# Physical activity during and after cancer treatment

*Barriers, facilitators, predictors and adherence*

**Masterthesis**
**December 19th, 2010**

G.B. Aarnoudse, PT
Student 9944613
Utrecht University
Henegouwen 32, 3524RA Utrecht, The Netherlands
e-mail: gerbenaarnoudse@hotmail.com

Faculty supervisor: Dr. T. Takken, Utrecht University
1st External supervisor: Dr. M.J. Velthuis
2nd External supervisor: Prof. Dr. P.H.M. Peeters

Setting: Comprehensive Cancer Center Middle Netherlands, University Medical Center Utrecht, Julius Center for Health Sciences and Primary Care; Physical Activity during Cancer treatment (PACT) Study

Utrecht University,
School of Clinical Health Sciences, Department of Physiotherapy Science

ONDERGETEKENDE


<u>G.B. Aarnoudse (Gerben)</u>............

Bevestigt hierbij dat de onderhavige verhandeling mag worden geraadpleegd en vrij mag worden gefotokopieerd. Bij het citeren moet steeds de titel van de auteur van de verhandeling worden vermeld.

# INHOUDSOPGAVE

**SAMENVATTING** Facilitators and barriers towards physical exercise during or after cancer treatment: *A narrative review*

**Achtergrond:** Tijdens en na de behandeling van kanker lijkt het moeilijk te zijn voor patiënten om zich te houden aan de voorgeschreven fysieke activiteiten. Ook daalt het niveau van de dagelijkse activiteiten van veel patiënten met kanker. Doel van dit review is het geven van een overzicht van bestaande literatuur aangaande belemmerende en bevorderende factoren van fysieke activiteiten (PA) gedurende en na de behandeling van kanker.

**Methode:** Elektronische databases (MedLine, CancerLit, The Cochrane Library, Cinahl, EMBASE, en PsycINFO) zijn doorzocht om studies te vinden die bevorderende en/ of belemmerende factoren aangaande fysieke activiteiten tijdens of na de behandeling van kanker. Subgroep analyses zijn gedaan voor training onder supervisie, training thuis en dagelijks activiteiten niveau bij patiënten met borstkanker en patiënten met een andere vorm van kanker.

**Resultaten:** Achttien studies (11 met borstkanker en 7 met overige kankerpatiënten) voldeden aan alle inclusiecriteria en beschreven 63 bevorderende en 80 belemmerende factoren. Borstkankerpatiënten ervaren de meeste ziekte- en behandeling gerelateerde belemmerende factoren (n=25), bevorderende factoren zijn meest functie gerelateerd (n=26). Meest voorkomende belemmerende (-) en bevorderende (+) factoren zijn: tijdgebrek (-), vermoeidheid (-), verbeteren algehele gezondheid (+) en optimaal gewicht handhaven (+). Patiënten met een andere kankerdiagnose ervaren meest 'ziekte en behandeling' en 'activiteiten' gerelateerde belemmerende factoren (n=9) en 'functie' gerelateerde bevorderende factoren (n=7). Meest voorkomende factoren zijn: tijdgebrek (-), vermoeidheid (-), ervaren van controle over gedrag (+) en intentie ten opzichte van PA (+).

**Conclusie:** Het is belangrijk rekening te houden met belemmerende factoren en persoonlijke voorkeuren bij het optimaliseren van PA bij patiënten met kanker. Aanbevelingen zijn gedaan voor verder onderzoek naar- en praktische toepassingen van de bevindingen.

**SAMENVATTING** Reliability analyses of two Theory of Planned Behavior-based questionnaires and Relation between the individual intention to be physical active and adherence to activity programs in cancer patients. *Analyses in an on-going RCT*

**Achtergrond:** Therapietrouw en het lichamelijk actief blijven in het algemeen blijkt moeilijk voor borstkankerpatiënten die nog onder behandeling zijn. De Theory of Planned Behavior (TPB): subjective norm (Subj), attitude (Att), perceived behavior control (PBC) en intention (Int), gecombineerd met self efficacy (SE) is gebruikt als een raamwerk voor de ontwikkeling van twee vragenlijsten naar fysieke activiteiten (PA) (Qadvice en Qprogramme). Deze studie heeft als doel de betrouwbaarheid (test-hertest en interne consistentie) van twee vragenlijsten te onderzoeken en de therapietrouw aan twee interventies aangaande PA te beschrijven. TPB determinanten die therapietrouw van de interventies voorspellen worden vermeld.

**Methode:** Patiënten met borstkanker (n=51) die deelnemen aan de 'Physical Activity during Cancer treatment (PACT) Study' zijn middels loting verdeeld over interventie A (n=24): advies om lichamelijk actief te blijven conform de Nederlandse Norm voor Gezond Bewegen (NNGB) gedurende de behandeling en interventie B: gesuperviseerd 18-weeks trainingsprogramma, gecombineerd met de adviezen van interventie A.

**Resultaten:** Test-hertest betrouwbaarheid van Qadvice: enkel de *Subj* subschaal is van gematigde betrouwbaarheid (ICC=0.50), andere subschalen zijn onacceptabel (ICC<0.4). Qprogramme: gematigde betrouwbaarheid voor *Subj* (ICC=0.53), *Att* (ICC=0.42) en *SE* (ICC=0.56). Betrouwbaarheid van *Int* en *PBC* is onacceptabel (ICC<0.4). Interne consistentie (Cronbach's α) varieert van matig (α<0.7) tot goed (α≥0.7) voor Qadvice (Int=0.59; Subj=0.09; PBC=0.43; Att=0.81; SE=0.89) als ook voor Qprogramme (Int=0.87; Subj=0.08; PBC=0.26; Att=0.90; SE=0.94).

Van de 36 gesuperviseerde trainingen bezochten de patiënten er gemiddeld 27 (SD:5.7), waar ≥30 sessies vooraf als doel was gesteld. Van de 18 weken hielden patiënten zich gemiddeld 13.3 (SD:4.5) weken aan de NNGB, waar ≥14 weken vooraf als doel was gesteld. Analyses tonen aan dat SE een significante voorspeller is van het opvolgen van de PA-norm volgens de NNGB betreffende alle deelnemers (β=1.27; p=0.001) als ook voor de 'interventie B' groep (β=1.41; p=0.02).

**Conclusie:** Test-hertest betrouwbaarheid van beide vragenlijsten is matig tot slecht en aanpassingen als geadviseerd zullen de interne consistentie doen toenemen tot een acceptabel niveau. Het opvolgen van de geadviseerde PA-norm (NNGB) wordt voorspeld door een hoge score op de SE determinant van Qadvice.

# Facilitators and barriers towards physical exercise during or after cancer treatment: A 'narrative review'

G.B. Aarnoudse, PT
Student 9944613
Utrecht University
Henegouwen 32, 3524RA Utrecht, The Netherlands
e-mail: gerbenaarnoudse@hotmail.com

Faculty supervisor: Dr. T. Takken, Utrecht University
1st External supervisor: Dr. M.J. Velthuis
2nd External supervisor: Prof. Dr. P.H.M. Peeters

Setting: Comprehensive Cancer Center Middle Netherlands, University Medical Center Utrecht, Julius Center; Physical Activity during Cancer treatment (PACT) Study

Utrecht University,
School of Clinical Health Sciences, Department of Physiotherapy Science

**Abstract**

**Objective:** During and after cancer treatment, it seems to be difficult for patients to adhere to exercise prescriptions. Also the activity level of many cancer patients decreases. The purpose of this review was to evaluate and summarize the current literature on barriers and facilitators concerning physical exercise programs and physical activities (PA) during and after cancer treatment.

**Methods:** Database searches of MedLine, CancerLit, The Cochrane Library, Cinahl, EMBASE, and PsycINFO were undertaken to find studies describing barriers and/ or facilitators towards physical exercise or daily physical activities, during or after cancer-treatment. Subgroup analyses were performed for supervised exercise, home-based exercise and physical activities including non-restricted physical exercise in breast cancer patients and patients with other cancer diagnosis.

**Results:** In total, 18 studies (11 in breast, 7 in other cancer populations) met all inclusion criteria and described a total of 63 facilitators and 80 barriers. Breast cancer patients experience the most disease and treatment related barriers (n=25), facilitators are mostly function related (n=26). Barriers (-) and facilitators (+) most frequently found are: lack of time (-), fatigue/tiredness (-), improve general health (+) and maintain optimal weight (+). Patients with other cancer diagnosis experience the most 'disease and treatment-' and 'activities and participation' related barriers (n=9) and function related facilitators (n=7). Barriers and facilitators most frequently found are: lack of time (-), fatigue/tiredness (-), perceived behavior control (+) and intention towards PA (+).

**Conclusions:** To optimize PA in cancer patients, it is important to take barriers and patients preferences into account. Recommendations were made for further research and practical applications of the outcomes.

*Key words:* physical activity, exercise, cancer, barriers, facilitators, literature review

## Introduction

Each year worldwide 10.9 million people are diagnosed with cancer (1). Though cancer-survivor rates differ strongly between the type of cancer and the stage of disease, in countries with adequate healthcare roughly 50% of the people diagnosed with cancer survive the disease (2,3).

It is estimated, that worldwide there are 24.6 million people alive who have received a diagnosis of cancer in the last five years (1).

As a result of the cancer diagnosis, surgery, and adjuvant treatments, 60-96% of the cancer patients experience fatigue during or after treatment (4,5). Depression, anxiety, reduced overall quality of life and weight gain are also well known side effects (6,7). Recent evidence shows that physical activity improves the physical and psychological health of patients with cancer (8-10). On the other hand, during and after cancer treatment, it seems to be difficult for patients to adhere to exercise prescriptions and the physical activity (PA) level of many cancer patients decreases (8).

Though some research has focused on reasons why patients find it difficult to start or continue exercising (barriers) during and after cancer treatment (11,12), still little is known about understanding why patients do or do not participate in exercise programs and the factors that might influence the adherence rates. A previous review on this topic included 9 studies, published till March 2000 (12). This study focused primary on the use of a suitable framework to identify barriers to physical activity during treatment or intervention instead of the barriers it selves (12). Brawley et al. concluded that it is important to have proper measurement and theory based guidance in barriers research (12). On the topic of facilitators to physical exercise during or after cancer treatment, no previous reviews are found.

Summarizing and evaluating these barriers as well as facilitators is important to get an overview of the understandings and the actual behavior concerning physical exercise, of this patient category. With additional information about the barriers and facilitators of physical exercise, future exercise programs and prescriptions can be developed taking into account these barriers and facilitators which may lead to higher participation and compliance rates towards exercise programs and recommendations.

*Objective*

We aimed to evaluate and summarize the current literature describing barriers and facilitators concerning physical exercise programs and physical activities during and after cancer treatment. In addition to the update of the previous review on barriers to physical activity for cancer patients (12), we also aimed to identify facilitators in this topic.

Subgroup analyses concerning barriers and facilitators for several cancer types and exercise regimes will be performed.

## Methods

*Literature search*

A literature search was done, from 1 January 2000 up to 31 July 2009, within the following electronic databases: MedLine, CancerLit, The Cochrane Library, Cinahl, EMBASE, and PsycINFO. Because this review partly attunes to the review of Brawley et al. (12), 2000 - the endpoint of the search of Brawley et al.- was chosen as starting point. Searches contained the following search terms, or a combination of these terms: Neoplasms, Exercise therapy, Cancer treatment, Adjuvant therapy, Facilitator, Barrier and related (free-text) words. Search terms as used were adapted to database specific indexing if needed. A more extended description of the search is enclosed in appendix I. Furthermore, reference tracking of selected articles was performed.

*Inclusion criteria*

- Types of participants: studies describing participants who suffer any form of cancer; >18 years of age
- Studies have to describe (one of) the following outcome measures:

Barriers and/ or facilitators/incentives towards participation in a program containing supervised physical exercise, home-based physical exercise programs or daily physical activities (e.g. housekeeping), including non-prescribed physical exercise, during or after cancer-treatment.

Barriers are defined as 'actual barriers' and 'perceived barriers' (13). Actual barriers are material and may physically prevent a person form initiating physical exercise or

activity (13) (e.g. no facilities). Conversely to actual barriers, perceived barriers tend to slow or halt completion of physical exercise or activities (13) (e.g. not motivated). Drop out reasons are not considered as barriers in this review since they generally describe reasons of quitting participation in the containing study, instead of specific barriers towards physical activity.

The concept 'facilitator' is interpreted in this study as factors, either personal or environmental, which positively influence or stimulate the physical exercise or - activity behavior of patients, during or after cancer treatment.

This paper is written conform a narrative review design, which means that no restriction on study designs is maintained.

*Selection of studies and data extraction*
At first the studies are screened by one independent reviewer on relevancy on title and abstract, following the described inclusion criteria. Secondly, the full text articles of search results left are screened by the same reviewer for the same benchmarks.

Barriers and facilitators of physical exercise and –activity as found in the included studies were sorted and categorized conform a modified construct of the International Classification of Functioning, Disability and Health (ICF) (see figure 1). The ICF defines components of health and health-related components The main categories contain a) body functions b) body structures c) activities and participation and d) environmental factors. The category of 'body structures' seems to be of no value in this context and is therefore deleted.

Personal factors like sex, race, age, fitness, lifestyle, habits and coping styles are not classified in the current version of ICF (14).

Since 'personal factors' and 'disease and treatment related variables' seem to be of certain importance in the objectives of this review, we added 'personal factors' (14) and 'disease and treatment related variables' to the ICF framework by combining it with the frameworks of Turk and Meichenbaum (15) and Brawley et al. (12).

**Results**

*Study characteristics*

After the electronic search 243 potentially relevant hits (duplicates deleted) were found. Based on the screening of the title and abstract, 221 studies were excluded. After tracking the reference lists of the articles left, three new possible hits were added. The full text of 25 articles was read, which resulted in the exclusion of another eight studies. One study, published on the end of the search period was yielded by external supply. Finally, 18 studies (16-33) met all inclusion criteria and were selected for further analyses. The selection process is displayed in a flowchart (figure 2).

The 18 included studies describe 15 different populations, of which another four (27-30) seem to contain participants of the same population since they all participate in the Colorectal Cancer and Home-Based Physical Exercise (CAN-HOPE)–trial. The populations, described more than once for different outcomes and publications are displayed in tables 1 and 2 by merged cells.

These 18 studies contained a total of 2009 patients. The age of patients included in the selected studies ranged from 25 to 90 years (mean: 57.3).
All results and study characteristics are displayed in tables 1 and 2.

Barriers (-) and facilitators (+) as found in the included studies contain possible positive and negative predictors of physical exercise and activity as found after statistical analyses (16,17,19,21,22,26,27,29-32), answers in surveys or phone calls (18,28,33) and results from focus groups (20,23-25).
In total 143 barriers and 102 facilitators of physical exercise and activity were found. After fusion of facilitators and barriers with similar meanings, a total of 143 unique facilitators (n=63) and barriers (n=80) were identified.

Personal factors are responsible for the majority of the barriers (50.0%; 40 out of 80) and facilitators (73.0%; 46 out of 63). Disease and treatment related barriers (27.5%; 22 out of 80) and facilitators (7.9%; 5 out of 63) and environmental barriers ( 22.5%; 18 out of 80) and facilitators (19.1%; 12 out of 63) represent the other results.

