HAL
open science

Physical activity levels after treatment for breast cancer: one-year follow-up

Nele Devoogdt, Marijke Kampen, Inge Geraerts, Tina Coremans, Steffen Fieuws, Johan Lefevre, Renaat Philippaerts, Steven Truijen, Patrick Neven, Marie-Rose Christiaens

To cite this version:

Nele Devoogdt, Marijke Kampen, Inge Geraerts, Tina Coremans, Steffen Fieuws, et al.. Physical activity levels after treatment for breast cancer: one-year follow-up. Breast Cancer Research and Treatment, 2010, 123 (2), pp.417-425. 10.1007/s10549-010-0997-6 . hal-00550332

HAL Id: hal-00550332

https://hal.science/hal-00550332v1

Submitted on 27 Dec 2010

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Physical activity levels after treatment for breast cancer: one year follow-up

Nele Devoogdt, Marijke Van Kampen, Inge Geraerts, Tina Coremans, Steffen Fieuws, Johan Lefevre, Renaat Philippaerts, Steven Truijen, Patrick Neven, Marie-Rose Christiaens

N. Devoogdt, M. Van Kampen, I. Geraerts: Department of Physiotherapy, University Hospitals Leuven, Leuven, Belgium

N. Devoogdt, M. Van Kampen, I. Geraerts: Department of Rehabilitation Sciences, Katholieke Universiteit Leuven, Leuven, Belgium

J. Lefevre: Department of Kinesiology, Katholieke Universiteit Leuven, Leuven, Belgium

N. Devoogdt, T. Coremans, S. Truijen: Department of Health Care, Artesis University College of Antwerp, Antwerp, Belgium

S. Fieuws: I-BioStat, Katholieke Universiteit Leuven and Universiteit Hasselt, Belgium

R. Philippaerts: Department of Movement and Sport Sciences, University Ghent, Ghent, Belgium

M.R. Christiaens, P. Neven: Multidisciplinary Breast Center, University Hospitals Leuven and Faculty of Medicine, Katholieke Universiteit Leuven, Leuven, Belgium

N. Devoogdt (Corresponding author):

University Hospitals Leuven, Department of Physiotherapy, Herestraat 49, B-3000 Leuven, Belgium

Phone: 0032 16 348550

E-mail: nele.devoogdt@artesis.be

Abstract

Among patients with breast cancer, few studies have examined the pattern of change of physical activity levels over time or the predictive factors for this change. Particularly sparse are studies comparing pre-surgical physical activity levels with those 12 months post-surgery. Patients with a primary operable breast cancer (N=267) filled in the Physical Activity Computerised Questionnaire before breast surgery and one, three, six and twelve months postoperatively. Patient-, disease- and treatment-related factors were prospectively collected. Total physical activity level and occupational, sport and household activity levels were significantly decreased the first month postoperatively and did not recover during the first year after surgery. 'Being employed' was a predictive factor for a larger decrease of the total activity level, comparing the pre-operative and 12 months post-surgery stages. Having a spouse, a pN2-3 lesion and over 20 lymph nodes dissected predicted a decrease in occupational activity. Advanced age and smoking behaviour predicted a decrease in sport activities, and not having a spouse predicted a decrease in household activities.

This study showed that one year after breast cancer surgery, preoperative physical activity levels were not recovered. Breast cancer patients, and in particular those at risk for a decreased physical activity level, should be identified, encouraged and guided to increase their activities.

Key words

Breast cancer; physical activity; occupation; sport; household; predictive factors

Introduction

Worldwide, breast cancer is the most common female cancer. Because there are increasing numbers of breast cancer survivors [1], high quality of life and hence high physical activity levels become more and more important [2]. In addition, high physical activity levels are associated with 30% decreased risk of mortality after breast cancer [3].

The evolution of the physical activity levels of breast cancer survivors during the first year after surgery is poorly investigated. In the study of Pinto et al, moderate-intensity and vigorous-intensity exercise participation did not significantly increase between one and twelve months after surgery [4]. Harisson et al had comparable findings [5]. They reported an equal amount of minutes spent per week on vigorous, moderate and strength activities at 6 and 12 months post-surgery. Andrykowski et al reported a decrease in leisure-time exercise activity level shortly after the chemotherapy or radiotherapy but six months later, the activity level was similar to the level before those therapies [6]. Two studies compared total physical activity level before and after diagnosis of breast cancer [7,8]. Irwin et al concluded that between four and twelve months after diagnosis, physical activity level has still decreased by two hours per week (11%) [7]. In the study of Littman et al, leisure-time activity levels had decreased by 50% between one and twelve months post-surgery [8].

Different patient-, disease- and treatment-related factors can be associated with decreased physical activity levels after surgery for breast cancer. Irwin et al [7] and Littman et al [8] examined predictive factors for decreased activity levels compared with pre-diagnosis levels. Shorter time from diagnosis [7], high pre-diagnosis activity level [7,8], low age [8], high [7] or low [8] pre-diagnosis Body Mass Index (BMI) and adjuvant treatment with radiotherapy and chemotherapy [7] were associated with a larger decrease of the activity levels.

The first aim of our study was to investigate the evolution of the total physical activity level and occupational, sport and household activity levels of breast cancer survivors, pre-operatively to one, three, six and twelve months after surgery. The second aim was to find predictive factors for changes in these activity levels between the pre-operative stage and twelve months post-surgery.

