

## 3<sup>rd</sup> international, interdisciplinary symposium “Physical activity in Oncology” at the German Sport University Cologne from May 11<sup>th</sup> - 12<sup>th</sup> 2012 – Abstracts

### Encourage to exercise: this motto also applies for patients during clinical treatment of an SCT

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A number of publications have described the positive effects of physical exercise on the physical and psychological conditions of patients during hematopoietic stem cell transplantation (SCT). The next step is now to develop projects that implement therapeutic exercise during clinical treatment. The Medical Clinic and Polyclinic III has developed the “encourage to exercise” project in addition to the established physiotherapy during SCT. Patients are prepared for the project in a consultation. In addition, they are given specially developed media to inform them about exercise therapy during the SCT. Instructed by physiotherapists, patients perform exercises while lying, sitting, or standing, according to their needs. The goal is to teach patients how to perform the exercise program on their own as far as possible. A wall chart in each room reminds them of the exercises every day. During the SCT, the exercises are adapted to the patients’ general condition. Group exercises will also be offered in the future. At discharge, patients are given exercise recommendations to continue at home. A patient diary helps to evaluate the project. First, evaluations show that only to a certain extent can patients perform the exercise program on their own. This is due to the reduced health condition of stem cell-transplanted patients. As a result, we must intensify the established physiotherapy during these phases. This educative approach gives patients the chance to prevent the consequences of a lack of activity and to actively participate in their recovery. Physiotherapists, as well as doctors, nursing staff, and psycho-oncologists are part of the project, which can be implemented without additional staff being required.

### Effects of a 12-week Nordic Walking intervention on endurance capacity of breast cancer patients with emphasis on respiratory parameters

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### Background

The aspect of physical activity, particularly endurance performance, is delivered in oncological rehabilitation, insisting a great importance. Due to the limited overall performance in breast cancer patients, as a result of cancer-related therapy, there is still a demand for the individual determination procedures and interventions to improve endurance performance. The focus of this study is the evaluation of endurance capacity in breast cancer patients according to a Nordic Walking intervention on the basis of diagnostic performance parameters.

### Methods

As part of a pre- and post-study, breast cancer patients after chemotherapy ( $N=13$ ;  $51.1\pm 5.7$  years) completed a treadmill test. For this purpose, a modified step test protocol was used for individual training: start  $0.8\text{ ms}^{-1}$ , level  $0.2\text{ ms}^{-1}$ , and time 3 min (Baumann/Vafa test). The study participants completed a Nordic walking training over a period of 12 weeks, with two sessions per week.

### Results

The parameter of diagnostic examination performance is considered with the same intensity level (speed range  $0.8\text{--}1.8\text{ ms}^{-1}$ ), at a fixed lactate concentration ( $2\text{ mmol/l}$ ) and at rest. Results are as follows: for respiratory parameters, oxygen consumption pre-/post-test  $15.01/12.2\text{ ml/kgmin}^{-1}$ ,  $p=0.162$ ; for cardiopulmonary parameters, resting heart rate  $86.2/80.3\text{ smin}^{-1}$ ,  $p=0.068$ , and stress heart rate  $122.1/115.4\text{ smin}^{-1}$ ,  $p=0.052$ ; and for metabolic parameters, stress lactate  $1.9/1.4\text{ mmol/l}$ ,  $p=0.082$ ; considering a fixed lactate concentration ( $2\text{ mmol/l}$ ), a higher loading rate is observed ( $1.58/1.76\text{ m/s}$ ,  $p=0.058$ ).

### Discussion

The results of this study indicate an increase of aerobic capacity and an improvement towards commodification and thus considered measured variables. The claim of future rehabilitative measures should be to avoid stress injuries by careful and methodical approach to express individual intervention recommendations.

### Arm crank ergometry in breast cancer patients receiving adjuvant radiotherapy: design of a pilot study

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#### Background/objectives

In breast cancer patients, there are common side effects of medical treatment including reduced cardiorespiratory fitness, fatigue and shoulder-arm morbidity (e.g. pain, reduced shoulder mobility, lymphoedema). Aerobic exercise training during treatment can improve cardiorespiratory fitness and reduce fatigue, but there are, currently, no positive effects on shoulder-arm morbidity since aerobic exercise training in hospital is usually performed on treadmill or cycle ergometers without involving the arms. This raises the question whether arm crank ergometry might be a useful alternative for aerobic exercise training in breast cancer patients. Positive effects on cardiorespiratory fitness and fatigue and, additionally, on shoulder-arm morbidity are assumed. The authors could not identify any studies that investigated this topic. Therefore, a pilot study has been initiated.