An extensive overview of all facilitators and barriers as found in the selected studies and divided in subcategories conform the objectives of this review is displayed in tables 3 and 4.

BREAST CANCER

Of the 18 studies included, 11 studies (16-23,23-26) examined a population (n=1228; mean 137.4 (range 12-450); mean age in years: 53.5) of breast cancer patients only. In the breast cancer studies a total of 77 barriers and 61 facilitators is found.

Breast cancer patients seem to experience the most barriers (+) and facilitators (-) in 'disease and treatment related variables' (n=31; (+)6, (-)25) and the least amount in 'demographic variables' (n=15: (-)7, (+)8). The highest amount of barriers is found under 'disease and treatment' (n=25) and 'functions' scores the most facilitators (n=26). The most important barriers and facilitators, determined in ≥3 studies by breast cancer patients only are: difficulties prioritizing exercise n=3 (-; Activities and participation), maintain optimal weight n=4 (+; functions), higher post intervention peak oxygen uptake ($VO_{2PEAK}$) n=3 (+; functions) and group support n=3 (+; environmental factors).

*Home-based physical exercise*

We included four breast cancer studies (16,21,22,26) describing 'home-based exercise' , the described patients ((n=894; range: 24-450) mean age in years: 54.6), mentioned a total of 9 barriers and 15 facilitators. The highest amount of barriers (n=4), is found under *disease and treatment related variables*. *Mental functions, activities and participation* and *environmental factors* count for four facilitators each.

The most important barriers and facilitators, mentioned in ≥3 studies are lack of time n=1 (-; activities and participation), ill family member/family responsibilities n=1 (-; activities and participation), fatigue/tiredness n=1 (-; disease and treatment related variables), nauseated or sick n=1 (-; disease and treatment related variables) and bad weather n=1 (-; environmental factors), maintain optimal weight n=1 (+; functions), improve general health/feel better n=1 (+; functions), more positive attitude/self efficacy n=1 (+; functions), higher pretrial exercise n=2 (+; activities and participation) and group support/meeting new people(with cancer diagnosis) n=1 (+; environmental factors).

*Supervised physical exercise*

Four studies (17-20) which contain a population (n=278; range 36-424) of patients with breast cancer (mean age in years: 51.1) describe an intervention of supervised exercise.

The 'supervised exercise' category (all breast cancer studies) contains 38 barriers and 23 facilitators. The category of *Disease and treatment related variables* has the highest number of barriers (n=17). *Activities and participation* contains the most facilitators (n=6). The most important barriers and facilitators, mentioned in ≥3 studies are bad health n=1 (-; functions), lack of time n=1 (-; activities and participation), ill family member/family responsibilities n=2 (-; activities and participation), difficulties prioritizing exercise n=1 (-; activities and participation), fatigue/tiredness n=1 (-; disease and treatment related variables), nauseated or sick n=1 (-; disease and treatment related variables), weakness n=1 (-; functions), metastatic disease n=2 (-;disease and treatment related variables) and bad weather n=1 (-; environmental factors), maintain optimal weight n=2 (+; functions), improve general health/feel better n=2 (+; functions), higher post intervention $VO_{2PEAK}$ n=2(+; functions), more positive attitude/self efficacy n=1 (+; functions) and higher pretrial exercise n=1 (+; activities and participation).

*Non-prescribed physical activity*

Three of the included studies (23-25) describing the variables experienced during 'non prescribed PA' contain patients with breast cancer (n=56; mean age in years: 54.7). These studies contain a total 30 barriers and 23 facilitators, of which the highest amount of barriers is found under environmental factors (n=9) and the highest amount of facilitators in the category of mental functions (n=8). The most important barriers and facilitators, mentioned in ≥3 studies are bad health n=1 (-; functions), lack of time n=2 (-; activities and participation), ill family member/family responsibilities n=1 (-;activities and participation), difficulties prioritizing exercise n=2 (-; activities and participation), fatigue/tiredness n=2 (-; disease and treatment related variables) nauseated or sick n=2 (-; disease and treatment related variables), weakness n=2 (-; disease and treatment related variables) and bad weather n=1 (-; environmental factors), maintain optimal weight n=1 (+; functions), improve general health/feel better n=2 (+; functions),higher post intervention $VO_{2PEAK}$ n=1 (+; funtions)

OTHER THAN BREAST CANCER DIAGNOSIS

The other seven studies (27-33) contain patients with a diagnosis other than breast cancer (e.g. bladder, brain, colon) or mixed population (n=781; mean 130.2 (range 60-397).

In these seven studies a total of 36 barriers and 21 facilitators is found.

Populations with other cancer diagnosis experience the most 'disease and treatment'- and 'activities and participation' related barriers (n=9) and function related facilitators (n=7) they experience the least barriers in 'personal factors' (n=4) and facilitators (n=0) in the category of 'disease and treatment'. Perceived behavior control n=3 (+; functions) and intention n=3 (+; personal factors) are important variables, determined in three or more studies by patients with other than breast cancer diagnosis only.

*Home-based physical exercise*

In the four selected studies (27-30) which prescribe home based exercise and contain patients with other than breast cancer diagnosis (n=318; mean age in years:55.9) a total of 25 barriers and 11 facilitators is found. The category of *Activities and participation* contains a peak of barriers (n=8). (*Mental) functions* contains the most facilitators (n=4).

The most important barriers and facilitators, mentioned in ≥3 studies are flu n=1 (-; functions), lack of time n=2 (-; activities and participation), family responsibilities n=1 (-; activities and participation), fatigue n=2 (-; disease and treatment related variables) and bad weather n=1 (-; environmental factors), Perceived behavior control (PBC) n= 2 (+; functions), positive attitude/self efficacy n= 1 (+; functions), higher pretrial exercise n=2 (+; activities and participation) and intention n=2 (+; personal factors).

*Supervised physical exercise*

No studies are found containing other than breast cancer patients, participating in a supervised physical exercise program.

*Non-prescribed physical activity*

Three studies (31,32) containing patients with other than breast cancer diagnosis (n=463; mean age in years:66.6) describing the variables experienced during 'non

prescribed PA' show a total of 11 barriers and 10 facilitators. These studies show a peak of barriers (n=5) as well as facilitators (n=4) in the category of *environmental factors.*

The most important barriers and facilitators, mentioned in ≥3 studies are lack of time n1 (-; activities and participation) and metastatic disease n=1 (-; disease and treatment related variables).

**Discussion**

The aim of this study was to identify barriers and facilitators to physical activity for patients with cancer during or after their treatment. We also wanted to detect possible differences in barriers and facilitators to physical activity during or after cancer treatment between different research groups: a) breast- or other cancer diagnosis, b) home based or supervised exercise and non prescribed physical exercise or activity. In total, 18 studies were identified, 11 concerning patients with breast cancer and 7 describing patients with other types of cancer. In total 80 unique barriers and 63 facilitators are found in the selected literature.

In a previous review on (only) barriers to physical activity for cancer patients, Brawley et al. (12) identified a total of 16 unique barriers in nine studies. 'Fatigue/ tiredness' and 'no time to exercise' were the barriers most mentioned. Our findings regarding barriers are more extensive but correspond to the results described by Brawley et al.

In this review we found nine barriers (-) which are mentioned in ≥3 studies. 'Fatigue/ tiredness' and 'no time to exercise' are the barriers most mentioned, both are found in six studies, followed by 'family responsibilities' and 'nauseated or sick' (n=5), 'disease and treatment related physical discomforts' and 'bad weather' (n=4) and 'flu/cold, bad health', 'metastatic disease' and 'difficulties prioritizing exercise' (n=3). The breast cancer population scores the majority (74.4%) of the barriers mentioned (29 out of 39). The barriers found are mentioned in the home based and supervised exercise groups as well as the 'control' groups without any prescription for physical activity.

'Difficulties prioritizing exercise' is mentioned by breast cancer patients only. A possible explanation is the patient category; women who are often active in work-

and family life, which has higher priority than being physical active. The other barriers are also mentioned, though less frequent, in the population with patients with other cancer diagnosis.

The facilitators (+), mentioned in ≥3 studies contain 'feel better and improve wellbeing' and 'higher pretrial exercise'(n=6), 'more positive attitude/ self efficacy' and 'maintain optimal weight' (n=4) and 'higher post intervention $VO_{2peak}$', 'group support', 'perceived behavior control' and 'intention to be physical active' (n=3). The breast cancer population scores the majority (68.8%) of facilitators most mentioned (22 out of 32). 'Higher post intervention $VO_{2peak}$', 'maintain optimal weight' and 'group support' are only mentioned in the breast cancer population. This can be explained by the fact that these are (partly) related to supervised exercise, applied only in breast cancer populations as found in the current literature. 'Higher post intervention $VO_{2peak}$' or prevent a decrease of $VO_{2peak}$ is often a goal in supervised exercise groups and has to be measured, which requires equipment as well as expertise and professional supervision. 'Maintain optimal weight' might be characteristic for the breast cancer population, women who are aware of the risk of gaining- and difficulties of maintaining optimal weight during cancer treatment (20). It is not clear if the positive influence of 'group support' is specific for breast cancer patients or women in particular, though some of the included studies mention very specific, cancer related reasons for group exercise with other breast cancer patients e.g. being able to exercise without a wig and discuss disease and treatment related issues (20, 24).
'Perceived behavior control' and 'intention to be physical active' are only mentioned in the population with patients with other cancer diagnosis. Since they appear in a series of studies, using the same measurement methods, these facilitators seem to be specific for the methods as used (type of questionnaire) but not for the population they were mentioned in. Most frequently mentioned facilitators ('feel better and improve wellbeing' and 'higher pretrial exercise') seem to correspond with the more active patients. They are aware of the positive effects of PA and the perception of barriers may be lower, because they have successfully dealt with overcoming these barriers or the barriers may simply be 'excuses' given by the less active patients.
We have to take into account that the group with other than breast cancer diagnosis is only as large as 36% of the breast cancer population in the included studies

(n=318 vs n=894), which possibly influences the amount of barriers and facilitators as showed in the literature.

The number of studies classified in the different subgroups correspond very well for the two populations. Home-based exercise as well as non-prescribed physical exercise contain an equal number of studies (4 resp. 3) for breast cancer patients and patients with other cancer diagnosis. Studies with supervised exercise programs are only found for breast cancer populations.

The barriers and facilitators most frequently mentioned (n≥3) are mentioned for supervised as well as non-supervised exercise and appear in the breast cancer population as well as the population with other types of cancer. These barriers and facilitators, except for 'disease and treatment related physical discomforts' and 'metastatic disease' are also mentioned in 'healthy' populations (34) and therefore they do not seem to be disease related, though fatigue might be a cancer treatment specific side-effect (4,5).

The barrier 'no one to exercise with' is specific for the non-supervised study groups and the only specific barrier for home-based exercise. Remarkable are the barriers 'distance', 'location' and 'transportation', found for non-prescribed physical activity only where they seem to be 'supervised exercise' related. 'Lack of equipment and facilities', 'lack of knowledge exercise staff' (of local gym) and 'lack of family support' are as well specific, though less remarkable, for non-prescribed physical activity. There are no specific barriers found for supervised exercise.

Specific facilitators for home-based exercise are 'exercising conform a program' and 'get mind of cancer treatment'. Supervised exercise shows program specific facilitators e.g. towards aerobic training, as well as the positive experience of the availability of supervision and expertise and the ability to exercise without a wig. The specific facilitators for non-prescribed physical activity are 'planning' (flexible and independent of other people) and exercise at home, alone without supervision, flexible through the day and no prescribed exercise or exercise schedules.

At all domains, except demographic factors, breast cancer patients experience more types of barriers than patients with an other cancer diagnosis (tables 3 and 4). The subgroup of 'disease and treatment related variables' shows the largest difference (n=22) in number of variables. A likely explanation is that there are more studies

(n=11) available which describe patients with breast cancer diagnosis on this topic and contain a larger population (61% of total) than the studies (n=7) which describe patients with other cancer diagnosis.

*Study limitations*

Because of the variety of methods to identify types of facilitators and barriers as used in the included studies, the extent of comparison between these studies is limited. Heterogeneity in outcomes, partly caused by the differences between qualitative and quantitative approaches, makes the comparability of variables in the included studies very difficult. Only three studies mention the number of participants that report a specific barrier or facilitator. The best way to collect barriers and facilitators in physical exercise studies and activities, as experienced during or after cancer treatment, seems to be by qualitative methods over open surveys or interviews in a prospective or cross sectional study design. In this way, no assumptions are made towards the patients as questionnaires with possible barriers and facilitators listed do. Some studies describe the same population, which results in 18 studies describing 12 populations. It is possible that some studies describe the same results, used in a different context and publication; this will influence the number and appearance of specific types of barriers.

There is a big variety in patient numbers between the included studies; we have to keep this in mind when looking at the mentioned variables. A variable mentioned by many persons, or as an outcome in a study with a large study population, might be of greater importance as one experienced by a few people.

*Recommendations for future research*

There is a need for further research to describe the types of barriers and facilitators, experienced by patients with a cancer diagnosis other than breast cancer, who exercise under supervision. We did not find such outcomes in the current literature.

The modified ICF-construct as used in this study gives a clear and realistic view of types of barriers and facilitators in physical exercise during or after cancer treatment. This may help future researchers and PA trainers in the choice or development of interventions to increase the number of exercising patients and their adherence rates.

We think it is of greater value in future research to list the number of people experiencing a barrier or facilitator rather than e.g. just calculating correlations with 5-point Likert scores.

Finally we advise future researchers on the topic of barriers or facilitators to use a construct similar to or based on the construct we used in this study, to identify the domain of the variable. This is helpful in the development of accurate interventions through the specified facilitators or aiming at specific barriers.

*Recommendations for practice*

Fatigue is a well known barrier for PA of patients with cancer and PA improves the physical and psychological health of patients with cancer, which also means reduction of fatigue (8-10). Lack of time is known as a barrier to PA in healthy populations as well as for patients with a cancer diagnosis (4,34). Considering this it might be useful to anticipate at these two important barriers, by e.g. discussing exercise hours with the patients, when starting an exercise group or when instructing or advising people about PA.

The fact that the physical activity level of cancer patients might be reduced by the (side) effects of surgery and adjuvant therapy, as in radiation- and chemo-therapy (8) is confirmed by the number of barriers as found under 'disease and treatment related variables'. It might be useful to focus on these domains when developing or modifying a supervised exercise program for physical activity during or after cancer treatment, by e.g. taking the chemo-therapy cycle and treatment days into account when planning exercise days and making training schedules. Informing family and friends about the use of being physical active during cancer treatment is useful to create social support. The supervised group-wise exercise is experienced as positive and might be preferred to individual supervised programs, though transportation, location and distance can be important factors.

When instructing people for a home-based exercise program, it is recommended to make sure that the patients have access to equipment if needed and to create a possibility of support of an expert e.g. by phone, website or e-mail.

