75 years of age spend at least 30 min on moderate-to-vigorous physical activities on at least 5 days of the week.[8] We therefore believe it is unlikely that levels of pre-diagnosis physical activity as compared with post-diagnosis levels have been markedly over- or underestimated using the questionnaire regarding specific leisure time activities.

The difficulty in unravelling the sequentiality in our data is a clear limitation of our study. Physical activity and body weight may not only affect quality of life. Quality of life, especially as expressed by symptoms such as fatigue, pain, and dyspnoea, may also affect levels of physical activity. We aimed to focus specifically on the first association by examining lifestyle factors at T0 and at T1 and their association with quality of life assessed 1 year later at T2. We cannot exclude the possibility, however, that symptoms and quality of life at T1 influenced levels of physical activity at that same time point. Due to collinearity of the quality-of-life data at T1 and T2, this could not be examined in our analyses.

Decreased levels of physical activity as well as unintentional weight gain have been previously described in breast cancer patients.[20] However, our study is the first study of physical activity after early breast cancer in a Dutch population. The levels of physical activity are clearly higher than in other breast cancer populations (e.g. North America and Australia).[21,22] However, decreases in post-diagnosis physical activities, and some recovery to pre-diagnosis levels after longer follow-up, are observed in each population. Post-diagnosis weight gain has been previously observed in Dutch breast cancer patients receiving chemotherapy, especially when combined with endocrine therapy.[23] In our study population of relatively active postmenopausal breast cancer patients, the effect of maintaining high levels of recreational physical activity was stronger than the effect of small increases in physical activity (Figure 3A). It should be noted that the number of women who increased their level of recreational physical activity after the breast cancer diagnosis is insufficient to draw conclusions about possible beneficial effects of increasing physical activity in addition to the benefits of maintaining a high pre-diagnosis level of physical activity. In addition, the overall number of women in our study does not allow formal statistical analyses of differences in the above-described associations between different treatment categories (exemestane versus tamoxifen, adjuvant chemotherapy or not).

The magnitude of the differences in quality-of-life scores between women who maintain high levels of physical activity and a normal body weight as compared with patients who decreased their level of physical activity or gained weight is clearly of clinical significance. We observed statistically significant mean differences in the range between 8

and 22 points on a 0–100 scale. This reflects differences of at least 50% of the SD of these scores. A change of 8–10 points in a 0–100 scale, or 33%–50% of the SD, in any quality-of-life tool is usually considered clinically relevant.[24,25]

The results of our study are in line with results of others. In an Australian study, it was found that female breast cancer survivors who met the recommended physical activity guidelines reported better quality of life than patients who did not.[22] Similarly, healthy weight survivors reported high-