#### Design/methods

At Chemnitz Clinical Centre, breast cancer patients can participate in a supervised arm cranking exercise programme during adjuvant radiotherapy (three times per week for 6 weeks). Training duration progresses from 5 to 20 min of continuous arm cranking. Intensity is adjusted according to patients' heart rate, self-reported exertion (Borg scale) and self-reported pain (NRS). Before and after the exercise intervention, the following measurements are assessed: cardiorespiratory fitness (oxygen uptake during cycle test), fatigue (MFI-20), pain (BPI), shoulder-arm mobility (goniometry), lymphoedema (arm circumference) and health-related quality of life (EORTC-QLQ-C30/BR23). The results are compared with those of a non-training control group. Drop-outs of the training group are documented.

#### Prospects

Positive findings will lead to further studies to evaluate whether arm crank ergometry might be a useful alternative for aerobic exercise training in breast cancer patients.

#### Establishment of a specific and individualized exercise program for children following intensive oncological treatment

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#### Background

Progress in treatment and the improvement of survival rates in childhood cancer make the "quality of survival" become a more important issue in therapeutic concerns. However, childhood cancer is associated with a wide spectrum of specific disease- and treatment-related long-term consequences. Earlier research has shown a reduced activity level and an impaired physical fitness of children with cancer.

#### Methods

Motor performance of 20 children aged 4–17 years, who are treated for cancer, was examined with age-related motorical test batteries (MOT4-

6; DMT6-18) during maintenance therapy or after oncological treatment.

#### Results

The results show an impaired motorical functioning compared to motor norms of same aged and healthy children provided by both motorical tests. Specific deficits were identified in endurance, strength, and coordination.

#### Discussion

The implementation of a specific, individualized, and holistic exercise program in the Children's Hospital Amsterdamer Street in Cologne intends to improve physical functioning as well as psychological, social, and educational aspects within weekly exercise units in small groups. Assuring a close connection of science and therapeutic care, a scientific monitoring and evaluation is guaranteed. Overall, the exercise program aims to facilitate the transition after intensive medical treatment back to daily life. Therefore, this specific and individualized exercise program including its close connection between science and therapeutic care may provide an important contribution to improve (early) rehabilitation of children with cancer.

#### From neuromuscular electrical stimulation and biofeedback-assisted exercise up to Triathlon competitions—regular physical activity in cancer patients and its different ways

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#### Objective

Regular physical activity has been shown to be very important and effective for functional health and participation of cancer patients. However, not all cancer patients need the same form of regular physical activity.

#### Methods

Experiences of the outpatient clinic for cancer patients of the Department of PMR (Medical University of Vienna) are presented.

#### Results

Regular physical activity of cancer patients should be planned according their individual (medical) risk factors and can include the application of neuromuscular electrical stimulation (in form of a so-called "passive training"), biofeedback-assisted active exercises, active aerobic exercise, active strength exercise, and even sports and competitions, for example, marathon running and triathlon (Iron man). Several examples are shown.

#### Conclusion

Regular physical activity has been described to be an important part in the treatment and rehabilitation of cancer patients, but it can differ in its motivations and goals. Nevertheless, most of cancer patients should start as soon as possible to be physically active, but under the supervision of specialized physicians (and sport scientists) and within their individual "right" setting. This setting should be planned according their individual (medical) risk factors and according their individual (sportive) goals, to find the right way for the individual cancer patient.

#### Biofeedback for cancer patients

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#### Objective

This presentation aims to highlight the indications for biofeedback in cancer patients.

## Methods

A survey about the clinical use of biofeedback in cancer patients and their relatives is given.