# Figures and Tables

| Subgroups; variables (n) | Personal variables | | | | | Disease and treatment related variables | Environmental factors |
|---|---|---|---|---|---|---|---|
| | Functions | | Activities and participation | Personal factors | | | |
| | Physical | Mental | | Demographic | Lifestyle | | |

**Figure 1. Division of subgroups conform the modified ICF construct.**

```
┌─────────────────────────────┐
│ Potentially relevant articles│
│ after search in digital      │
│ databases: n=385             │
└─────────────────────────────┘
            │         ┌──────────────────┐
            ├────────▶│ Double: n=142    │
            ▼         └──────────────────┘
      ┌──────────┐
      │ n=243    │
      └──────────┘
            │         ┌──────────────────────────┐
            │         │ Exclusions on title and  │
            ├────────▶│ abstract: n=221          │
            │         │ intervention (n=95),     │
            ▼         │ outcome (n=64), population│
      ┌──────────┐    └──────────────────────────┘
      │ n=22     │
      └──────────┘
┌──────────────────┐  │       ┌──────────────────────────┐
│ Inclusion after  │──┤       │ Exclusions on full text: │
│ reference        │  ├──────▶│ n=8;                     │
│ tracking: n=3    │  │       │ design (n=1), outcome    │
└──────────────────┘  ▼       │ measures (n=6), population│
      ┌──────────┐            └──────────────────────────┘
      │ n=17     │
      └──────────┘
┌──────────────────┐  │
│ Inclusion by     │──┤
│ external supply: │  │
│ n=1              │  ▼
└──────────────────┘ ┌──────────────────┐
                     │ Analyses: n=18   │
                     └──────────────────┘
```
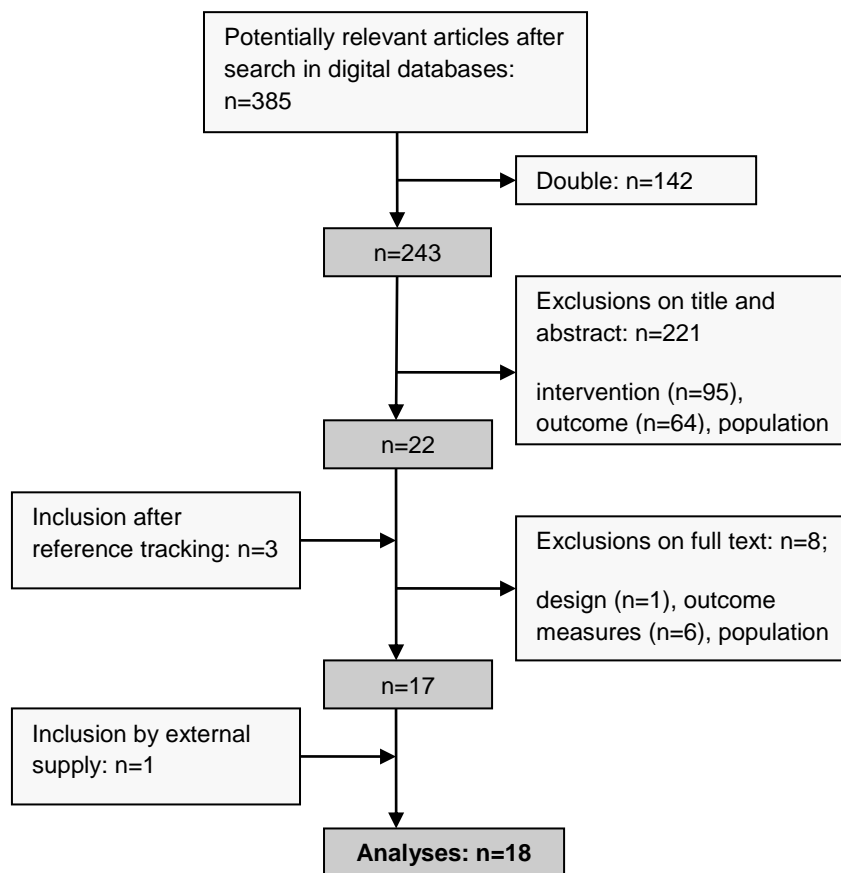
**Figure 2. Flow diagram for trial identification and selection.**

**Table 1. Overview of included studies concerning breast cancer populations (merged cells contain same population).**

| Study | Design | Home-based- / supervised physical exercise | Population (n) and characteristics | Adjuvant therapy | Outcomes (in Bold); Assessment of barriers and facilitators |
|---|---|---|---|---|---|
| **Home based exercise** | | | | | |
| Courneya, 2001 (16) | Prospective cohort | Dragon boat racing competition training: twice/week during 12 weeks | n=24<br><br>age, mean(SD):51.13(6.89)<br><br>months since diagnosis, mean(SD):53.48(31.41)<br><br>Posttreatment:83% | 17%CT 17%RT 48%C+RT 100%S | **Possible predictors of exercise adherence rates:** Correlates of behavioral, control and normative beliefs and its respective global construct (attitude, PBC or subjective norm by TPB -based questionnaire), intention and **program attendance** |
| Jones, 2004 (21) | 3-armed RCT | Oncologist's recommendation towards physical exercise; recommendation + referral to exercise specialist<br><br>usual care(n=150) intervention(n=150) intervention + referral (n=150) | n=450<br><br>age, mean(SD):56(12) | 44%CT 63%RT 100%S | **Possible effect of oncologist's recommendation on self-reported total exercise** (LSI) in MET hours per week; total exercise frequency during cancer treatment |
| Pinto, 2009 (22) | Prospective cohort; intervention group of an RCT | 12-week home-based moderate-intensity exercise intervention (walking) | n=43;♀100%<br><br>age, mean(SD):53.42(9.08)<br><br>mean years since diagnosis(SD):1.74(1.94) | 55.8%CT 65.1%RT 92%S | **Predictors of exercise adherence**; whether weekly exercise goal is met (by phone); demographic and medical data, pretreatment exercise, motivation and exercise self-efficacy: baseline questionnaire |
| Vallance, 2007 (26) | RCT; 4-armed | Recommendation to perform moderate/vigorous physical activity: all participants;<br>**group1:** pedometer for 12 weeks(n=94)<br>**group2:** exercise guide for breast cancer survivors(n=94)<br>**group3:** receives both(n=93)<br>**group4:** recommendation only(n=96) | n=377<br><br>age in years, mean:58 (range 30-90)<br><br>months postdiagnosis, mean(SD):39.0(11.3) | 38%CT | **Effect of recommendation, exercise guide and/or pedometer on PA:** Self reported PA: LSI; 7-day step test with pedometer (at baseline and 12 weeks) |
| **Supervised exercise** | | | | | |
| Courneya, 2009 (17) | 3-armed retrospective | Both exercise groups exercise for the duration of chemotherapy | n=242 | 100%CT | **Possible predictors of exercise adherence:** Demographic and medical data; physical fitness |

| | | | | | |
|---|---|---|---|---|---|
| | | aerobic exercise(n=78) resistance exercise(n=82) usual care(n=82) | age: mean:49.2 (range 25-78) | | variables; PRO's:cancer-specific QoL and fatigue by FACT-an scale; Motivational constructs by TPB-based questionnaire and follow-up exercise adherence (exercise behavior over past 6 months(follow-up exercise adherence) by LTEQ) |
| Courneya, 2008[a] (18) | Prospective three-armed RCT | | | | **Barriers to supervised exercise** (responses on open ended question by phone, when participant cancels training or did not show up) |
| Courneya, 2008[b] (19) | | | | | **Predictors of adherence to supervised exercise training during breast cancer chemotherapy** measured via analyses of demographic and medical data, behavioral and fitness data, PRO and TPB constructs |
| Emslie, 2007 (20) | Qualitative research (7 focus groups) in participants of an ongoing RCT | Intervention group: supervised group exercise program, for 12 weeks | n=36 age, mean 53 (range 40-76) | n=10RT n=23CT+RT | **Barriers and facilitators in group exercise:** focus groups; items contain: **1)**Supervised exercise; **2)**group exercise; **3)**barriers related to gender and identity: appearance and body image or **4)**women's social roles |
| **Non prescribed physical exercise** | | | | | |
| Rogers, 2007 (23) | Pilot study, cross-sectional | No intervention; Focus groups | n=23 age in years: <50:26%; 50-60:52%; >60:22% | 39%CT | **Perceived barriers** (survey, how often 30 barriers interfered with exercise and focus groups) |
| Rogers, 2004 (24) | Retrospective qualitative (3 focus groups) | No intervention; Focus groups | n=12 age, mean(SD): 54(7.5) mean months since treatment(n=10) (SD): 16(21) | 16.7%UT | **Barriers and facilitators in group exercise:** focus groups; items contain: **1)**self-efficacy; **2)**environmental factors; **3)**expectancies |
| Rogers, 2005 (25,25) | Cross-sectional survey | No intervention; Focus groups | n=21 age in years: <50:24%; 50-60:52%; >60:24% time in weeks post-surgery >6 | 38%CT 48%UCT 100%S | **Barrier self-efficacy to PA** by five items in questionnaire **Perceived barriers to PA** by rating 30 possible barriers |

RCT=randomized controlled trial;  CT=chemotherapy; RT=radiotherapy; S=surgery UT=under treatment; UCT=undergoing chemotherapy; URT=undergoing radiotherapy;   TPB=Theory of Planned Behavior; PBC=Perceived Behavior Control; PRO=patient rated outcome;  Qol=quality of life;  FACT-an= functional assessment of cancer therapy-anemia; LTEQ= leisure time exercise questionnaire; MET=metabolic equivalent;  LSI=Leisure Score Index of the Godin Leisure Time Exercise Questionnaire; PA=physical activity

**Table 2. overview of included studies concerning cancer, other than breast, or mixed populations (merged cells contain same population).**

| Study | Design | Control / Intervention Home-based / supervised physical exercise | | Population (n) + characteristics | Cancer(s) | Adjuvant therapy | Outcomes (in Bold) Assessment of barriers and facilitators |
|---|---|---|---|---|---|---|---|
| **Home based exercise** | | | | | | | |
| Courneya, 2004[a] (27) | Two-armed RCT (Colorectal Cancer and Home-Based Physical Exercise (CAN-HOPE) - trial) | Control: no start of structured exercise program, no exercise prescription | | n=93 (Intervention:n=62); ♂:58.1% | Colorectal | 46.2%CT 19.4%C+RT 100%S | **predictors of exercise contamination and adherence:** TPB- and FFM-based questionnaire; demographic an medical data, (past) exercise (LSI) and exercise stage of change and physical fitness |
| | | | | age, mean(SD):60.3(10.4) | | | |
| | | Intervention: fitness consultation following a personalized 16 week exercise prescription; weekly phone calls to report exercise behavior and solving exercise barriers | | inclusion: surgery within past 3 months | | | |
| | | | | days post surgery, mean(SD):73.6(29.6): | | | |
| Courneya, 2005 (28) | Longitudinal study with exercise group CAN-HOPE-trial | | | n=69; ♂:56.5% | | 43.5%CT 21.0%C+RT 100%S | weekly phone call: If reported that exercise was <3x30 min in past week, **main reason for not achieving** prescription was asked **Baseline predictors of exercise adherence** |
| | | | | age, mean(SD):59.9(10.7) | | | |
| | | | | days post surgery, mean(SD):74.6(34.0) | | | |
| Courneya, 2002 (29) | RCT group-Home Based Physical Exercise (HOPE) trial | Control: Asked not to start a structured exercise program, not provided with an exercise prescription | Exercise group: home-based personalized exercise program. Weekly report of past week exercise | n=96 (exercise group;n=51); ♀:86.7% | Any, cancer survivors (breast: 44.4%) | 66.7%CT (38.1%UCT) 45.2%RT (19.0%URT) 85.7%S | **possible predictors of exercise adherence:** Past exercise (LSI); exercise adherence and contamination (LSI); TPB constructs through survey (intention and PBC) |
| | | | | age, mean(SD):50.53(10.08) | | | |
| | | | | months since diagnosis, mean(SD):15.71(16.70) | | | |
| Courneya, 2004[b] (30) | Prospective cohort with exercise group GROUP-HOPE-trial | - | | n=60; ♀:80% | Any, cancer survivors (breast 33%) | 71%CT (23%UCT) 55%RT (17%URT) | **Predictors of postprogram exercise:** Perceived success; Causal dimensions (CDSII); Affective reactions; Expected success; Program and postprogram exercise (LSI); Objective |
| | | | | age, mean(SD):52.8(10.0) | | | |

24

| | | | | | 73%S | success; |
|---|---|---|---|---|---|---|
| | | | months since diagnosis, mean(SD):17.8(19.1) | | | |

| **Non prescribed physical exercise** | | | | | | |
|---|---|---|---|---|---|---|
| Karvinen, 2009 (31) | Prospective cohort | | n=397; ♂74.7% | | | **exercise counseling and programming preferences** measured by a self-developed questionnaire |
| Karvinen, 2007 (32) | Prospective cohort | No intervention | age, mean(SD):70.2(11.2) 30%<65 year≥70% months since diagnosis: mean(SD): 72.4(42.4) 46.6%<60≥53.4% | Bladder | 64.8%CT or RT | **Possible predictors of exercise behavior:** Demographic, medical, behavioral and social cognitive (TPB-constructs) variables, assessed in a baseline questionnaire; Exercise behavior via 3-month questionnaire (LSI) |
| Peeters, 2009 (33) | Program evaluation (qualitative + quantitative approach) | No intervention | n=66 age, mean(SD):62.9(11.3) mean years since diagnosis(SD):3.6(2.7) | Breast(n=35), prostate (n=26), colorectal(n=5) | 9%UT | **Barriers/costs to structured exercise intervention during treatment:** Structured phone survey; open ended-questions Structured phone survey; questions contain perceived need for and preferred characteristics of exercise program; open ended-questions: perceived benefits |

RCT=Randomized Clinical Trial;  CT=chemotherapy; RT=radiotherapy; S=surgery UT=under treatment; UCT=undergoing chemotherapy; URT=undergoing radiotherapy;  TPB=Theory of Planned Behavior; FFM=five factor model; LSI=Leisure Score Index of the Godin Leisure Time Exercise Questionnaire; PBC=Perceived Behavior Control