Patients and methods

This study is a longitudinal cohort study and had approval from the Ethical Committee from University Hospitals Leuven (ML 3513).

Subjects

Three hundred ninety-eight consecutive breast cancer patients treated in the Multidisciplinary Breast Clinic of Leuven (where all kinds of breast cancer patients are treated) between September 2006 and September 2007 were asked to participate. Two hundred sixty-seven patients (67%) with an axillary lymph node dissection or a sentinel node biopsy for a primary breast cancer were included. One hundred thirty-one patients (33%) were excluded for various reasons: they were not available before the surgery (N=21); they did not understand Dutch language (N=8); they were mentally unable to participate (N=24); or they refused to participate (N=78).

Procedure

The day before surgery, breast cancer patients meeting our inclusion criteria were asked to participate in the study. They signed informed consent forms and filled in the Flemish

Physical Activity Computerised Questionnaire (FPACQ) about their physical activities over the past year. One, three, six and twelve months after surgery, patients filled in the FPACQ again to report their physical activities of the previous month.

Flemish Physical Activity Computerised Questionnaire (FPACQ)

FPACQ is a reliable and valid questionnaire [9]. The first part collects patient-related data (see 'predictive factors'). The second part concerns occupational activities: occupational status (employed or unemployed), working hours per week, job intensity and transport to the job. The third part records information on sport activities: the three most frequently performed sports, frequency and duration of each sport. The fourth part collects household activities (light, moderate and vigorous). Transport during leisure time and sedentary activities (TV and sleep) were also collected.

Four different physical activity variables were calculated: total activity level and occupational, sport and household activity levels. All Metabolic Equivalent Task (MET) values used for calculating the activity variables were determined using the Ainsworth compendium of activities [10]. Using the definition for a MET as the ratio of work metabolic rate to a standard resting metabolic rate of 1.0 kcal kg^{-1} h^{-1}, one MET is considered as the resting metabolic rate during quiet sitting. Calculation of each variable is explained with an example:

Total physical activity level is the sum of occupational, sport, household activity levels (explained below) and active transport in leisure time (1.0 hours/week x 4 MET), eating (8.8 hours/week x 1.8 MET), sleeping (49 hours/week x 0.9 MET) and quiet leisure time (47.7 hours/week x 1.5 MET) = 306 MET-hours/week.

A patient worked 38 hours per week with 20% light, 70% moderate and 10% vigorous activities. The activity level during her job was: (38 hours/week x 20% x 2 MET) + (38

hours/week x 70% x 3 MET) + (38 hours/week x 10% x 4 MET) = 110 MET-hours per week. She drove 1.3 hours/week for work by car. So, activity level for transport for work was: 1.3 hours/week x 1.5 MET = 2 MET-hours/week. Occupational activity level was: 110 + 2 = 112 MET-hours/week.

The same patient performed two sports. She danced 2 hours/ week and walked 0.7 hours/week. Sport activity level was: (2 hours/week x 5.5 MET) + (0.7 hour/week x 3.5 MET) = 13 MET-hours/week.

She also performed 10 hours/week light, 4 hours/week moderate and 1.5 hour/week vigorous household activities. Household activity level was: (10 hours/week x 2.5 MET) + (4 hours/week x 3.5 MET) + (1.5 hours/week x 4.5 MET) = 46 MET-hours/week.

Predictive factors

Patients-, disease- and treatment-related factors were prospectively collected. Patient-related factors were age, body weight and height (BMI), having a spouse, educational level, employment status, lymphoedema, impaired shoulder mobility and smoking behaviour. Disease -related factors included tumour size, lymph node stage and type of breast cancer. Treatment-related factors included type of breast surgery, surgery at the dominant side, type of axillary surgery, number of lymph nodes dissected and whether chemotherapy, radiotherapy and hormonal therapy were given.

All patient-related factors were collected with FPACQ, excepted for lymphoedema [11] (criterion >200ml difference) and impaired shoulder mobility [12] (criterion >20° difference) which were measured 12 months after surgery (N=166 or 62%). Smoking behaviour was asked before surgery. Disease- and treatment-related factors were collected from the patient's medical file.

Statistical analysis

To investigate the representativeness of our study population, Independent T-tests and χ^2-tests were used to compare the characteristics of included and excluded breast cancer patients.

A linear model for repeated measures was used to evaluate the evolution of various continuous variables (total, occupational, sport and household activity levels) over time. The model used an unstructured covariance matrix for measurements over time and has – compared to classical repeated measures ANOVA – the advantage that subjects with one or more missing measurements were still included in the analysis [13]. The values were transformed (natural logarithm after adding a constant if necessary) to handle the right-skewed distribution of model residuals. Geometric means and 95% confidence intervals were obtained after transforming the means of the transformed variable to the original scale. Tukey adjustments were used for multiple comparisons between points in time. Notify that the analysis of the occupational activity level was restricted to preoperatively employed patients and of the sport activity level to patients practising some sport preoperatively.

Further, specific interest was given to the evaluation of changes between the preoperative stage and 12 months after surgery of the total, occupational, sport and household activity levels. More specifically, changes that depended on particular patient-, disease-, or treatment-related characteristics were verified. For this purpose, parametric tests (Independent T-test, ANOVA and Pearson correlation) were performed on the sample of subjects with data after 12 months, the aim being to study the association between these characteristics and the observed change (=bi-variable analyses). General linear models were used to perform multi-variable analyses.