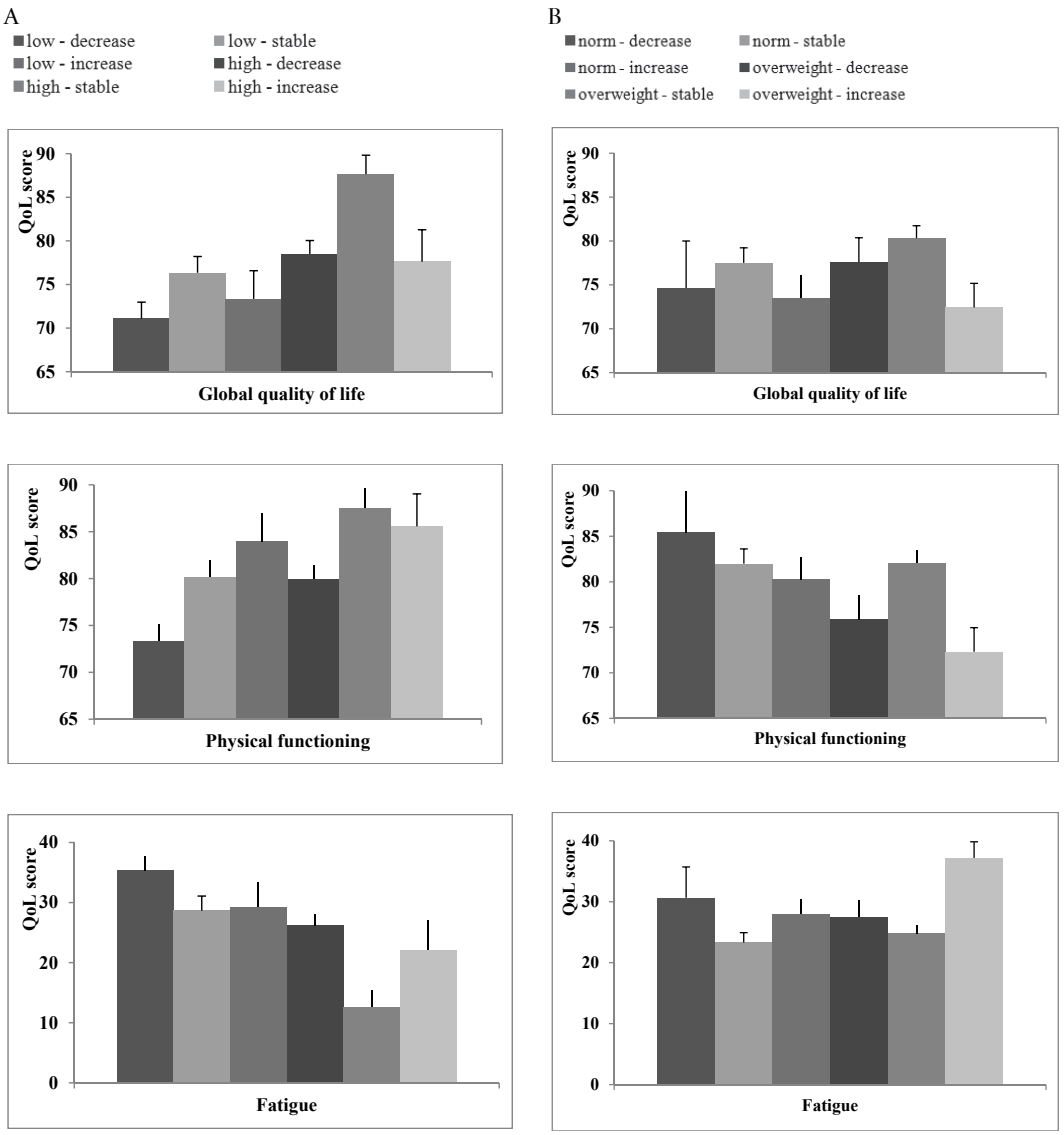

Figure 3 Adjusted mean (vertical bar: standard error) quality-of-life (T2) scores for categories of recreational physical activity pattern (A; T0 and change from T0 to T1; low/high cut-off is the median, decrease/increase is >3.5 MET h/week) and body weight (B; T0 and change from T0 to T1; normal/overweight cut-off is BMI < 25; decrease/increase is ≥5% change in body weight), derived from ANCOVA models adjusted for age, occupational status, TNM stage, adjuvant chemotherapy, endocrine therapy (exemestane versus tamoxifen), smoking status, and BMI or physical activity, respectively. Pairwise comparisons between categories: if two categories have the same superscript, they differ statistically significantly from each other; $p < 0.01$.[1-7] *ANCOVA* analysis of covariance; *BMI* body mass index; *MET* metabolic equivalent intensity; *TNM* tumour–node–metastasis.

er quality-of-life scores than obese survivors. In a weight loss intervention in obese early-stage breast cancer patients, it was shown that, at 12 months, greater weight loss was associated with improvements in overall, physical, and functional quality of life and fatigue.[26] The effects of physical activity on quality of life in (breast) cancer patients, usually in a rehabilitation setting, have also been studied in many exercise interventions. The majority of these studies demonstrated beneficial effects like reduced cancer-related fatigue and increased overall quality of life.[5,27] In the general population and noncancer patient populations, there is increasing evidence that exercise has positive effects on health-related quality of life, depression, and anxiety.[28,29] Besides psychological effects and improved quality of life, physical activity and a healthy body weight may have substantial benefits on breast cancer-specific and overall survival in breast cancer patients.[30,31] Intervention trials of physical activity and/or weight maintenance/loss on long-term aspects quality of life, breast cancer recurrence and survival have not yet been conducted.

In conclusion, our prospective approach to examine the association between pre- and post-diagnosis lifestyle factors and subsequent quality of life shows that patients who manage to maintain high pre-diagnosis physical activity levels and a healthy body weight have a clinically relevant advantage with respect to quality of life. It should be noted that a patient's psychological well-being and quality of life may influence the patient's ability to be physically active and maintain a healthy body weight. Although further studies with respect to long-term effects of lifestyle factors on both quality of life and breast cancer outcomes are needed, the current evidence directs physicians to advise and support their patients in staying physically active and maintaining a healthy body weight after a breast cancer diagnosis.

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