## Results

In cancer patients, stress management, anxiety, and depression are typical indications for the use of biofeedback (case 1, hyperventilation). Musculoskeletal pain syndromes, such as cervical syndrome, back pain, and sciatica, are very interesting indications regarding biofeedback (EMG)-assisted exercise and physiotherapy (case 2, multiple myeloma). Furthermore, biofeedback can be used for breathing exercises before and after thoracic surgery (case 3, lung cancer). Some cancer patients are suffering from headache, where biofeedback can reduce pain and help to reduce medication (and side effects). Female and male incontinences (after prostate cancer) are often seen in cancer patients. For incontinence, the use of biofeedback shows the best scientific evidence available. In patients suffering from terminal cancer, who are not able to communicate, heart rate variability can help to find the right dosage of pain medication. Biofeedback can be an effective part of a multimodal treatment regimen of burnout syndrome, a very well-known form of depression often affecting nursing partners and relatives, and medical staff.

## Conclusion

In cancer patients, there are some interesting indications for the use of biofeedback, where it can help to improve functional health, activities, and participation of patients.

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## First tumour board for cancer rehabilitation

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## Objective

Typically, a tumour board represents an institutional multidisciplinary treatment planning approach for a specific cancer entity in which physicians of different medical specialties present, review and discuss challenging medical cases, e.g. the individual medical treatment options of patients suffering from cancer. At the end of this process, there is a statement (tumour board review) where the individual treatment plan is defined.

## Material/methods

The first Tumour Board for Cancer Rehabilitation in an acute hospital is presented.

## Results

Since its implementation in November 2010, the tumour board for cancer rehabilitation has been an untypical, but regular tumour board, such as the other existing tumour boards within the General Hospital of Vienna/Medical University of Vienna/Comprehensive Cancer Center. It is guided by a psychiatrist who has his expertise in the field of oncologic rehabilitation and pain medicine. Referring specialists from different medical specialties—all involved in the rehabilitation process of cancer patients—are invited to attend this tumour board. Challenging cases of cancer patients with the intention of out- or inpatient rehabilitation are discussed with the goal to plan their rehabilitation (but not to treat their cancer itself!). An individual rehabilitation concept depending on individual functional deficits and on medical conditions of cancer patients is defined, which has to be executed.

## Conclusion

This first worldwide tumour board for cancer rehabilitation has found good acceptance and has become an important interdisciplinary and multi-professional help to plan rehabilitation and supportive strategies in challenging cancer patients.

## Psychological changes in breast cancer through sports

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Previous results demonstrate that sporting activity and exercise have a positive effect on breast cancer patients' quality of life (Baumann 2009). Therefore, we carried out a survey within the context of the project "Über den Berg Zwanzigelf" and interviewed breast cancer patients ( $N=10$ ) after adjuvant therapy. During the survey timeframe, the patients' stamina, strength, and proprioception got trained within a 3-month preparation time. Subsequently, the women attended a hiking week in the Alps, which contained daily 5–9 h hiking and meditations. Using a questionnaire, we captured changes in general health, disease management, perception of body image, self-esteem, and depressive symptoms. The questionnaire was composed by established psychological scales (SEL, TSK, SF-36, MSW, ADS, and FKB-20). Patients were interviewed four times. The surveys were accomplished before starting the sports program and immediately before and after the hiking week. Additionally, we analyzed the long-term effects 3 months after the project's ending. The baseline already provided evident differences between experimental and control groups ( $N=25$ ), particularly in terms of self-esteem and depressive symptoms. After 3 months of sports program, significant improvements of subjective well-being and coping in almost all areas turned out in the experimental group. Directly after the hiking week, these improvements were conspicuous and significant ( $r=0.706$ ) in relation to the baseline measurement. Additional measurements indicated that the subjects considered their personal expectations and goals to be achieved. Physical activity and communicating with other affected people had a highly positive effect for their health and, especially, mental state.

## Influences of Nordic Walking on breast cancer patients in rehabilitation phase

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## Introduction

Cancer patients suffer from various symptoms due to medical therapies, fatigue, and immobility (Baumann 2005). A recently published study by Fong (2012) suggests physical activity for patients after treatment for breast cancer in order to improve body composition and quality of life. To verify the feasibility and efficiency of endurance training, this study was conducted to examine the influence of the method Nordic Walking in breast cancer rehabilitation.

## Methods

One hundred and five patients aged between 30 and 59 took part in a 3-week Nordic Walking intervention, exercising three to five times a week a 4-km trail (medium duration, 45 min). The 6-min walk test with pulse oximetry before and after the intervention was used to measure endurance and functional status at the end of the first, second, and third week. To evaluate quality of life, the questionnaire EORTC QLQ-C30 was used on the first and last day of rehabilitation phase.