Results should be interpreted with care given the multitude of models and p-values.

All analyses were performed with the statistical packages SPSS 17.0 and SAS 9.2.

Results

Two hundred sixty-seven patients filled in FPACQ before surgery, 242 (91%), 243 (91%), 234 (88%) and 236 (88%) at 1, 3, 6 and 12 months, respectively. Exploratory analyses did not reveal any relation between missing and available data (data not shown).

Age of included patients ranged between 21 and 90 years, with a mean of 55 year. Eighty patients were retired, 145 patients were employed and 42 patients were unemployed before surgery. Other baseline characteristics of included and excluded breast cancer patients are shown in Table 1. The participants were 9 year younger and their BMI was 2.4 kg/m² lower ($p<0.05$). More participants underwent sentinel node biopsy ($p=0.03$) and received chemotherapy ($p=0.03$) in comparison with the non-participants. Other factors were comparable between both groups.

Evolution of physical activity

Total activity level of the breast cancer patients decreased from 269 MET-hours/week before surgery to 241 MET-hours/week the first month after surgery. After three, six and twelve months total activity level was 244, 248 and 256 MET-hours/week respectively (see Fig. 1). At each follow-up, total activity level was significantly lower than before surgery ($p<0.01$).

A similar trend was found for occupational, sport and household activity levels (see Fig. 2). For breast cancer patients employed before surgery (N=145), average amount of MET-hours per week spent on occupational activities decreased from 79 MET-hours/week before surgery to 1, 1 and 3 MET-hours/week at one, three and six months, respectively. Twelve months after surgery, occupational activity level was increased to 12 MET-hours/week. At each follow-up, occupational activity level was significantly lower than at baseline ($p<0.01$).

Before surgery, 145 of 187 non-retired patients were employed. At 1, 3, 6 and 12 months only 21%, 19%, 33% and 60% of patients employed preoperatively had gone back to work. Furthermore, significantly lower numbers of patients worked full-time after 12 months compared to the preoperative stage (34% versus 43% of patients employed preoperatively) ($p<0.01$).

The sport activity level of preoperatively sport-active patients (N=144, 13 MET-hours/week) was almost reduced to zero after one, three and six month (see Fig. 2). After 12 months, the activity level was increased to 5 MET-hours/week, but remained significantly lower than before. Only 40%, 52%, 55% and 78% of preoperatively sport-active patients were practising some sports between 1 and 12 months after surgery. From patients not performing a sport before surgery, 16% reported performing a sport after 12 months.

Household activities were decreased from 35 MET-hours/week before to 16 MET-hours/week the first months after surgery (N=267, see Fig. 2). After three, six and twelve months, household activity level was 25, 27 and 29 MET-hours/week respectively.

Predictive factors for changed physical activity levels

Table 2 gives an overview of the bi-variable analyses for prediction of changes in total, occupational, sport and household activity levels between the preoperative and 12 month post-operative stages. It appeared that younger patients had a greater decrease in total activity level than older patients. Other significant predictive factors for a greater decrease in total activity level were being employed (versus unemployed and retired) and having a ductal carcinoma. A greater decrease in occupational activities was associated with following factors: having a spouse, lymph node stage pN2 or pN3 (versus stage pN0 or pN1), complete axillary dissection (versus sentinel node biopsy), more than 20 lymph nodes dissected (versus less than 10) or undergoing chemotherapy. Older patients and those smoking before surgery

had a higher risk of having a decreased sport activity level 12 months after surgery. The only predictive factor for a decrease in household activity levels was having no spouse.

In the multi-variable model all patient-, disease- and treatment-related factors were included except lymphoedema and impaired shoulder mobility (see Table 3): these measurements were taken for only 166 of the 236 included patients. The other patients refused to come especially for the measurements to our hospital. We compared the multi-variable model for these 166 patients with and without inclusion of lymphoedema and impaired shoulder mobility as fixed factors, and the obtained results were the same. Table 4 gives an overview of arm lymphoedema and shoulder mobility as predictive factors for change in the physical activity levels of the 166 measured breast cancer patients. Employment status remained a significant predictive factor for change of the total physical activity level ($p=0.02$). Employed patients had a significantly greater decrease (of 12 MET-hours/week) of the total activity level than retired patients. Having a spouse ($p=0.02$), higher lymph node stage ($p=0.03$) and more axillary lymph nodes dissected ($p=0.03$) remained significant predictive factors for a greater decline of occupational activities. Occupational activities of patients with a spouse decreased 26 MET-hours/week more on average than those of patients without a spouse. Activities of patients with pN2 or pN3 diminished 39 MET-hours/week more than activities of patients with pN1. Dissection of 20 axillary lymph nodes or more was associated with 45 MET-hours/week larger decrease than dissection of 10 lymph nodes or less. Patient's age was retained as predictive factor for a higher reduction of sport activities ($p<0.01$). A one year older patient had 0.7 MET-hours/week larger decrease in her sport activity level than a one year younger patient. Having no spouse was predictive of a larger decrease in household activities. Patients without a spouse had 10 MET-hours/week greater reduction of their household activities than patients with a spouse.