**Table 3. Barriers (-) and facilitators (+)(divided by ---- line) as found in studies describing populations with breast cancer diagnosis; categorized conform the modified ICF construct.**

| Personal variables | | | Disease and treatment related variables | Environmental factors |
|---|---|---|---|---|
| **Functions** | **Activities and participation** | **Personal factors** | | |
| **Patients with breast cancer** | | | | |
| **Home based physical exercise** | | | | |
| **Physical functions (-)n=1; (+)n=2** | **(-)n=2; (+)n=4** | **Demographic** | **(-)n=4; (+)n=0** | **(-)n=2; (+)n=4** |
| pain or soreness (-) (16) | lack of time (-) ♦ (16) | - | fatigue/tiredness (-) ♦ (16) | bad weather (-) ♦ (16) |
| ------------------------------------------------------- | ill family member/family | | nauseated or sick (-) ♦ (16) | no one to exercise with (-) (16) |
| maintain optimal weight (+) ♦ (16) | responsibilities (-) ♦ (16) | **Lifestyle/behavior (-)n=0; (+)n=1** | too busy/no time, if treatment | ---------------------------------------------------- |
| improve general health/ feel better (+) ♦ (16) | ---------------------------------------------- | maintain a normal lifestyle (+) (16) | (appointments) related (-) (16) | group support / meeting new people / |
| | meeting exercise guidelines prior to | | other medical/health problems (-) (16) | other persons with cancer (+) ♦ (16) |
| **Mental functions (-)n=0; (+)n=4** | trial(+)/higher pretrial exercise (+) ♦ | | | recommendation by specialist/physician |
| more positive attitude/self efficacy (+) ♦ (22) | (16,22) | | | (+) (16,21) |
| feel better and improve well being (+) ♦ (16) | social/friends (+) (16) | | | support of other people (+) (16) |
| relieve stress (+) (16) | maintain social interactions (+) (16) | | | use of equipment (+) (26) |
| get mind off cancer and treatment (+) (16) | spouse(partner) (+) (16) | | | |
| **Supervise physical exercise** | | | | |

| | | | | |
|---|---|---|---|---|
| **Physical functions (-)n=3; (+)n=3**<br>injury (-) (18)<br>forgot (-) (18)<br>flu/cold /bad health (-) ♦ (18)<br>maintain optimal weight (+) ♦ (17,19)<br>higher postintervention $VO_{2PEAK}$ (+) ♦ (17,19)<br>stronger/strength improvement (+) (17,19)<br><br>**Mental functions (-)n=2; (+)n=4**<br>fear to get injured (-) (20)<br>personal issues (-) (18)<br>-------------------------------------------------------<br>more positive attitude/self efficacy (+) ♦ (17)<br>stronger perceptions of control over RET (+) (17)<br>stronger subjective norm over AET (+) (17)<br>feeling safe(supervised) (+) (20) | **(-)n=9; (+)n=6**<br>lack of time (-) ♦ (18)<br>ill family member/family responsibilities (-) ♦ (18,20)<br>difficulties prioritizing exercise (-) ♦ (20)<br>work issues (-) (18,20)<br>vacation (-) (18)<br>out of town (-) (18)<br>transportation problems (-) (18)<br>home exercise (-) (18)<br>miscommunication (-) (18)<br>-----------------------------------------------<br>meeting exercise guidelines prior to trial(+)/higher pretrial exercise (+) ♦ (17)<br>social/friends (+) (20)<br>education (higher) (+) (19)<br>structure and distraction (+) (20)<br>motivation (by others) (+) (20)<br>able to discuss (disease related) experiences (+) (20) | **Demographic (-)n=0; (+)n=1**<br>younger age (+) (17)<br><br>**Lifestyle/behavior (-)n=3; (+)n=3**<br>lost interest (-) (18)<br>depression (-) (19)<br>smoking (-) (19)<br>---------------------------------------------<br>higher baseline motivation for AET and RET (+) (17)<br>more favorable instrumental attitudes toward AET and RET (+) (17)<br>appearance and gender identity (+) (20) | **(-)n=17; (+)n=3**<br>fatigue/tiredness (-) ♦ (18)<br>nauseated or sick (-) ♦ (18)<br>physical discomforts: diarrhea, dizziness, tachycardia, headache, weakness, general malaise (-) ♦ (18)<br>too busy/no time, if treatment (appointments) related (-) (18)<br>metastatic disease (-) ♦ (18,19)<br>pain (-) (18)<br>lumpectomy (-) (17)<br>hospitalized (-) (18)<br>infection (-) (18)<br>line inserted (-) (18)<br>medical complication (-) (18)<br>low blood counts (-) (18)<br>depressed (-) (18)<br>radiation markings (-) (18)<br>blisters (-) (18)<br>dealing with problems of hair loss (-) (20)<br>weight gain (-) (20)<br>-----------------------------------------------------<br>reduction of fatigue (+) (17) *if not cancer related: functions*<br>nontaxane chemotherapy (+) (17)<br>breast conserving surgery (+) (17) | **(-)n=4; (+)n=3**<br>bad weather (-) ♦ (18)<br>holiday/closure (-) (18)<br>lack of childcare (-) (18)<br>visitors (-) (18)<br>-------------------------------------------------<br>location/center (+) (19)<br>ability to exercise without wig (+) (20)<br>supervision/expertise (+) (20) |

**Non prescribed physical exercise**

| | | | | |
|---|---|---|---|---|
| **Physical functions (-)n=2; (+)n=5**<br>increased fatigue (-) (24)<br>flu/cold /bad health (-) ♦ (23)<br>------------------------------------------------------<br>maintain optimal weight (+) ♦ (23)<br>improve general health/ feel better (+) ♦ (23,24)<br>higher postintervention $VO_{2PEAK}$ (+) ♦ (23) | **(-)n=5; (+)n=1**<br>lack of time (-) ♦ (23,24)<br>ill family member/family responsibilities (-) ♦ (23)<br>difficulties prioritizing exercise (-) ♦ (23,24)<br>discouragement(by others and instructor) (-)(23) | **Demographic**<br>-<br>**Lifestyle/behavior (-)n=4; (+)n=3**<br>lost interest (-) (23)<br>procrastination (-) (23)<br>boring (-) (23)<br>exercise too strenuous (-) (23)<br>--------------------------------------------- | **(-)n=4; (+)n=3**<br>fatigue/tiredness (-) ♦ (23,24)<br>nauseated or sick (-) ♦ (23,24)<br>physical discomforts: diarrhea, dizziness, tachycardia, headache, weakness, general malaise (-) ♦ (23,24)<br>pain (-) (23)<br>------------------------------ | **(-)n=9; (+)n=3**<br>bad weather (-) ♦ (23)<br>no one to exercise with (-) (23)<br>inconvenient exercise schedule (-) (23)<br>cost (-) (23)<br>lack of equipment (-) (23)<br>lack of facilities (-) (23)<br>lack of knowledge exercise staff (-) (23) |

| | | | | |
|---|---|---|---|---|
| improving survival (+) (24)<br>less fatigue (+) (24)<br><br>**Mental functions (-)n=6; (+)n=8**<br>fear to get injured (-) (23)<br>fear of contracting an infection from germs (-) (23,24)<br>lack of self-discipline (-) (23)<br>lack of enjoyment (-) (23)<br>not knowing how/lack of skills (-) (23)<br>feeling self-conscious about their looks (-) (23)<br>------------------------------------------------------------<br>more positive attitude/self efficacy (+) ♦ (23)<br>feel better and improve well being (+) ♦ (24)<br>relieve stress (+) (23)<br>get mind off cancer and treatment (+) (23)<br>providing motivation (+) (24)<br>higher barrier- and task self-efficacy (+) (25)<br>greater physical activity enjoyment (+) (25)<br>lower negative value score (+) (25) (i.e., less important to the subject to avoid negative exercise | lack of skills (-)(23)<br>----------------------------------------------<br>working less hours(+) (24) | feeling less bored (+) (23)<br>feeling more attractive (+) (23)<br>feeling less depressed (+) (23) | feeling less fatigued (+) (23)<br>feeling less nausea (+) (23)<br>waiting until the 10th day post treatment (+) (24) | lack of family support (-) (23)<br>lack of transportation (-) (23)<br>------------------------------------------------------<br>group support / meeting new people / other persons with cancer (+) ♦ (23,24)<br>presence of exercise partner (+) (25)<br>exposure to breast cancer exercise role models(+) (25) |

RET=resistance exercise training; AET=aerobic exercise training; ♦:mentioned in ≥3 studies

**Table 4. Results barriers (-) and facilitators (+)(divided by ---- line) as found in studies describing populations with a cancer diagnosis, other than breast, or mixed; categorized conform the modified ICF construct.**

| Personal variables | | | Disease and treatment related variables | Environmental factors |
|---|---|---|---|---|
| **Functions** | **Activities and participation** | **Personal factors** | | |
| **Other than breast cancer patients** | | | | |
| **Home based physical exercise** | | | | |
| **Physical functions (-)n=4; (+)n=0** | **(-)n=8; (+)n=2** | **Demographic (-)n=0; (+)n=1** | **(-)n=7; (+)n=0** | **(-)n=3; (+)n=1** |
| car injury (-) (28) | employment status(fulltime) (-) (27,28) | sex (+) (29) | fatigue (-) ♦ (26,28) | treatment protocol(radio- &chemotherapy/multimodal)(-) (27) |
| flu/sore throat (-) ♦ (28) | lack of time/too busy (-) ♦ (27,28) | | surgical complications (-) (28) | doctor's orders/ physician recommendation (-) (28) |
| physical discomforts: *joint pain/ tendonitis, not feeling well, trouble breathing, back problems, mouth soreness, blood clot, weakness, vertigo, leg problems, low blood count, urinary tract infection, bad hip, broken rib, concurrent medical condition, shingles* (-) (28) | not completed university studies (-) (28) | **Lifestyle/behavior (-)n=2; (+)n=3** | nonspecific treatment side effects (-) (28) | bad weather (-) ♦ (28) |
| | not part of routine (-) (28) | progressing toward exercise prescription (-) (28) | nausea (-) ♦ (28) | --------------------------------------------- |
| | enough activity elsewhere (-) (28) | depression (-) (28) | Physical discomforts (-) ♦ (28) | program exercise (+) (30) |
| fever (-) (28) | holidays (-) (28) | --------------------------------------------- | hospitalized (-) (28) | |
| | social responsibilities (-) (28) | intention (+) ♦ (27,29) | transfusion (-) (28) | |
| | family death/responsibilities (-) ♦ (28) | extraversion (+) (29) | | |
| **Mental functions (-)n=1; (+)n=4** | --------------------------------------------- | normative beliefs (+) (29) | | |
| confusion (-) (28) | baseline exercise level/exercise stage (+) ♦ (27,29) | | | |
| --------------------------------------------- | assignment to experimental condition (+) (29) | | | |
| PBC (+) ♦ (27,29) | | | | |
| more positive attitude/self efficacy (affective reactions) (+) ♦ (30) | | | | |
| perceived success (+) (30) | | | | |
| expected success (+) (30) | | | | |
| influenced by an interaction between perceived success and personal perceived control (high expected success-> high perceived success and control) | | | | |

**Non prescribed physical exercise**

| | | | | |
|---|---|---|---|---|
| **Physical functions (-)n=1; (+)n=1** | **(-)n=1; (+)n=2** | **demographic (-)n=1; (+)n=0** | **(-)n=2; (+)n=0** | **(-)n=5; (+)n=4** |
| car injury (-) (28,33) | lack of time/too busy (-) ♦ (33) | age (-) (32) | adjuvant therapy (-) (32) | parking (-) (33) |
| ------------------------------------------- | --------------------------------------------- | | cancer invasiveness (-) ♦ (32) | distance/location/transportation (-) (33) |
| improved physical functioning (+) (33) | planning (+) (32) | **Lifestyle/behavior (-)n=1; (+)n=1** | | location in hospital (-) (33) |
| | increased social | lack of motivation (-) (33) | | equipment (-) (33) |
| **Mental functions (-)n=0; (+)n=2** | support/camaraderie (+) (33) | --------------------------------------------- | | prefer exercise outdoors (-) (33) |
| PBC (+) ♦ (32) | | intention (+) ♦ (32) | | ---------------------------------------------------- |
| feel better / improved psychological well- | | | | programming preferences: |
| being (+) ♦ (33) | | | | walking, starting immediately after |
| | | | | treatment, exercise alone, at home, at |
| | | | | moderate intensity, unsupervised, in the |
| | | | | morning or flexible through day and |
| | | | | flexible/not scheduled, counseling by |
| | | | | exercise specialist from cancer center, at |
| | | | | cancer center, face to face  (+) (31) |
| | | | | supervision (+) (33) |
| | | | | not a normal gym (+) (33) |
| | | | | access to equipment (+) (33) |

PBC=perceived behavior control; ♦:mentioned in ≥3 studies

**Table 5. Division of variables mentioned in ≥3 studies per category; *cursive*: only in concerning population.**

| Category | Personal variables | | | | | Disease and treatment related variables | Environmental factors |
|---|---|---|---|---|---|---|---|
| | Functions | | Activities and participation | Personal factors | | | |
| | physical | mental | | demographic | lifestyle | | |
| **Breast a)Home based b)supervised c)non prescribed PA** | flu/cold/bad health (-) b:n=1; c:n=1<br><br>*maintain optimal weight* (+) a:n=1; b:n=2; c:n=1<br><br>*higher post intervention VO$_{2PEAK}$* (+) b:n=2; c:n=1<br><br>more positive attitude/self efficacy (+) a:n=1; b:n=1; c:n=1<br><br>feel better and improve well being/ Improve general health (+) a:n=2; c:n=3 | | lack of time (-) a:n=1; b:n=1; c:n=2<br><br>family responsibilities (-) a:n=1; b:n=2; c:n=1<br><br>*difficulties prioritizing exercise* (-) b:n=1; c:n=2<br><br>higher pretrial exercise (+) a:n=2; b:n=1; c:n=1 | | | fatigue/tiredness (-) a:n=1; b:n=1; c:n=2<br><br>nauseated or sick (-) a:n=1; b:n=1; c:n=2<br><br>disease/treatment related physical discomforts (-) b:n=1; c:n=2<br><br>Metastatic disease (-) b:n=1 | bad weather (-) a:n=1; b:n=1; c:n=1<br><br>*group support* (+) a:n=1; c:n=2 |
| **Other a)Home based b)non prescribed PA** | flu/cold/bad health (-) a:n=1<br><br>more positive attitude/self efficacy (+) a:n=1<br><br>feel better and improve well being/ Improve general health (+) b:n=1<br><br>*perceived behavior control* (+) a:n=2; b:n=1 | | lack of time (-) a:n=1; b:n=1<br><br>family responsibilities (-) a:n=1<br><br>higher pretrial exercise (+) a:n=2 | *intention* (+) a:n=2; b:n=1 | | fatigue/tiredness (-) a:n=2<br><br>nauseated or sick (-) a:n=1<br><br>disease/treatment related physical discomforts (-) a:n=1<br><br>metastatic disease (-) b:n=1 | bad weather (-) a:n=1 |

Breast:population of breastcancer patients; other: population with other (than breast)cancer patients; home based:home based exercise; supervised:supervised exercise; PA:physical activity; (-) :barriers of physical activity and activity adherence; (+):facilitators of physical activity and activity adherence

# References

(1) Ferlay J, Bray F, Pisani P, Parkin DM. GLOBOCAN 2002. Cancer Incidence, Mortality and Prevalence Worldwide. 2004;IARC Cancer Base No.5 Version 2.0.

(2) American Cancer Society. Cancer Atlas cancer survivors. Available at: http://www.cancer.org/downloads/AA/CancerAtlas15.pdf. Accessed 4/9, 2010.

(3) Kennisnetwerk Integrale Kankercentra. Tabel A1c: Aantal invasieve tumoren bij mannen en vrouwen naar lokalisatie en incidentiejaar. Available at: www.ikcnet.nl. Accessed March 3, 2009.

(4) Lucia A, Earnest C, Perez M. Cancer-related fatigue: can exercise physiology assist oncologists? Lancet Oncol. 2003 Oct;4(10):616-625.

(5) Wagner LI, Cella D. Fatigue and cancer: causes, prevalence and treatment approaches. Br.J.Cancer 2004;91(5):822-828.

(6) Doyle C, Kushi LH, Byers T, Courneya KS, Demark-Wahnefried W, Grant B, et al. Nutrition and physical activity during and after cancer treatment: an American Cancer Society guide for informed choices. CA Cancer.J.Clin. 2006 Nov-Dec;56(6):323-353.

(7) Irwin ML, Crumley D, McTiernan A, Bernstein L, Baumgartner R, Gilliland FD, et al. Physical activity levels before and after a diagnosis of breast carcinoma: the Health, Eating, Activity, and Lifestyle (HEAL) study. Cancer 2003 Apr 1;97(7):1746-1757.

(8) Cramp F, Daniel J. Exercise for the management of cancer-related fatigue in adults. Cochrane Database Syst.Rev. 2008 Apr 16;(2)(2):CD006145.

(9) McNeely ML, Campbell KL, Rowe BH, Klassen TP, Mackey JR, Courneya KS. Effects of exercise on breast cancer patients and survivors: A systematic review and meta-analysis. Can.Med.Assoc.J. 2006 Jul;175(1):34-41.

(10) Knols R, Aaronson NK, Uebelhart D, Fransen J, Aufdemkampe G. Physical exercise in cancer patients during and after medical treatment: a systematic review of randomized and controlled clinical trials. J.Clin.Oncol. 2005 Jun 1;23(16):3830-3842.

(11) Leddy SK. Incentives and barriers to exercise in women with a history of breast cancer. Oncol.Nurs.Forum 1997 Jun;24(5):885-890.

(12) Brawley LR, CulosReed SN, Angove J, HoffmanGoetz L. Understanding the barriers to physical activity for cancer patients: Review and recommendations. J.Psychosoc.Oncol. 2002;20(4):1-21.

(13) Bandura A. Self-efficacy: The exercise of control. New York: W.H. Freeman; 1997.

(14) World Health Organization. International Classification of Functioning, Disability and Health: ICF. Geneva: World Health Organization; 2001.

(15) Meichenbaum D, Turk DC editors. Facilitating treatment adherence. New York: Plenum Press; 1987.

(16) Courneya KS, Blanchard CM, Laing DM. Exercise adherence in breast cancer survivors training for a dragon boat race competition: a preliminary investigation. Psychooncology 2001 Sep-Oct;10(5):444-452.

(17) Courneya KS, Friedenreich CM, Reid RD, Gelmon K, Mackey JR, Ladha AB, et al. Predictors of follow-up exercise behavior 6 months after a randomized trial of exercise training during breast cancer chemotherapy. Breast Cancer Res.Treat. 2009 Mar;114(1):179-187.

(18) Courneya KS, McKenzie DC, Reid RD, Mackey JR, Gelmon K, Friedenreich CM, et al. Barriers to supervised exercise training in a randomized controlled trial of breast cancer patients receiving chemotherapy. Ann.Behav.Med. 2008 Feb;35(1):116-122.

(19) Courneya KS, Segal RJ, Gelmon K, Reid RD, Mackey JR, Friedenreich CM, et al. Predictors of supervised exercise adherence during breast cancer chemotherapy. Med.Sci.Sports Exerc. 2008 Jun;40(6):1180-1187.

(20) Emslie C, Whyte F, Campbell A, Mutrie N, Lee L, Ritchie D, et al. 'I wouldn't have been interested in just sitting round a table talking about cancer'; exploring the experiences of women with breast cancer in a group exercise trial. Health Educ.Res. 2007 Dec;22(6):827-838.

(21) Jones LW, Courneya KS, Fairey AS, Mackey JR. Effects of an oncologist's recommendation to exercise on self-reported exercise behavior in newly diagnosed breast cancer survivors: a single-blind, randomized controlled trial. Ann.Behav.Med. 2004 Oct;28(2):105-113.

(22) Pinto BM, Rabin C, Dunsiger S. Home-based exercise among cancer survivors: Adherence and its predictors. Psychooncology 2009 Apr;18(4):369-376.

(23) Rogers LQ, Courneya KS, Shah P, Dunnington G, Hopkins-Price P. Exercise stage of change, barriers, expectations, values and preferences among breast cancer patients during treatment: a pilot study. Eur.J.Cancer.Care.(Engl) 2007 Jan;16(1):55-66.

(24) Rogers LQ, Matevey C, Hopkins-Price P, Shah P, Dunnington G, Courneya KS. Exploring social cognitive theory constructs for promoting exercise among breast cancer patients. Cancer Nurs. 2004 Nov-Dec;27(6):462-473.

(25) Rogers LQ, Shah P, Dunnington G, Greive A, Shanmugham A, Dawson B, et al. Social cognitive theory and physical activity during breast cancer treatment. Oncol.Nurs.Forum 2005 Jul 1;32(4):807-815.

(26) Vallance JK, Courneya KS, Plotnikoff RC, Yasui Y, Mackey JR. Randomized controlled trial of the effects of print materials and step pedometers on physical activity and quality of life in breast cancer survivors. J.Clin.Oncol. 2007 Jun 10;25(17):2352-2359.

(27) Courneya KS, Friedenreich CM, Quinney HA, Fields AL, Jones LW, Fairey AS. Predictors of adherence and contamination in a randomized trial of exercise in colorectal cancer survivors. Psychooncology 2004 Dec;13(12):857-866.

(28) Courneya KS, Friedenreich CM, Quinney HA, Fields AL, Jones LW, Vallance JK, et al. A longitudinal study of exercise barriers in colorectal cancer survivors participating in a randomized controlled trial. Ann.Behav.Med. 2005 Apr;29(2):147-153.

(29) Courneya KS, Friedenreich CM, Sela RA, Quinney HA, Rhodes RE. Correlates of adherence and contamination in a randomized controlled trial of exercise in cancer survivors: an application of the theory of planned behavior and the five factor model of personality. Ann.Behav.Med. 2002 Fall;24(4):257-268.

(30) Courneya KS, Friedenreich CM, Sela RA, Quinney HA, Rhodes RE, Jones LW. Exercise motivation and adherence in cancer survivors after participation in a randomized controlled trial: an attribution theory perspective. Int.J.Behav.Med. 2004;11(1):8-17.

(31) Karvinen KH, Courneya KS, Plotnikoff RC, Spence JC, Venner PM, North S. A prospective study of the determinants of exercise in bladder cancer survivors using the Theory of Planned Behavior. Support.Care Cancer 2009 Feb;17(2):171-179.

(32) Karvinen KH, Courneya KS, Venner P, North S. Exercise programming and counseling preferences in bladder cancer survivors: a population-based study. J.Cancer.Surviv. 2007 Mar;1(1):27-34.

(33) Peeters C, Stewart A, Segal R, Wouterloot E, Scott CG, Aubry T. Evaluation of a cancer exercise program: patient and physician beliefs. Psychooncology 2009 Aug;18(8):898-902.

(34) Trost SG, Owen N, Bauman AE, Sallis JF, Brown W. Correlates of adults' participation in physical activity: review and update. Medicine & Science in Sports & Exercise 2002;34(12):1996.

Appendix I: example of search strategy as executed in Medline

|      |                                                              | MedLine |
| ---- | ------------------------------------------------------------ | ------- |
| #1   | "Neoplasms"[Mesh]*                                           | 869328  |
| #2   | "Patients"[Mesh]                                             | 20433   |
| #3   | #1 AND #2                                                    | 3500    |
| #4   | "Exercise"[Mesh]                                             | 30238   |
| #5   | "Exercise therapy"[Mesh]                                     | 9631    |
| #6   | "Resistance training"[Mesh]                                  | 228     |
| #7   | "Physical therapy modalities"[Mesh]                          | 36166   |
| #8   | #4 OR #5 OR #6 OR #7                                         | 65085   |
| #9   | (#3) AND (#8)                                                | 144     |
| #a   | "Patient Dropouts"[Mesh]                                     | 3251    |
| #b   | #3 AND #9a                                                   | 177     |
| #c   | "Patient Compliance"[Mesh]                                   | 20260   |
| #d   | #3 AND #8 AND #c                                             | 14      |
| #10  | "Cancer treatment"[tw]                                       | 3154    |
| #11  | Adjuvant therapy[tw]                                         | 5857    |
| #12  | Chemotherapy[tw] OR "Chemotherapy, Adjuvant"[Mesh]           | 110717  |
| #13  | "Radiotherapy"[Mesh]                                         | 42282   |
| #14  | "Hormon* therapy"[tw] OR "Hormone replacement therapy"[Mesh] | 10739   |
| #15  | #10 OR #11 OR (#12) OR #13 OR (#14)                          | 157212  |
| #16  | (#9) AND (#15)                                               | 43      |
| #17  | Facilitator*[tw]                                             | 1652    |
| #18  | (#16) AND #17                                                | 0       |
| #19  | Barrier*[tw]                                                 | 21741   |
| #20  | Burden*[tw]                                                  | 21473   |
| #21  | Obstacl*[tw]                                                 | 3622    |
| #22  | #19 OR #20 OR #21                                            | 46065   |
| #22a | #17 AND (#22)                                                | 500     |
| #23  | (#18) AND (#22)                                              | 0       |
| #24  | (#3) AND #17                                                 | 5       |
| #25  | (#3) AND (#22)                                               | 140     |

* Mesh terms used contain all registered synonyms in the extended search strategy
e.g. "Neoplasms"[Mesh] : Neoplasm; Tumors; Tumor; Benign Neoplasms; Neoplasms, Benign; Benign Neoplasm; Neoplasm, Benign; Cancer; Cancers

# Reliability analyses of two Theory of Planned Behavior-based questionnaires

## And

# Relation between the individual intention to be physical active and adherence to activity programs in cancer patients

Analyses in an on-going RCT

G.B. Aarnoudse, PT
Student 9944613
Utrecht University
Henegouwen 32, 3524RA Utrecht, The Netherlands
e-mail: gerbenaarnoudse@hotmail.com

Setting: Comprehensive Cancer Center Middle Netherlands, University Medical Center Utrecht, Julius Center; Physical Activity during Cancer treatment (PACT) Study

Utrecht University,
School of Clinical Health Sciences, Department of Physiotherapy Science

**ABSTRACT**

**Objective:** Exercise adherence and staying physically active (PA) in general is a challenge for breast cancer patients during treatment. The Theory of Planned Behavior (TPB): subjective norm (Subj), attitude (Att), perceived behavior control (PBC) and intention (Int), combined with self efficacy (SE) is used as a framework to develop two questionnaires about PA adherence (Qadvice and Qprogramme). The objective of this study was to examine the reliability (test-retest and internal consistency) of two TPB-based questionnaires and report adherence rates of two PA interventions. TPB-determinants predicting adherence rates are reported.

**Methods:** Breast cancer patients (n=51), participating in the 'Physical Activity during Cancer treatment (PACT) Study' were randomly assigned to intervention A (n=24): receiving advise to stay physically active conform the Dutch norm for healthy physical activity (NNGB) or Intervention B (n=27): 18-week supervised training programme in combination with the PA advise of intervention A.

**Results:** Test-retest analyses show for Qadvice: only the *Subj* subscale is of moderate reliable quality (ICC=0.50), other subscales are not acceptable (ICC<0.4). Qprogramme: moderate reliability at *Subj* (ICC=0.53), *Att* (ICC=0.42) and *SE* (ICC=0.56). Reliability of *Int* and *PBC* is not acceptable (ICC<0.4). Internal consistency (Cronbach's α) varies from poor (α<0.7) to good (α≥0.7) for Qadvice (Int=0.59; Subj=0.09; PBC=0.43; Att=0.81; SE=0.89) as well as Qprogramme (Int=0.87; Subj=0.08; PBC=0.26; Att=0.90; SE=0.94).

Out of 36 supervised exercise sessions, the mean attendance was 27 (SD:5.7) where ≥30 sessions were set before as a target. Out of 18 weeks the mean attendance towards the advised PA-norm (NNGB) was 13.3 (SD:4.5), where ≥14 weeks were set before as a target.

Analyses indicated SE as a significant positive predictor of adherence to advised PA-norm for all participants (β=1.27; p=0.001) as well as Intervention B only (β=1.41; p=0.02).

**Conclusions:** Test-retest reliability of both questionnaires is moderate to poor and advised modifications will increase the internal consistency to an acceptable level. Adherence to advised PA-norm (NNGB) was predicted by higher scores on the SE determinant of Qadvice.

*Key words:* physical activity, supervised exercise, cancer, adherence, reliability

## INTRODUCTION

In The Netherlands, over 80.000 people are newly diagnosed with cancer every year (1). Though cancer-survival rates differ strongly between types of cancer and the stadium of disease during diagnosis, roughly 50% of the people diagnosed with cancer survive the disease (1). In total the prevalence of people with cancer and cancer survivors in The Netherlands is estimated at 400.000 (1).

As a result of the cancer, surgery, and/ or adjuvant treatments, 60-96% of the cancer survivors experience fatigue, depression, anxiety, reduced overall quality of life and weight gain (2,3).

Various studies found evidence that physical activity improves the physical and psychological health of patients with cancer (4). On the other hand, adoption and maintenance of physical activity is a challenge for healthy adults, and is likely to be even more difficult after a cancer diagnosis (3). The (side)effects of surgery and adjuvant therapy, as in radiation- and chemo-therapy, might be reasons for reduced activity levels in cancer patients (3,4). Oldervoll et al. (5) found that adherence to an exercise program may be lower during cancer treatment as a result of associated adverse effects, such as increased fatigue and decrease of well being.

Despite the knowledge of the positive effects of physical activity, few cancer survivors exercise at the recommended level (3). Irwin and colleagues reported a decrease in physical activity of two hours per week in a group of breast cancer survivors (6). A decrease in exercise of approximately 30% in 352 adult cancer survivors was reported by Blanchard et al. (7).

In addition to adverse treatment effects, the patient's attitude towards physical activity and external factors seem to influence continuation of physical activity too.

There is evidence that patients who participate in a supervised exercise program are significant more frequent and longer active than patients who exercise on their own or participate in a home-based program (8).

The intention to be physical active possibly predicts the actual lifestyle behavior or activity level during adjuvant treatment. To determine the difficult area of human behavior, we used the Theory of Planned Behavior (TPB, figure 1), as developed by Ajzen (9), as a template to measure several aspects related to (the intention to) human behavior.

Central to the theory of planned behavior is the idea that behavior is determined by behavioral intentions and perceived behavioral control. Behavioral intentions are representations of people's plans of action which summarise people's motivation to engage in behaviour (10). Behavioral intentions are influenced by 1) perceived behavioral control, 2) subjective norm (perceived social pressure to perform behavior) and 3) attitude (positive-negative evaluations of behavior) as summarized in figure 1. Perceived behavioral control reflects people's confidence to carry out a particular behavior. In this theory demographic (age, gender, race, ethnicity, education, income, religion), environmental (diagnosis, stress, media exposure) and personal characteristics (self-esteem, personality traits, locus of control, emotions, health concern) are considered determinants of behavior through affecting behavioral, normative and control beliefs (11).

We conclude that the TPB hypothesizes that the actual performance of a certain behavior can be predicted by the intention of a person to perform this behavior (12). Behavioral, normative and control beliefs and the intention to an active lifestyle during cancer treatment can be measured by a questionnaire, based on the TPB.