Patient's BMI, educational level, presence of lymphoedema or impaired shoulder mobility, tumour size, type of breast surgery, surgery at the dominant side, radiotherapy and hormonal therapy did not predict changes of total, occupational, sport or household activity levels.

Discussion

Total physical activity level of patients treated for primary breast cancer decreased by 10%, 9% and 7% one, three and six months after surgery. Even after one year, total activity level remained significantly lower (4%) than before surgery. In the study of Irwin and colleagues [7] decrease of the total activity level was larger (11%), but a section of their patients were evaluated earlier, i.e. between 4 and 12 months after diagnosis. In addition, total activity level in their study was the sum of only sport and household activities. In our breast cancer patients, these specific activities showed a larger decrease of 60% and 17% respectively. In contrast to our study, some authors did not find a significant change of the activity levels from immediately after surgery until 12 months post surgery [4] or between 6 and 18 months after surgery [5].

At 12 months, occupational activities in our breast cancer patients showed an 85% reduction from baseline. We did not find a study examining the occupational activities as part of physical activities and expressed in MET-hours per week. Other studies investigated return to work following breast cancer surgery. In the present study, at 3 months postoperatively, only 19% of patients working preoperatively had returned to work. At 12 months, this proportion had increased to 60% with more patients working in a part-time employment than before surgery. Working rates after breast cancer surgery are remarkably variable in literature, despite comparable study populations. After 3 months, 60% of breast cancer patients living in

California were working [14]. At 12 months, 88% of Canadian patients had returned to work [15]. In studies from the Netherlands, Sweden and France, working rates were more comparable with the present study: at 12 months 63%, 59% and 54% respectively of the patients were returned to work [16-18]. A possible explanation for this variability is the difference in the health care systems in the US and Canada compared toWestern Europe. In West European countries, employees are fully compensated during the first year of sickness.

Similar to our study, Littman et al [8] reported 50% decrease of sport activities between the first and twelve months after surgery. The study of Andrykowski et al [6] reported a decreased sport activity level during adjuvant therapy and the activity level rebounded after completion of adjuvant therapy. But, in contrast with our study, six months after completion of adjuvant therapy the sport activity level was completely recovered. We did not find other studies evaluating sport participation or household activity levels after breast cancer surgery to compare with.

Previous mentioned studies about physical activity levels after breast cancer surgery had a few limitations. There was no comparison of the activity level of breast cancer patients with pre-surgical values [4-6]. The assessment of physical activity before surgery was retrospective [7,8]. The postoperative assessment was at a variable time interval [7,8], only patients with a cancer stage between 0 and II were included [4,6] and occupational activities were not assessed [4-8].

Predictive factors for decreased activity levels one year after the surgery for breast cancer were only investigated in three studies. One study examined the prediction of return to work ten months after breast cancer surgery [17]. They reported axillary lymph node dissection and chemotherapy as predictive factors for no return to the job. These two factors were significant in our bi-variable model, but not in our multi-variable model. The difference of decrease

between patients with and without chemotherapy was comparable in both models (19 MET-hours/ week versus 16 MET-hours/ week). Hence, the non-significance of chemotherapy as predictive factor in our multi-variable model is rather due to an increased width of the 95% confidence interval of the difference, i.e. (-6 – 37) compared to (4 – 34), than to a decrease in effect size. In addition, we did not examine 'prediction of no return to work' but 'change in occupational levels'. Irwin et al [7] examined predictive factors for decreased sport and household activities between 4 and 12 months after diagnosis of breast cancer. They found other predictive and non-predictive factors than ours. A possible explanation is that their study population was not comparable with our population: their patients had more in situ breast cancer, less chemotherapy and less hormonal therapy. Littman et al [8] reported lower age and lower Body Mass Index as significant predictive factors for decreased sport activity levels, whereas the present study showed that older patients had larger decreases in their sport activity levels. Pinto et al [4] and Hong et al [19] investigated predictive factors for a low physical activity level after breast surgery, but made no comparison with the preoperative value. Surprisingly, lymphoedema or impaired shoulder mobility did not predict changes of total, occupational, sport or household activity levels. We cannot compare the result of the present study with other studies, since arm lymphoedema and impaired shoulder mobility as predictive factors for changes of activity levels have never been investigated. From the present study, it seemed that the presence of arm lymphoedema was not at predictive factor for decreased activity levels at all. The presence of impaired shoulder mobility was associated with a greater decrease in occupational activity levels, although this difference was borderline significant (p=0.05).

Our study had several strengths. Firstly, breast cancer patients were measured prospectively before surgery and at fixed time intervals after surgery up to 12 months. Secondly, all aspects

of physical activity were measured: occupational, sport and household activities, transport during leisure time and sedentary activities. Thirdly, return rate of questionnaires was very high. A weakness of our study was that a questionnaire was used to assess activity levels, which is a subjective measurement method. In addition, the FPACQ was tested on reliability and validity in 117 healthy adults and not specifically in breast cancer patients. Our study population was not fully representative for all breast cancer patients since participants were younger, had lower BMI, had more frequently sentinel node biopsy and chemotherapy compared with non-participants.

The evolution and predictive factors for decreased occupational, sport and household activities have to be further investigated since this topic is poorly investigated and there are contradictory results between the present and other studies. Furthermore, it would be interesting to investigate physical activity levels at longer term and factors associated with it. Finally, rehabilitation programmes have to be developed and examined on effectiveness to improve physical activity levels following breast cancer surgery.

In conclusion, physical activity levels are still significantly lower 12 months after treatment for breast cancer than at the preoperative level. Being employed was a predictive factor for a greater decrease of total activity level between pre and 12 months post-surgery. Predictive factors for a greater decrease of occupational activities were having a spouse, pN2 or pN3 lymph node stage and more than 20 lymph nodes dissected. Older and smoking patients demonstrated to have greater decrease of their sport activities and patients without a spouse, had a greater decrease of their household activities.

The results suggest that breast cancer patients, and in particular those at risk for decreased physical activity levels, should be identified, encouraged and guided to increase their physical activities.

Acknowledgements

This study was supported by a grant from the agency for Innovation by Science and Technology (Applied Biomedical Research). We wish to thank all the patients participating in this study, to fill in the questionnaire at five different time points and to come to the hospital for the measurements of their arm. Furthermore, we would like to thank Shirli Roimi, Tinne Van Dyck and Julie Reyniers to help with the collection of data.

References

1. Glass AG, Lacey JV, Carreon JD, Hoover RN (2007) Breast cancer incidence, 1980-2006: combined roles of menopausal hormone therapy, screening mammography, and estrogen receptor status. J Natl Cancer Inst 99:1152-1161. Doi: 10.1093/jnci/djm059
2. Alfano CM, Smith AW, Irwin ML et al (2007) Physical activity, long-term symptoms, and physical health-related quality of life among breast cancer survivors: a prospective analysis. J Cancer Surviv 1:116-128. Doi: 10.1007/s11764-007-0014-1
3. Patterson RE, Cadmus LA, Emond JA, Pierce JP (2010) Physical activity, diet, adiposity and female breast cancer prognosis: a review of the epidemiologic literature. Maturitas (epub). Doi: 10.1016/j.maturitas.2010.01.004
4. Pinto BM, Trunzo JJ, Reiss P, Shiu SY (2002) Exercise participation after diagnosis of breast cancer: trends and effects on mood and quality of life. Psycho-oncology 11:389-400. Doi: 10.1002/pon.594
5. Harisson S, Hayes SC, Newman B (2009) Level of physical activity and characteristics associated with change following breast cancer diagnosis and treatment. Psycho-oncology 18:387-394. Doi: 10.1002/pon.1504
6. Andrykowski MA, Beacham AO, Jacobsen PB (2007) Prospective, longitudinal study of leisure-time exercise in women with early-stage breast cancer. Cancer Epidemiol Biomarkers Prev 16:430-438. Doi: 10.1158/1055-9965.EPI-06-0735
7. Irwin ML, Crumley D, McTiernan A et al (2003) Physical activity levels before and after a diagnosis of breast carcinoma: the Health, Eating, Activity, and Lifestyle (HEAL) study. Cancer 97:1746-1757. Doi: 10.1002/cncr.11227

8. Littman AJ, Tang MT, Rossing MA (2010) Longitudinal study of recreational physical activity in breast cancer survivors. J Cancer Surviv (epub). Doi: 10.1007/s11764-009-0113-2
9. Matton L, Wijndaele K, Duvigneaud N et al (2007) Reliability and validity of the Flemish physical activity computerized questionnaire in adults. Res Q Exerc Sport 78:293-306
10. Ainsworth BE, Haskell WL, Whitt MC et al (2000) Compendium of physical activities: an update of activity codes and MET intensities. Med Sci Sports Exerc 32:S498-504
11. Devoogdt N, Lemkens H, Geraerts I et al (2010) A new device to measure upper limb circumferences: validity and reliability. Int Angiol (in publication).
12. Rietman JS, Dijkstra PU, Debreczeni R, Geertzen JHB, Robinson DPH, De Vries J (2004) Impairments, disabilities and health related quality of life after treatment for breast cancer: a follow-up study 2.7 years after surgery. Disab Rehabil 26:78-84. Doi: 10.1080/09638280310001629642
13. Verbeke G, Molenberghs G (1997) Linear mixed models in Practice: A SAS-Oriented Approach. Lecture Notes in Statistics 126. Springer-Verlag, New York
14. Satariano WA, DeLorenze GN (1996) The likelihood of returning to work after breast cancer. Public Health Rep 111:236-241
15. Drolet M, Maunsell E, Mondor M et al (2005) Work absence after breast cancer diagnosis: a population-based study. CMAJ 173:765-771. Doi: 10.1503/cmaj.050178
16. Roelen CAM, Koopmans PC, de Graaf JH, Balak F, Groothoff JW (2009) Sickness absence and return to work rates in women with breast cancer. Int Arch Occup Environ Health 82:543-546. Doi: 10.1007/s00420-008-0359-4

17. Johnsson A, Fornander T, Rutqvist L et al (2009) Predictors of return to work ten months after primary breast cancer surgery. Acta Oncol 48:93-98. Doi: 10.1080/02841860802477899
18. Fantoni SQ, Peugniez C, Duhamel A, Skrzypczak J, Frimat P, Leroyer A (2009) Factors related to return to work by women with breast cancer in Northern France. J Occup Rehabil (epub). Doi: 10.1007/s10926-009-9215-y
19. Hong S, Bardwell WA, Natarajan L et al (2007) Correlates of physical activity level in breast cancer survivors participating in the Women's Healthy Eating and Living (WHEL) study. Breast Cancer Res Treat 101:225-232. Doi: 10.1007/s10549-006-9284-y

Figure legends

Fig. 1 Evolution of the total physical activity level of breast cancer patients (N=267) from the preoperative stage to 12 months after the surgery. Whiskers refer to 95% confidence interval for the (geometric) mean.