In addition to the TPB a fifth factor, self efficacy (SE), is added to the model. Self efficacy was first described by Bandura et al. (13) and is posted to have a fundamental role in human behavior. SE can be defined as a judgment regarding one's capabilities to execute a behavior required to attain a certain outcome, and it is believed to be critical to any attempt at behavioral change (14,15). Further on we will describe the TPB, combined with SE as TPB.


We will study the relations between subjective psychological determinants in the TPB (see figure 1) and adherence to a 1) supervised physical exercise program and 2) recommended daily activity level, during adjuvant cancer treatment.

To measure the TPB-subscales (see figure 1) in relation to adherence to physical activity in cancer patients two questionnaires (Qadvice and Qprogramme) were developed. In this study, we assessed internal consistency and test-retest reliability of these questionnaires.


Objectives

A: Reliability analyses of two TPB-based questionnaires
- a1) What is the test-retest reliability of Qprogramme and Qadvice measured over a one-week interval

- a2) Assess the internal consistency of Qprogramme and Qadvice, based on the TPB determinants *attitude toward specific behaviour, subjective norm, perceived behavioural control* and *intention to accomplish a specific behaviour* and *self efficacy* concerning:
    - Intervention A: recommendations according to the Dutch norm for healthy physical activity (NNGB), i.e. five times a week physical activity for at least 30 minutes on a moderate intensity (16) (Qadvice)
    - Intervention B: 18-week supervised training programme (Qprogramme), in addition to intervention A.

B: Examine the relation between TPB-determinants, as mentioned above, of:
- b1: Qprogramme and the actual exercise adherence (adherence rates) of the supervised exercise group
- b2: Qadvice and the adherence towards the NNGB of
    - b1) the supervised exercise group (intervention A + B)
    - b2) the group receiving NNGB recommendations only (intervention A)

**METHODS**

Design

Reliability- and longitudinal analyses in an ongoing trial.

Setting

This study is based on the data, gathered from cancer patients who were participating in the 'Physical Activity during Cancer treatment (PACT) Study'.

The PACT-study is a randomized clinical trial of physical exercise during cancer treatment. The study aims to get insight in the (cost-)effectiveness of early physical exercise and to reduce complaints of fatigue and improve health related quality of life, physical fitness, body composition and cognitive behavioral aspects.

The study population of the PACT-study is divided in an intervention and a control group. The intervention group is asked to take part in an 18-week supervised program, containing group wise training during one hour, two times per week. The intervention as well as the control group is advised to adhere to the NNGB, i.e. five times a week physical activity for at least 30 minutes on a moderate intensity (16).

Study population

*Inclusion criteria*

Newly diagnosed breast cancer patients (stage M0) were eligible for this study. Breast cancer patients were admitted for chemotherapy and/ or hormonal therapy. Patients have to meet inclusion criteria as displayed in table 1.

The population is randomized into two groups, receiving two different interventions. **Intervention A** contains recommendations of daily physical activity according to the NNGB i.e. five times a week physical activity for at least 30 minutes on a moderate intensity (16); **intervention B** is an supervised training programme, containing two exercise sessions (a combination of aerobic and strength training) a week during 18 weeks, in addition to intervention A.

a) Reliability analyses of TPB-based questionnaires

Two versions of a TPB-based questionnaire (Qadvice and Qprogramme) were used. The questionnaires were divided into five subscales to assess the four subscales of the TPB determinants and self efficacy (17), towards the concerning intervention.

- Qadvice concerns the adherence to intervention A and contains 23 questions, recorded on a 10-point Likert scale
- Qprogramme concerns the adherence to intervention B and contains 26 questions, recorded on a 10-point Likert scale

Both questionnaires were completed at moment of inclusion (T0) and one week after T0 (T1) (figure 2) and are displayed (in Dutch) in appendix I and II.

*a1) Test-retest reproducibility of TPB-based questionnaires*

Test-retest reliability, which measures stability over time, administers the same test to the same subjects at two points in time. In this case a one-week interval was used. Test-retest reliability of both questionnaires was assessed by calculating the intraclass correlation coefficients (ICC's) and 95% confidence intervals (CI's) of the subscales, with the scores of both questionnaires at T0 and T1.

ICC-values can be interpreted as followed: ICC>0.70 is considered acceptable (18,19). Other state that an ICC of 0.40 to 0.59 is of moderate reliability, 0.60 to 0.79 substantial and 0.80 outstanding (18).

*a2) Internal consistency of TPB-based questionnaires*

Internal consistency is calculated to measure the homogeneity of different questions, concerning the same subscale. A range of 0.7-0.8 for Cronbach's alpha has been accepted as valid; values substantially lower indicate an unreliable scale (5). Kline (20) noted that, although the generally accepted value of 0.8 is appropriate for cognitive tests such as intelligence tests, for ability tests a cut-off point of 0.7 is more realistic. When dealing with psychological constructs even lower values may be expected because of the diversity of constructs being measured (20).

Cronbach's alpha is calculated at T0 for all five TPB-subscales of both questionnaires.

b) <u>Adherence</u>

*b1)* Adherence to the exercise programme was measured by attendance checks during the training sessions (two times a week during 18 weeks(T0-T2)). Attendance rate for the exercise sessions  were recorded in a Case Record Form by the supervising physiotherapist.

*b2*) The daily physical activity of the participants, according to the NNGB advice, was self-registered by the patient during 18 weeks (T0-T2) in an 'activity diary'. At the start of this study all participants received an 'activity diary' and were instructed how to register their daily activities, with the option to adjust comments on their health status of the day.

The Mann-Whitney test will be calculated to detect possible differences in adherence between the two groups.

Univariate, linear regression analyses were done to find the values of the subscales of Qadvice, predicting the adherence rates of intervention A of 1) patients receiving intervention A only and 2) all participants; and the values of the subscales of Qprogramme, predicting adherence rates towards intervention B.

The outcomes of the regression analyses ($\beta$ (p)) indicate the probability of the increase of adherence of $\beta$ times the increase of the score on the concerning subscale.

*Data analyses*

Baseline characteristics were reported as means ± SD or as percentage of the study groups.

All data were entered into a database and all analyses were done using the Statistical Package for the Social Sciences (SPSS for Windows, release 15.0; SPSS Inc. Chicago Illinois, USA) and Microsoft Excel.

## RESULTS

*Sample size*

A total of 51 patients are included in the study. Reliability analyses contain the results of patients who were still participating in the programme at the time of the analyses, but had finished the questionnaire(s) at T1. Analyses for adherence were done only for the patients who have finished the 18-week study programme (T2) on December 2009.

Of the 51 people who completed the questionnaires at T0, the age varied between 30 and 69 years, mean(SD):46.7(9.1).

Response rates at T0 and T1 are given in table 2. Reasons for drop-out were lack of time, travel distance/transport problems, time of the day of exercise groups.

*a) Reliability analyses of TPB-based questionnaires*

*a1) Test-retest reliability*

Conform the ICC interpretations as described under methods,  the *subjective norm* subscale of Qadvice is of moderate reliable quality (0.50), other subscales are not acceptable (ICC<0.4). Qprogramme scores moderate reliability (ICC) at *subjective norm* (0.53), *attitude* (0.42) and *self efficacy* (0.56). *Intention* and *PBC* score below 0.4 (table 4).

*a2) Internal consistency*

Cronbach's alpha was calculated for all five TPB-subscales of both questionnaires at T0. Conform the cut-off points as given under methods, the subscales Att, SE and Int are reliable at both questionnaires at T0. Note that the subscale intention of the Qadvice will be more reliable (alpha=0.88) if question five is deleted from the questionnaire. The alpha of the PBC subscale  will increase when question 10 of Qprogramme is deleted (alpha increases to 0.46) and question 11 of Qadvice (alpha increases to 0.52) (see appendix III). An extended table with analyses per item and questionnaire is added in appendix III.

44

*b) Adherence*

*b1) Adherence to supervised exercise*

In total, 12 participants, age 29-55; mean (SD): 47.9(7.5), had finished the supervised exercise programme. Participation rates range between 16 (44.4%) and 33 (91.7%) out of 36 exercise sessions; mean (SD): 27(5.7). Five (42%) of the 12 patients attended ≥30 sessions (targeted in the questionnaire Qprogramme). At T0, all 12 participants expected to visit ≥30 sessions.

*b2) Adherence to activity advice*

In total, 26 people turned in their completed exercise diaries before December 2009. They started the 18 week-period between July 29, 2008 and May 28, 2009. Registrations per person: age; gender; exercised: yes, no, not mentioned; minutes of exercise per day; advised norm of physical exercise per week reached: yes, no. Age in years varies from 33-62, mean(SD): 48.19 (7.49). In total, 14 of 26 (53.8%) reached the advised norm during ≥14 weeks (range 0-18; Mean(SD): 13.3(4.5)). Out of these 14 patients, 8 (57.1%) participated in the supervised intervention group. If we compare the groups, the supervised intervention (B) group shows an adherence of 66.7% versus 43.0% of the 'intervention A' group.

*Advised norm of physical exercise per week, per person:*

Three out of 26 participants (11.5%) reached the advised NNGB PA-norm every week during this study. Only one person (3.8%) never reached this norm during the 18 weeks. On average over 18 weeks, per person, 73.9% (n=13 weeks) of the advised norm is reached. On average per week, 73.1% of the participants reached the advised norm.

*Intervention versus control*

Of the 26 completed activity diaries, 12 (46.1%) were from patients joining the supervised exercise program (intervention group); table 5 shows the adherence rates per group. The average rank of the intervention B group (supervised) shows a larger adherence rate (mean rank 14.2) than the intervention A group (advice to stay physical active only) (mean rank 12.9); Mann-Whitney test indicates that both groups report comparable levels of adherence towards advice (p=0.67).

*Regression analyses*

Univariate, linear regression analyses were done for the subscales of the questionnaires and the adherence rates towards advice or supervised training sessions of the following groups: 1) the total population, 2) group 'intervention A' and 3) group 'Intervention B'. The only two significant predictors found are SE, predicting adherence towards advice of all participants; ($\beta$=1.27; p=0.001) and SE predicting adherence towards advice of the supervised exercise group ($\beta$=1.41; p=0.02).

## DISCUSSION

The goals of this study were to assess the test-retest reliability and internal consistency of two TPB-based questionnaires. Secondly, we examined the relation between the TPB-determinants of the questionnaires and the adherence rates towards two interventions (A and B).

This study demonstrated that Qadvice has poor test-retest reliability (ICC<0.4) for all subscales but *Subjective norm*, which has moderate test-retest reliability (ICC = 0.50). Qprogramme has poor test-retest reliability for *Intention*, *PBC* and Attitude; *Subjective norm* and *SE* have moderate ICC-scores (0.53 and 0.56 respectively). Possible explanations for these poor to moderate reliability scores are known difficulties in test-retest settings. There may be invalidity due to a learning/practice effect (subjects learn from the first administration and adjust their answers on the second) (21); differences in the environment (test location versus home) possibly influences the patients answers. We also have to take into account that participants receive information about the study and PA during cancer in particular during baseline measurements. This information might influence the patients knowledge and opinion about PA during cancer treatment, which causes a change of scores of the questionnaires at T1. Considering this, it is recommended to hand out the questionnaires at the same moment (T0) under identical circumstances for each patient, since scores seem to change substantial over time .

The internal consistency of both questionnaires is measured by calculating the Cronbach's alpha of the five subscales at T0. Cronbach's alpha is the most common way to measure scale reliability (22) and is influenced by the heterogeneity of the sample and the number of items per scale (more items cause a higher α). Our

findings show that the subscales Att, SE and Int are reliable at both questionnaires, though Int of Qadvice is poor/ moderate (α=0.59). Note that the subscale *Intention* of the Qadvice will be reliable (alpha=0.88) if question five is deleted from the questionnaire. It is recommended to replace question five instead of deleting it, since the subscale *Intention* contains only three items. As a rule of thumb, a minimum of three items per scale is given (23); two items might be too little to cover the whole topic of the subscale. The alpha of the PBC subscale will increase when question 10 of Qprogramme is deleted (alpha increases to 0.46) and question 11 of Qadvice (alpha increases to 0.52). Deletion of these items is recommended since it increases the α-values substantially though reliability is still poor to moderate. The internal consistency of the *Subjective norm* subscale is very poor but will never be reliable because this subscale considers the opinion of other people than the participant who answers the questionnaire (e.g. would your partner think you are able to adhere to this advice?).

Only 42% of the patients receiving supervised exercise reached the norm of ≥30 sessions. Most frequent reasons for non-attendance in this group of well motivated cancer patients are holidays, illness and work or family responsibilities. One might take into account, when developing a supervised training programme, that patients undergoing a tough and busy period might take a break when possible. This, in combination with absence because of (treatment related) illness, makes it very difficult to reach adherence rates >80%. A mean score of 27 sessions (75%) is within the range reported for other trials of exercise during breast cancer treatment (24-26) and can be considered as good adherence.

According to the self-registered activity diaries, 53.8% reached the advised norm during ≥14 weeks. The mean adherence to PA conform the given advice (NNGB) was 13.3 out of 18 weeks (73.9%), which corresponds very well with the adherence to supervised exercise. The patients who did not train in the supervised exercise group showed higher (mean) adherence rates toward advice than the patients who received advice only (14.2 versus 12.5 weeks of NNGB-norm reached). Analyses show that there is no significant difference in adherence to advice between the two intervention groups.

A possible explanation for the difference in adherence rates is that the people in the supervised exercise group are more aware of their PA, since they are meeting other

patients and PA experts up to two times a week. The main limitation is the self-registering part, some people do not follow the instructions as received at T0 which causes overreport or underreport of PA time. When using self registration methods considering daily PA it might be helpful to hand out an extensive list with examples of activity intensities to help people recognize and distinguish moderate and strenuous activities.

In this study we found SE to be the strongest independent predictor of adherence to advice (NNGB-norm) for the whole group ($\beta$=1.267; p=0.001) as well as the supervised exercise group only ($\beta$=1.413; p=0.022). This is supported by the findings of Van Weert et al. (15), who found evidence that self-efficacy enhancing programmes have beneficial effects on exercise adherence. Other researchers (27,28) also found SE as a predictor of adherence to PA and/ or supervised exercise. Previous research (29-31) found Intention and PBC as predictors of adherence, which is not confirmed in our results.

Our study is limited by its small sample size, reducing study power and making it hard to run reliable regression analyses. Therefore it is recommended to repeat the analyses with data of a larger sample.