Fig. 2 Evolution of the occupational (N=145), sport (N=144) and household activity level (N=267) of breast cancer patients from the preoperative stage to 12 months after the surgery. Whiskers refer to 95% confidence interval for the (geometric) mean.

Tables

Table 1 Characteristics of the excluded (N=131) and included (N=267) breast cancer patients (N=131). Median (interquartile range) and counts (%) are given for continuous and categorical data respectively. p= p-values from Mann-Whitney U and χ^2 tests.

Table 2 Predictors of changes in physical activity levels (MET-hours/ week) of breast cancer patients between the preoperative stage and 12 months following surgery determined with bi-variable analyses. r= Pearson correlation; mean= mean change, a negative value refers to a decrease; SD= standard deviation; p= p-value from Independent T-test, ANOVA or Pearson correlation.

Table 3 Predictors of changes in physical activity levels (MET-hours/week) of breast cancer patients between the preoperative stage and 12 months following surgery determined with multi-variable analyses. B= estimated change (and 95% confidence interval) of the activity level compared with the change in the reference category (=0), thus a negative value refers to a stronger decrease as compared to the reference category; p= p-value from the multivariable regression model.

Table 4 Arm lymphoedema and impaired shoulder mobility as predictors of changes in physical activity levels (MET-hours/week) of breast cancer patients between the preoperative stage and 12 months following surgery determined with multi-variable analyses. B= estimated change (and 95% confidence interval) of the activity level compared with the change in the reference category (=0), thus a negative value refers to a stronger decrease as compared to the reference category; p= p-value from the multivariable regression model.

Table 1 Characteristics of excluded (N=131) and included (N=267) breast cancer patients. Mean (SD) and counts (%) are given for continuous and categorical data respectively. p= p-values from Independent T-test and χ^2-test.

	Breast cancer patients		
	Excluded N=131	Included N=267	p
Age (year)	64 (13)	55 (11)	<0.01
Body Mass Index (kg/m²)	27.5 (5.1)	25.1 (4.4)	0.02
Gender			
Women	130 (99%)	265 (99%)	0.96
Men	1 (1%)	2 (1%)	
Tumour stage			
Tis	8 (6%)	7 (3%)	
T1	52 (40%)	123 (46%)	0.94
T2	59 (44%)	107 (40%)	
T3	9 (7%)	18 (7%)	
T4	3 (2%)	12 (5%)	
Lymph node stage			
N0	81 (62%)	154 (58%)	
N1	38 (29%)	93 (35%)	0.56
N2	8 (6%)	13 (5%)	
N3	4 (3%)	7 (2%)	
Type of breast surgery			
Mastectomy	64 (49%)	119 (45%)	0.42
Breast conserving	67 (51%)	148 (55%)	
Type of axillary surgery			
Axillary dissection	92 (70%)	158 (59%)	0.03
Sentinel biopsy	39 (30%)	109 (41%)	
Radiotherapy	106 (81%)	231 (87%)	0.15
Chemotherapy	52 (40%)	137 (51%)	0.03
Hormonal therapy	102 (78%)	213 (80%)	0.66

Table 2 Predictors of changes in physical activity levels (MET-hours/ week) of breast cancer patients between the preoperative stage and 12 months after the surgery determined with bi-variable analyses. r= Pearson correlation; mean= mean change, a negative value refers to a decrease; SD= standard deviation; p= p-value from Independent T test, ANOVA or Pearson correlation.

	Total activity			Occupational activity			Sport activity			Household activity		
	N	r*	p	N	r*	p	N	r*	p	N	r*	p
Patient- related												
Age (year)	236	0.18	<0.01	131	0.07	0.46	131	-0.25	<0.01	236	-0.08	0.25
	N	mean (SD)	p	N	mean (SD)	p	N	mean (SD)	p	N	mean (SD)	p
Patient- related												
Spouse												
No	33	-14 (23)	0.68	16	-19 (28)	0.03	20	-2 (25)	0.88	33	-13 (25)	0.03
Yes	203	-13 (22)		115	-44 (44)		111	-2 (17)		203	-4 (22)	
Employment status												
Unemployed	37	-9 (23)	<0.01				23	-8 (24)	0.17	37	-7 (27)	0.18
Employed	131	-18 (23)					78	0 (17)		131	-2 (19)	
Retired	68	-5 (18)					30	-2 (15)		68	-8 (26)	
Smoking												
No	189	-14 (23)	0.35	101	-44 (45)	0.13	109	0 (17)	0.04	189	-5 (22)	0.40
Yes	47	-10 (19)		30	-31 (36)		22	-9 (22)		47	-2 (24)	
Breast cancer- related												
Lymph node stage												
pN0	132	-12 (22)	0.75	74	-39 (40)	0.04	73	-2 (17)	0.95	132	-3 (24)	0.07
pN1	87	-14 (23)		50	-39 (45)		46	-2 (21)		87	-9 (20)	
pN2-3	17	-10 (23)		7	-80 (45)		12	-3 (13)		17	2 (23)	
Type of breast cancer												
Ductal	214	-14 (22)	0.04	121	-43 (43)	0.25	116	-2 (19)	0.35	214	-5 (22)	0.56
Other	22	-4 (19)		10	-26 (39)		15	2 (14)		22	-2 (29)	
Treatment- related												

Type of axillary surgery												
Sentinel Biopsy	90	-11 (17)	0.19	52	-32 (37)	0.04	49	0 (14)	0.19	90	-4 (24)	0.62
Axillary Dissection	146	-14 (25)		79	-47 (46)		82	-4 (20)		146	-5 (22)	
Number of lymph nodes dissected												
<10	103	-11 (16)	0.07	57	-31 (36)	0.01	54	0 (14)	0.20	103	-4 (23)	0.92
10-19	87	-12 (23)		44	-43 (46)		50	-2 (18)		87	-6 (22)	
≥20	46	-20 (30)		30	-59 (46)		27	-7 (25)		46	-4 (23)	
Chemotherapy												
No	115	-10 (19)	0.09	47	-29 (38)	0.01	54	-4 (18)	0.32	115	-6 (25)	0.29
Yes	121	-15 (25)		84	-48 (45)		77	-1 (18)		121	-3 (20)	

Table 3 Predictors of changes in physical activity levels (MET-hours/week) of breast cancer patients between the preoperative stage and 12 months following surgery determined with multi-variable analyses. B= estimated change (and 95% confidence interval) of the activity level compared with the change in the reference category (=0), thus a negative value refers to a stronger decrease as compared to the reference category; p= p-value from the multivariable regression model.

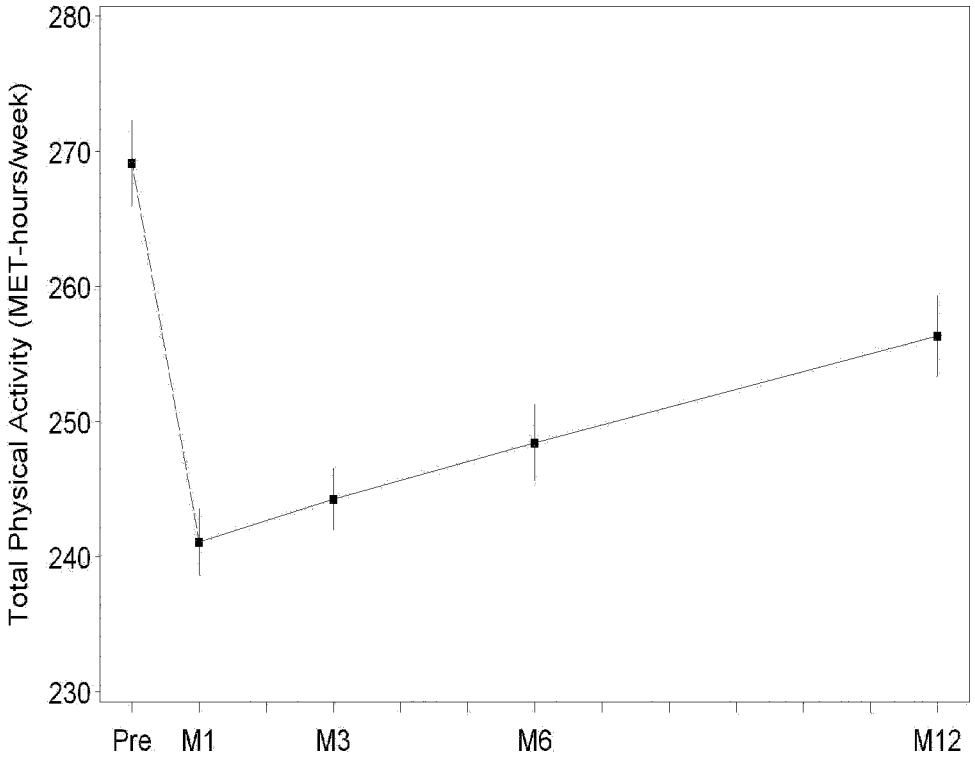
	Total activity N=236 B (95% CI)	p	Occupational activity N=131 B (95% CI)	p	Sport activity N=131 B (95% CI)	p	Household activity N=236 B (95% CI)	p
Patient-related								
Age (year)*	0.1 (-0.3 - 0.6)	0.61	0.2 (-1.0 - 1.3)	0.79	-0.7 (-1.2 - -0.2)	<0.01	0.1 (-0.4 - 0.6)	0.65
Spouse								
No	-2 (-10 - 6)	0.64	26 (4 - 49)	0.02	3 (-6 - 11)	0.56	-10 (-18 - -1)	0.03
Yes	0		0		0		0	
Employment status								
Unemployed	-4 (-15 - 7)	0.47			-17 (-29 - -4)	0.01	1 (-10 - 12)	0.90
Employed	-12 (-22 - 2)	0.02			-11 (-23 - 0)	0.05	6 (-5 - 16)	0.29
Retired	0				0		0	
Smoking								
No	-6 (-14 - 1)	0.10	-16 (-35 - 1)	0.07	10 (2 - 19)	0.02	-4 (-11 - 4)	0.37
Yes	0		0		0		0	
Disease-related								
Lymph node stage								
pN0	-3 (-17 - 10)	0.63	13 (-26 - 52)	0.50	-2 (-17 - 13)	0.80	-3 (-18 - 11)	0.67
pN1	0 (-12 - 12)	0.97	39 (3 - 73)	0.03	-1 (-13 - 12)	0.93	-12 (-24 - 1)	0.07
pN2-3	0		0		0		0	
Type of breast cancer								
Ductal	-9 (-19 - 1)	0.07	-16 (-45 - 13)	0.27	-5 (-13 - 12)	0.37	-3 (-14 - 8)	0.56
Other	0		0		0		0	
Treatment-related								
Type of axillary surgery	2 (-13 - 17)	0.79	-25 (-70 - 20)	0.27	4 (-15 - 23)	0.70	0 (-16 - 15)	0.96