In summary, we examined the test-retest reliability and internal consistency of two TPB-based questionnaires and rates of supervised exercise adherence and adherence towards recommendations according daily PA (NNGB-norm) in breast cancer patients, receiving adjuvant therapy. Test-retest analyses show poor reliability within a one-week interval and internal consistency of the subscales varies from poor to good, but improves to moderate to good if recommended modifications are made. Our exercise adherence rates were good, but not optimal and partly predicted by the SE score of Qadvice.
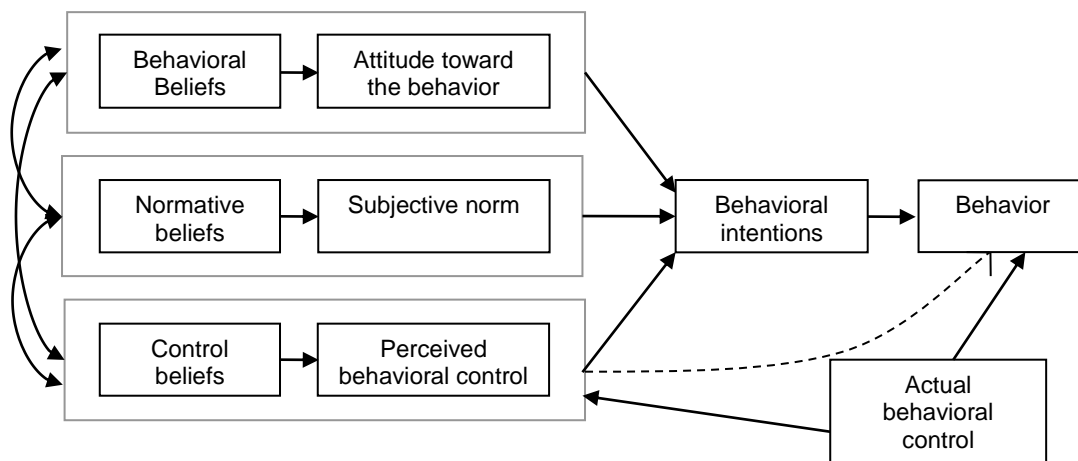
# Figures and Tables



**Figure 1. Schematic representation of the theory of planned behavior (in Behavioral Interventions Based on the Theory of Planned Behavior)** (10)
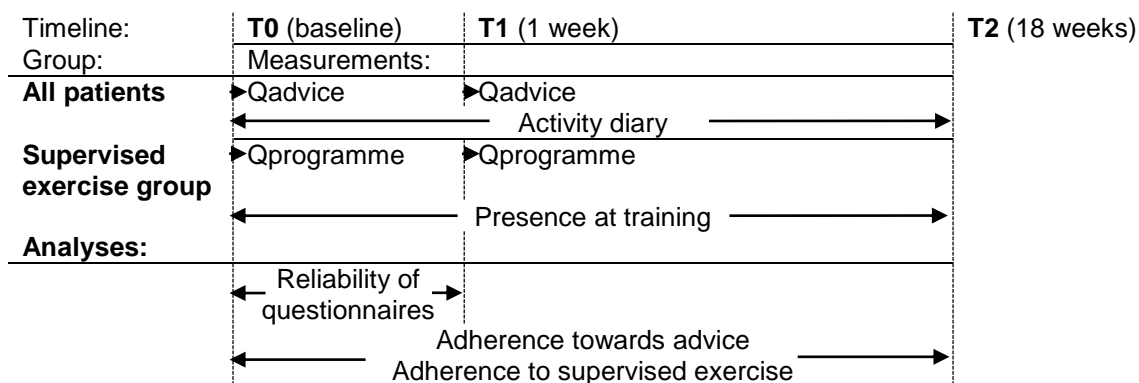


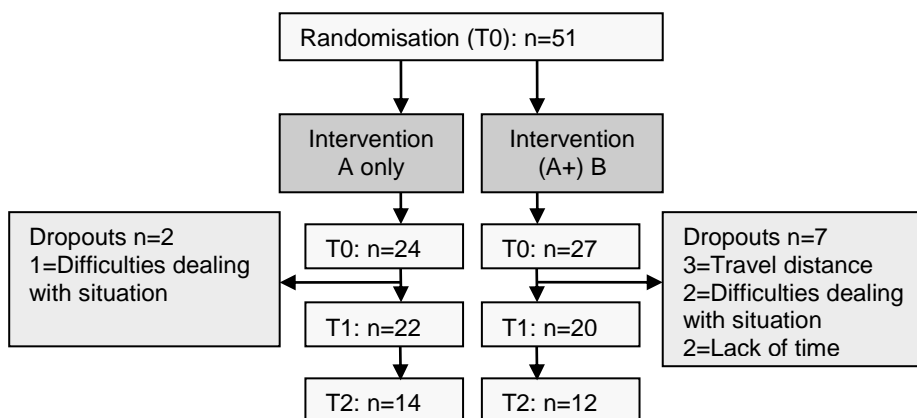**Figure 2. Time schedule of measurements and analyses**



**Figure 3. Flow of participants through the trial.**
Number of dropouts T1-T2 not clear since some patients are still in the 18-week period

**Table 1.** Inclusion criteria

- diagnosis of cancer was less than six weeks before applying to the Physical Activity during Cancer treatment (PACT)-study
- starting adjuvant therapy (i.e. chemo-, radio- or hormone therapy, or a combination of these therapies)
- not treated for cancer (except basal skin cancer) in the previous 5 years
- age 25-75 years
- able to read and understand the Dutch language
- Karnovsky Performance Status of 60 or higher
- able to walk 100 meter or more
- not reporting contra indications for physical activity on the Revised Physical Activity Readiness Questionnaire (PARQ)


**Table 2.** completed questionnaires at T0 (start) and T1 (after 1 week)

|  | T0 (n) | T1 (n) |
|---|---|---|
| Qadvice | 51 (100%) | 42 (82%) |
| Qprogramme | 27 (100%) | 20 (74%) |


**Table 3.** test-retest reliability of the questionnaires; ICC-scores of the TPB subscales

| Subscale of TPB[*]-questionnaire→ | intention | Subjective norm | PBC[**] | Attitude | Self efficacy |
|---|---|---|---|---|---|
| Qadvice; ICC (95%CI) | 0.02 (-.30 to .34) | 0.50 (.21 to .70) | 0.26 (-.06 to .54) | 0.26 (-.09 to .53) | 0.26 (-.09 to .54) |
| Qprogramme; ICC (95%CI) | 0.15 (-.35 to .58) | 0.53 (.09 to .80) | 0.09 (-.40 to .54) | 0.42 (-.07 to .74) | 0.56 (.01 to .82) |

* TPB: Theory of Planned Behavior; ** PBC: perceived behavior control


**Table 4.** internal consistency (Cronbach's α) of the TPB* subscales at T0

| Subscale of TPB*-questionnaire→ | intention | Subjective norm | PBC[**] | Attitude | Self efficacy |
|---|---|---|---|---|---|
| Qadvice T0 | 0.59 | 0.09 | 0.43 | 0.81 | 0.89 |
| Qprogramme T0 | 0.87 | 0.08 | 0.26 | 0.90 | 0.94 |

* TPB, Theory of Planned Behavior;  **PBC, perceived behavior control


**Table 5.** Adherence rates  to advised norm (in weeks activity norm is reached)

|  | N | Minimum | Maximum | Mean | Mean Rank | SD |
|---|---|---|---|---|---|---|
| Intervention A | 14 | 0 | 18 | 12.5 | 12.9 | 5.4 |
| Intervention B | 12 | 8 | 18 | 14.3 | 14.2 | 3.1 |

**Table 6.** Regression analyses of TPB* subscales: β (p) predicting adherence towards intervention A

| Subscale | Intention | Subj | PBC | Att | SE |
|---|---|---|---|---|---|
| Int A+B | -0.49 (0.179) | -0.38 (0.372) | redundant | 0.24 (0.492) | 1.27 (0.001**) |
| Int A | 2.74 (0.228) | 0.47 (0.332) | redundant | -0.52 (0.451) | 0.83 (0.228) |
| Int B | -0.57 (0.586) | -0.88 (0.363) | -0.56 (0.645) | 0.24 (0.897) | 1.41 (0.022**) |

* Theory of Planned Behavior
** Correlation is significant at the 0.05 level (2-tailed).
Int A: Patients randomized to intervention A
Int B: Patients randomized to intervention B

**Table 7.** Regression analyses of TPB* subscales: β (p) predicting adherence towards intervention B

| Subscale | Intention | Subj | PBC | Att | SE |
|---|---|---|---|---|---|
| Int B | 2.25 (0.191) | 0.58 (0.707) | 0.91 (0.410) | 0.57 (0.245) | -0.22 (0.830) |

* Theory of Planned Behavior
Int B: Patients randomized to intervention B

## REFERENCES

(1) Kennisnetwerk Integrale Kankercentra. Tabel A1c: Aantal invasieve tumoren bij mannen en vrouwen naar lokalisatie en incidentiejaar. Available at: www.ikcnet.nl. Accessed March 3, 2009.

(2) Doyle C, Kushi LH, Byers T, Courneya KS, Demark-Wahnefried W, Grant B, et al. Nutrition and physical activity during and after cancer treatment: an American Cancer Society guide for informed choices. CA Cancer.J.Clin. 2006 Nov-Dec;56(6):323-353.

(3) Irwin ML. Physical activity interventions for cancer survivors. Br.J.Sports Med. 2009 Jan;43(1):32-38.

(4) Cramp F, Daniel J. Exercise for the management of cancer-related fatigue in adults. Cochrane Database Syst.Rev. 2008 Apr 16;(2)(2):CD006145.

(5) Oldervoll LM, Kaasa S, Hjermstad MJ, Lund JÅ, Loge JH. Physical exercise results in the improved subjective well-being of a few or is effective rehabilitation for all cancer patients? Eur.J.Cancer 2004 5;40(7):951-962.

(6) Irwin ML, Crumley D, McTiernan A, Bernstein L, Baumgartner R, Gilliland FD, et al. Physical activity levels before and after a diagnosis of breast carcinoma: the Health, Eating, Activity, and Lifestyle (HEAL) study. Cancer 2003 Apr 1;97(7):1746-1757.

(7) Blanchard CM, Denniston MM, Baker F, Ainsworth SR, Courneya KS, Hann DM, et al. Do adults change their lifestyle behaviors after a cancer diagnosis? Am.J.Health Behav. 2003 May-Jun;27(3):246-256.

(8) Courneya KS, Friedenreich CM, Sela RA, Quinney HA, Rhodes RE. Correlates of adherence and contamination in a randomized controlled trial of exercise in cancer survivors: an application of the theory of planned behavior and the five factor model of personality. Ann.Behav.Med. 2002 Fall;24(4):257-268.

(9) Ajzen I. The theory of planned behavior. Organ.Behav.Hum.Decis.Process. 1991 12;50(2):179-211.

(10) Ajzen I. Behavioral Interventions Based on the Theory of Planned Behavior. 2006.

(11) Ajzen I, Manstead ASR. Changing health-related behaviors: An approach based on the theory of planned behavior. In: van den Bos K, Hewstone M, de Wit J, Schut H, Stroebe M, editors. The scope of social psychology: Theory and applications New York: Psychology Press; 2007. p. 43-63.

(12) Perkins MB, Jensen PS, Jaccard J, Gollwitzer P, Oettingen G, Pappadopulos E, et al. Applying theory-driven approaches to understanding and modifying clinicians' behavior: what do we know? Psychiatr.Serv. 2007 Mar;58(3):342-348.

(13) Bandura A, Adams NE. Analysis of self-efficacy theory of behavioral change. Cognitive Therapy and Research 1977;1(4):287-310.

(14) Bandura A, Cervone D. Differential engagement of self-reactive influences in cognitive motivation* 1. Organ.Behav.Hum.Decis.Process. 1986;38(1):92-113.

(15) van Weert E, Hoekstra-Weebers JEHM, May AM, Korstjens I, Ros WJG, van der Schans CP. The development of an evidence-based physical self-management rehabilitation programme for cancer survivors. Patient Educ.Couns. 2008 5;71(2):169-190.

(16) Kostalova B, Frenken F, Storm I. Norm gezond bewegen 2001-2004. In: Volksgezondheid Toekomst Verkenning, Nationale Atlas Volksgezondheid. 2005;3.14.

(17) Ajzen I. Constructing a TpB Questionnaire: Conceptual and Methodological Considerations. 2002 (Revised January, 2006).

(18) Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33:159-174.

(19) Garson GD. Quantitative Methods. 2009; Available at: http://faculty.chass.ncsu.edu/garson, 2009.

(20) Kline P. The handbook of psychological testing. 2nd ed. ed. London: Routledge; 1999.

(21) Portney LG, Watkins MP. Foundations of clinical research: applications to practice. 2nd ed. ed. Upper Saddle River, New Jersey: Prentice-Hall, Inc.; 2000.

(22) Field AP. Discovering Statistics using SPSS. 2nd ed. ed. London: Sage; 2005.

(23) Baarda DB, de Goede MPM, van Dijkum CJ. Basisboek Statistiek met SPSS. 2nd ed ed. Groningen/Houten: Wolters-Noordhoff bv; 2003.

(24) Markes M, Brockow T, Resch KL. Exercise for women receiving adjuvant therapy for breast cancer. Cochrane Database Syst.Rev. 2006 Oct 18;(4)(4):CD005001.

(25) McNeely ML, Campbell KL, Rowe BH, Klassen TP, Mackey JR, Courneya KS. Effects of exercise on breast cancer patients and survivors: A systematic review and meta-analysis. Can.Med.Assoc.J. 2006 Jul;175(1):34-41.

(26) Mutrie N, Campbell AM, Whyte F, McConnachie A, Emslie C, Lee L, et al. Benefits of supervised group exercise programme for women being treated for early stage breast cancer: pragmatic randomised controlled trial. BMJ 2007;334(7592):517.

(27) Pinto BM, Rabin C, Dunsiger S. Home-based exercise among cancer survivors: Adherence and its predictors. Psychooncology 2009 Apr;18(4):369-376.

(28) Rogers LQ, Courneya KS, Shah P, Dunnington G, Hopkins-Price P. Exercise stage of change, barriers, expectations, values and preferences among breast cancer patients during treatment: a pilot study. Eur.J.Cancer.Care.(Engl) 2007 Jan;16(1):55-66.

(29) Courneya KS, Blanchard CM, Laing DM. Exercise adherence in breast cancer survivors training for a dragon boat race competition: a preliminary investigation. Psychooncology 2001 Sep-Oct;10(5):444-452.

(30) Courneya KS, Friedenreich CM, Quinney HA, Fields AL, Jones LW, Fairey AS. Predictors of adherence and contamination in a randomized trial of exercise in colorectal cancer survivors. Psychooncology 2004 Dec;13(12):857-866.

(31) Karvinen KH, Courneya KS, Plotnikoff RC, Spence JC, Venner PM, North S. A prospective study of the determinants of exercise in bladder cancer survivors using the Theory of Planned Behavior. Support.Care Cancer 2009 Feb;17(2):171-179.

## APPENDICES

## Appendix I. (in Dutch)

Questionnaire Qadvice (target behavior)

**Original division of items to subscales**

| Subscale | Intention | Subj[1] | PBC[2] | Attitude | SE[3] |
|---|---|---|---|---|---|
| **Items Qadvice** | 1,5,9 | 3,7,10 | 2,6,8,11,12 | 4a-e | 13a-g |

1:Subj=subjective; 2:PBC=perceived behavior control; 3: SE=self efficacy

**Het bewegingsadvies dat onderdeel uitmaakt van de studie luidt:**

*een half uur* matig intensieve lichamelijke activiteit op *tenminste vijf*, maar bij voorkeur alle *dagen van de week*.

Met **matig intensieve lichamelijke activiteiten** wordt bedoeld: stevig doorwandelen, stevig doorfietsen, zwaar huishoudelijk werk, joggen en andere inspannende vormen van sport, spitten in de tuin, trap oplopen en elke andere activiteit die ongeveer even zwaar is. Het volgen van het bewegingsprogramma valt hier ook onder.