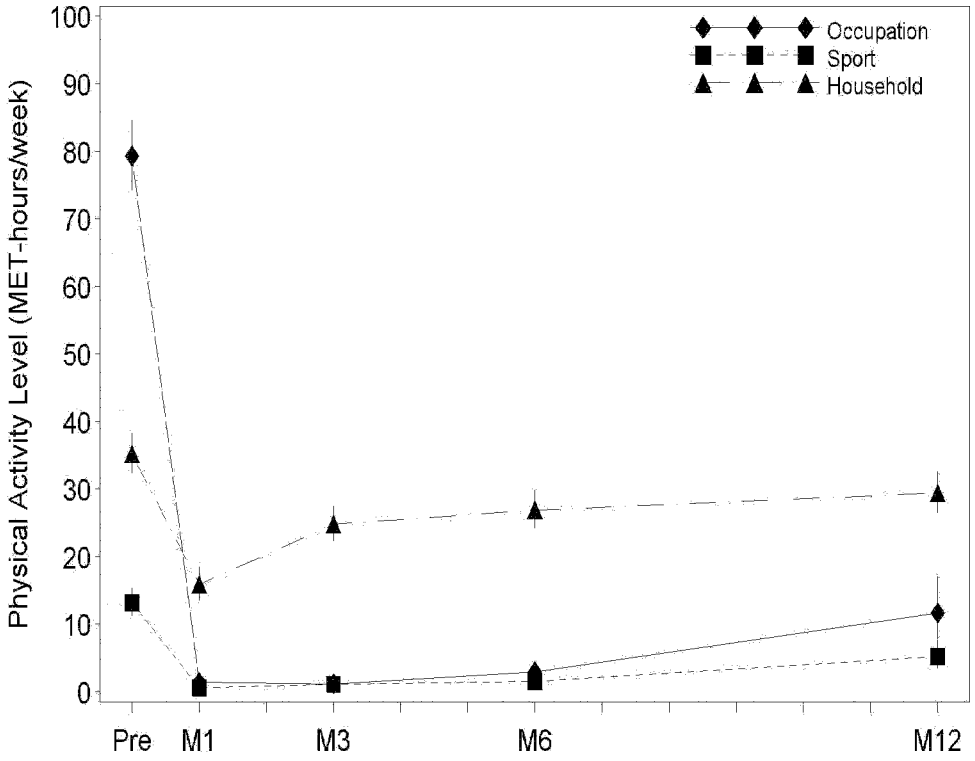
Sentinel Biopsy	0		0		0		0	
Axillary Dissection								
Number of lymph nodes dissected								
<10	9 (-5 - 23)	0.20	45 (4 - 86)	0.03	12 (-6 - 30)	0.20	-2 (-17 - 12)	0.78
10-19	7 (-2 - 15)	0.11	15 (-5 - 35)	0.14	9 (0 - 18)	0.06	-1 (-9 - 8)	0.90
≥20	0		0		0		0	
Chemotherapy								
No	-5 (-13 - 3)	0.26	16 (-6 - 37)	0.15	-1 (-10 - 8)	0.81	-8 (-16 - 1)	0.08
Yes	0		0		0		0	

* Increase of the predictive factor with one unit is associated with a change of B (95% CI) of the activity level.

Table 4 Arm lymphoedema and impaired shoulder mobility as predictors of changes in physical activity levels (MET-hours/week) of breast cancer patients between the preoperative stage and 12 months following surgery determined with multi-variable analyses. B= estimated change (and 95% confidence interval) of the activity level compared with the change in the reference category (=0), thus a negative value refers to a stronger decrease as compared to the reference category; p= p-value from the multivariable regression model.

	Total activity (N=166) B (95% CI)	p	Occupational activity (N=96) B (95% CI)	p	Sport activity (N=99) B (95% CI)	p	Household activity (N=166) B (95% CI)	p
Patient-related								
Arm lymphoedema								
No	-3 (-13 - 8)	0.58	-11 (-35 - 14)	0.39	-4 (-16 - 8)	0.52	5 (-7 - 16)	0.41
Yes	0		0		0		0	
Impaired shoulder mobility								
No	5 (-3 - 14)	0.22	21 (0 - 43)	0.05	3 (-7 - 13)	0.53	0 (-10 - 10)	0.98
Yes	0		0		0		0	


Total Physical Activity (MET-hours/week)
280
270
260
250
240
230
Pre
M1
M3
M6
M12


Occupation
Sport
Household
Physical Activity Level (MET-hours/week)
100
90
80
70
60
50
40
30
20
10
0
Pre
M1
M3
M6
M12