Het gaat er om dat u deze activiteiten tenminste 5 dagen per week uitvoert en dat deze activiteit minimaal 30 minuten duurt. Deze 30 minuten per dag, hoeven niet aan een gesloten plaats te vinden, verdeeld over verschillende perioden (van minimaal 10 minuten) mag ook.
*U kunt bijvoorbeeld*:
**1.** Eén keer 30 minuten stevig gaan wandelen **OF**
**2.** Drie keer 10 minuten stevig gaan wandelen **OF**
**3.** 10 minuten zwaar huishoudelijk werk doen + 10 minuten stevig gaan wandelen + 10 minuten spitten in de tuin.

**Alle onderstaande vragen gaan over het bovenbeschreven gedrag en wordt samengevat in** *"tenminste 5 dagen per week gedurende minimaal 30 minuten lichamelijk actief zijn".*

Wilt u voor elke vraag telkens <u>één </u>nummer omcirkelen dat het meest met uw mening overeenkomt.

**Intentie algemeen:**
Vraag 1: I1. Ik ben van plan om tijdens mijn behandeling tenminste 5 dagen per week, gedurende <u>minimaal</u> 30 minuten lichamelijk actief te zijn.

Geheel mee oneens    1   2   3   4   5   6   7   8   9   10   Geheel mee eens

Vraag 2: PBC 1: Ik ben er zeker van dat ik tijdens mijn behandeling tenminste 5 dagen per week, gedurende minimaal 30 minuten lichamelijk actief kan.

Geheel mee oneens    1   2   3   4   5   6   7   8   9   10   Geheel mee eens

Vraag 3: S1: De meeste mensen die belangrijk voor me zijn denken dat ik tijdens mijn behandeling

Tenminste 5 dagen per week gedurende 30 min actief <u>moet</u> zijn    1 2 3 4 5 6 7 8 9 10    Niet op 5 dagen per week lichamelijk actief moet zijn.

Vraag 4: A 1t/m5
In het algemeen is het tenminste 5 dagen per week, gedurende <u>minimaal</u> 30 minuten lichamelijk actief zijn tijdens mijn behandeling volgens mij:

a. Schadelijk voor mijn lichamelijke    1 2 3 4 5 6 7 8 9 10   Bevorderlijk voor mijn lichamelijke

gesteldheid                                          gesteldheid

b. Prettig        1      2      3      4      5      6      7      8      9      10    Niet prettig

c. Verkeerd om te doen      1   2   3   4   5   6   7   8   9   10   Juist om te doen

d. Een nuttige tijdbesteding  1   2   3   4   5   6   7   8   9   10   Een nutteloze tijdsbesteding

e. Slecht voor mijn vermoeidheids-
klachten                         1  2  3  4  5  6  7  8  9  10   Goed voor mijn vermoeidheids-
                                                                 klachten


Vraag 5: I2. Ik verwacht dat ik tijdens mijn behandeling tenminste 5 dagen per week, gedurende minimaal 30 minuten lichamelijk actief zal zijn.

Geheel mee oneens    1  2  3  4  5  6  7  8  9  10  Geheel mee eens

Vraag 6: PBC 2: Het tenminste 5 dagen per week, gedurende minimaal 30 minuten lichamelijk actief zijn tijdens mijn behandeling is voor mij

Makkelijk         1      2      3      4      5      6      7      8      9      10    Moeilijk

Vraag 7: S2: Ik voel sociale druk om tijdens mijn behandeling, tenminste 5 dagen per week gedurende minimaal 30 minuten lichamelijk actief te zijn.

Geheel mee oneens    1    2    3    4    5    6    7    8    9    10  Geheel mee eens

Vraag 8: PBC3: Ik bepaal geheel zelf of ik tijdens mijn behandeling tenminste 5 dagen per week, gedurende minimaal 30 minuten lichamelijk actief ben.

Geheel mee oneens    1    2    3    4    5    6    7    8    9    10  Geheel mee eens


Vraag 9: I3:. Ik zou graag tijdens mijn behandeling tenminste 5 dagen per week, gedurende minimaal 30 minuten lichamelijk actief willen zijn.

Geheel mee oneens    1    2    3    4    5    6    7    8    9    10  Geheel mee eens

Vraag 10: S3:Mijn medische specialist verwacht van mij dat ik tijdens mijn behandeling tenminste 5 dagen per week, gedurende minimaal 30 minuten lichamelijk actief ben.

Geheel mee oneens    1    2    3    4    5    6    7    8    9    10  Geheel mee eens

Vraag 11: PBC4: De beslissing om tijdens mijn behandeling tenminste 5 dagen per week, gedurende minimaal 30 minuten lichamelijk actief te zijn ligt buiten mijn controle.

Geheel mee oneens    1    2    3    4    5    6    7    8    9    10  Geheel mee eens

Vraag 12: PBC5: Ik verwacht dat ik in staat ben om tijdens mijn behandeling tenminste 5 dagen per week, gedurende minimaal 30 minuten lichamelijk actief te zijn.

Geheel mee oneens    1    2    3    4    5    6    7    8    9    10  Geheel mee eens


Vraag 13: S At/mG
Ik ben er zeker van dat ik tijdens mijn behandeling tenminste 5 dagen per week, gedurende minimaal 30 minuten lichamelijk actief kan zijn, zelfs als ik:

|   |                | absoluut mee oneens |   |   |   |   |   | absoluut mee eens |   |   |   |
|---|----------------|---|---|---|---|---|---|---|---|---|---|
| A | vermoeid ben   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| B | weinig tijd heb | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C | misselijk ben | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| D | dit alleen, zonder anderen, moet doen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| E | me niet fit voel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| F | De weersomstandigheden slecht vind | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| G | het niet leuk of plezierig vind | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

## Appendix II. (in Dutch)

Questionnaire Qprogram (adherence to program)

**Original division of items to subscales**

| Subscale | Intention | Subj[1] | PBC[2] | Attitude | SE[3] |
|---|---|---|---|---|---|
| **Items Qprogram** | 3,7,11 | 5,9,12 | 4,8,10,13,14 | 6a-e | 15a-h |

1:Subj=subjective; 2:PBC=perceived behavior control; 3: SE=self efficacy

Vraag 1: Hoe graag zou u willen deelnemen aan het bewegingsprogramma?

Wil het absoluut **niet**         Wil het absoluut **wel**

1     2     3     4     5     6     7     8     9     10

Vraag 2: Het bewegingsprogramma heeft in totaal 36 bijeenkomsten (18 weken, 2 keer per week), hoeveel van deze bijeenkomsten verwacht u te gaan bijwonen.

….. … bijeenkomsten (aantal bijeenkomsten, minimaal 0 maximaal 36)

*De volgende vragen gaan over hoe u denkt over het volgen van het bewegingsprogramma. In de onderstaande vragen staat het volgende gedrag centraal:*

**Het volgen van minimaal 30 van de 36 bijeenkomsten (van één uur) van het bewegingsprogramma (twee keer per week gedurende 18 weken) in een revalidatie centrum/ polikliniek fysiotherapie tijdens de behandeling van kanker.**

Wilt u voor elke vraag telkens één nummer omcirkelen dat het meest met uw mening overeenkomt.

Vraag 3: I1  Ik ben van plan om minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma te volgen.

Geheel mee oneens     1   2   3   4   5   6   7   8   9   10   Geheel mee eens

Vraag 4: PBC1

Ik ben er zeker van dat ik minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma kan volgen.

Geheel mee oneens     1   2   3   4   5   6   7   8   9   10   Geheel mee eens

Vraag 5: S1
De meeste mensen die belangrijk voor me zijn denken dat ik

| Het bewegingsprogramma **wel** moet volgen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Het bewegingsprogramma niet moet volgen |
|---|---|---|---|---|---|---|---|---|---|---|---|

Vraag 6: A 1t/m5
Het volgen van een bewegingsprogramma tijdens mijn behandeling is volgens mij:

| a. Schadelijk voor mijn lichamelijke gesteldheid | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Bevorderlijk voor mijn lichamelijke gesteldheid |
|---|---|---|---|---|---|---|---|---|---|---|---|
| b. Prettig | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Niet prettig |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| c. Verkeerd om te doen | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Juist om te doen |
| d. Een nuttige tijdbesteding | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | een nutteloze tijdbesteding |
| e. Slecht voor mijn vermoeidheids-klachten | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Goed voor mijn vermoeidheids-klachten |

Vraag 7: I2. Ik verwacht dat ik minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma ga volgen.

| Geheel mee oneens | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Geheel mee eens |
|---|---|---|---|---|---|---|---|---|---|---|---|

Vraag 8: PBC2
Voor mij is het volgen van minimaal 30 tot 36 bijeenkomsten van het bewegingsprogramma.

| Makkelijk | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Moeilijk |
|---|---|---|---|---|---|---|---|---|---|---|---|

Vraag 8: S2
Ik voel sociale druk om minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma te volgen.

| Geheel mee oneens | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Geheel mee eens |
|---|---|---|---|---|---|---|---|---|---|---|---|

Vraag 9: PBC3
Ik bepaal geheel zelf of ik minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma ga volgen.

| Geheel mee oneens | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Geheel mee eens |
|---|---|---|---|---|---|---|---|---|---|---|---|

Vraag 10: I3. Ik zou graag minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma willen bijwonen.

| Geheel mee oneens | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Geheel mee eens |
|---|---|---|---|---|---|---|---|---|---|---|---|

Vraag 11: S3
Mijn medische specialist verwacht van mij dat ik minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma volg.

| Geheel mee oneens | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Geheel mee eens |
|---|---|---|---|---|---|---|---|---|---|---|---|

Vraag 12: PBC4.
De beslissing om minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma te volgen ligt buiten mijn controle.

| Geheel mee oneens | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Geheel mee eens |
|---|---|---|---|---|---|---|---|---|---|---|---|

Vraag 13: PBC5
Ik verwacht dat ik in staat ben om minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma te volgen.

| Geheel mee oneens | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Geheel mee eens |
|---|---|---|---|---|---|---|---|---|---|---|---|

Vraag 14: SE At/m H

Ik ben er zeker van dat ik tijdens mijn behandeling voor mijn kanker in staat ben om minimaal 30 van de 36 bijeenkomsten van het bewegingsprogramma in het revalidatiecentrum/ de polikliniek fysiotherapie te volgen <u>zelfs als ik</u>:

| | | absoluut mee oneens | | | | | | | absoluut mee eens | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | vermoeid ben | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| B | weinig tijd heb | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| C | misselijk ben | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| D | het reizen naar de locatie van het bewegings-programma me moeite kost | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| E | me niet fit voel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| F | de training erg zwaar vind | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| G | de training niet leuk of plezierig vind | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| H | me niet lekker voel | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

## Appendix III.

| Reliability analysis of Qprogramme and Qadvice (at T0) | | | | |
|---|---|---|---|---|
| Subscales and corresponding items | Scale mean if item deleted | Scale variance if item deleted | Corrected item-total correlation | Alpha if item deleted |
| **Qprogram** | | | | |
| Intention | | | | |
| BPS_prog_3 | 18.80 | 3.417 | .757 | .829 |
| BPS_prog_7 | 19.16 | 1.973 | .780 | .895 |
| BPS_prog_11 | 18.76 | 3.357 | .888 | .755 |
| Subjective norm | | | | |
| BPS_prog_5 | 9.04 | 25.798 | -.067 | .292 |
| BPS_prog_9 | 12.23 | 20.665 | .058 | .004 |
| BPS_prog_12 | 11.81 | 17.442 | .134 | -.239[a] |
| PBC | | | | |
| BPS_prog_4 | 21.92 | 15.077 | .674 | -.526a |
| BPS_prog_8 | 23.38 | 24.090 | .343 | .034 |
| BPS_prog_10 | 19.62 | 39.590 | -.405 | .462 |
| BPS_prog_13 | 23.54 | 13.269 | .238 | .066 |
| BPS_prog_14 | 25.69 | 39.731 | -.555 | .434 |
| attitude | | | | |
| BPS_prog_6a | 35.63 | 42.011 | .860 | .859 |
| BPS_prog_6b | 36.30 | 37.140 | .899 | .847 |
| BPS_prog_6c | 35.63 | 41.781 | .872 | .856 |
| BPS_prog_6d | 36.19 | 37.157 | .761 | .891 |
| BPS_prog_6e | 35.52 | 58.028 | .540 | .929 |
| Self efficacy | | | | |
| BPS_prog_15a | 48.00 | 169.043 | .674 | .933 |
| BPS_prog_15b | 47.50 | 154.261 | .859 | .920 |
| BPS_prog_15c | 49.42 | 175.558 | .641 | .935 |
| BPS_prog_15d | 49.17 | 163.797 | .586 | .944 |
| BPS_prog_15e | 48.42 | 160.341 | .874 | .919 |
| BPS_prog_15f | 48.42 | 155.645 | .904 | .917 |
| BPS_prog_15g | 48.75 | 158.543 | .828 | .922 |
| BPS_prog_15h | 49.12 | 160.462 | .876 | .919 |
| | | | | |
| **Qadvice** | | | | |
| Intention | | | | |
| BPS_adv_1 | 17.94 | 7.656 | .478 | .373 |
| BPS_adv_5 | 18.82 | 7.028 | .224 | .882 |
| BPS_adv_9 | 17.82 | 8.868 | .679 | .275 |
| Subjective norm | | | | |
| BPS_adv_3 | 9.98 | 18.980 | .064 | -.003a |
| BPS_adv_7 | 12.08 | 28.794 | -.173 | .541 |
| BPS_adv_10 | 10.22 | 16.253 | .321 | -.721a |
| PBC | | | | |
| BPS_adv_2 | 33.59 | 30.705 | .197 | .397 |

| | | | | |
|---|---|---|---|---|
| BPS_adv_6 | 34.59 | 31.288 | .267 | .338 |
| BPS_adv_8 | 32.96 | 37.540 | .216 | .386 |
| BPS_adv_11 | 33.73 | 32.574 | .075 | .517 |
| BPS_adv_12 | 33.29 | 31.292 | .494 | .222 |
| attitude | | | | |
| BPS_adv_4a | 35.08 | 39.994 | .606 | .776 |
| BPS_adv_4b | 36.35 | 26.793 | .685 | .753 |
| BPS_adv_4c | 35.29 | 36.372 | .775 | .732 |
| BPS_adv_4d | 35.98 | 27.060 | .722 | .731 |
| BPS_adv_4e | 35.57 | 45.210 | .373 | .825 |
| Self efficacy | | | | |
| BPS_adv_13a | 41.89 | 173.010 | .452 | .897 |
| BPS_adv_13b | 41.79 | 147.606 | .786 | .861 |
| BPS_adv_13c | 43.74 | 163.412 | .600 | .883 |
| BPS_adv_13d | 41.89 | 150.315 | .619 | .883 |
| BPS_adv_13e | 42.68 | 156.831 | .728 | .869 |
| BPS_adv_13f | 42.09 | 139.210 | .785 | .860 |
| BPS_adv_13g | 42.60 | 140.116 | .837 | .853 |

a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions. You may want to check item codings