## Results

The patients improved significantly in quality of life. High significant changes were achieved in fatigue, physical function, and cognition. The distance walked in 6 min increased significantly. A mean extension of 46.4 m was achieved.

#### Discussion

Nordic Walking training in rehabilitation phase has positive effects on quality of life and level of resistance. Signs of complication were not registered. Further studies have to follow to provide further and prolonged experimental support.

#### Conclusion

Maintenance and even improvement of physical resistance and quality of life in rehabilitation programs are health-related goals in breast cancer care.

#### Barriers to the implementation of an individualized exercise program at a pediatric cancer ward

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#### Background

Exercise programs are hardly integrated into the inpatient treatment of pediatric cancer patients, and physical activity (PA) is considerably reduced [1]. To fulfill the right of PA promotion and to practice secondary prevention, it seems to be useful integrating PA already during acute treatment. This project aimed at analyzing the barriers occurring during the implementation of an inpatient exercise program.

#### Methods

The exercise program was an individualized offer. Over 200 days, medical contraindications for PA for all inpatient patients ( $\geq 4$  years), and contraindications for going to the gym (leaving the ward) were documented. In case of concrete sports offer, frequency of participation and reasons for nonparticipation were ascertained.

#### Results

Medical contraindications for PA occurred in 10 % on average, mainly because of surgeries on the same day. Sixty-five percent of patients with permission for PA were not allowed to go to the gym due to chemotherapy. Fifty-six percent of all daily asked patients participated in the exercise program; most frequent exercise barriers were exhaustion/sleep and nausea.

#### Discussion

The exercise program was generally feasible; concrete prohibitions were rare. Because of often reduced physical conditions and the difficulties to leave the ward, a wide range of inpatient sports offers is essential to respond to the interests and the physical condition flexibly.

#### Bicycle training with patients undergoing allogeneic or autologous stem cell transplantation: feasibility and restraints

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#### Introduction

In recent years, some studies have shown positive effects of physical activity during the inpatient stay for hematopoietic stem cell transplantation (HSCT) [1]. Therefore, this study focused on examining the implementation of controlled endurance training and analyzing the inhibitory factors for bicycle training during HSCT.

#### Methods

Endurance training was performed with a bicycle ergometer four times a week. Participation in bicycle training and the reasons for nonparticipation were ascertained in 32 patients undergoing HSCT over a period of 10 weeks.

#### Results

Percentage participation on average was 44 % and showed a significant positive trend over the period of the study. Implementation of bicycle training was rarely possible on the day of HSCT and days 4 to 6 after HSCT. The most frequent causes for nonparticipation were medical contraindications (70 %). Other reasons were organizational problems and subjective complaints. Lack of motivation was individually taken the rarest reason of all.

#### Discussion

Bicycle training was generally feasible and could be integrated into the daily routine of the ward. Lack of motivation was very rare what underlines a great interest of the patients in physical activities [2]. Therefore, it should be tried to avoid the interruptions of exercise training by offering alternative exercise programs with lower intensity in addition. Future studies should focus on concepts to eliminate the revealed inhibitory factors and find ways to maintain physical activity during the inpatient stay.

#### Physical performance and quality of life in childhood cancer patients

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#### Background

Today, about 70 % childhood cancer patients become long-time survivors [1]. In spite of high cure rates, various studies show that childhood cancer is associated with reduced muscle strength and decreased quality of life, frequently associated with severe restrictions of activities of daily living mostly present into adulthood [2–4].

#### Methods

Muscle strength as determined by hand-held dynamometry and quality of life (QoL), by KINDL<sup>®</sup> questionnaire were examined in 23 patients (5–17 years) with mixed cancer types. Additionally, QoL of the parents was assessed. Time of investigation ranged from 6 to 84 days after diagnosis. Descriptive data analyses were performed and compared with age-specific reference values.

#### Results

The mean of muscle strength range from 80.4 N, SD=35.8 (elbow extension) to 163.6 N, SD=79.4 (knee extension) in subjects. In comparison to healthy peers, the greatest average deviation of –61.8 % was observed in knee extensors. The smallest difference could be seen for elbow extensors (–30.9 %). With regard to QoL, we could find minor deficits in patients' self-assessment and parents' report. Some QoL subscales were even above the reference values (–29.3 % “physical well-being” up to 6.1 % “family”).

#### Discussion

In line with previous studies, our results demonstrate the limited strength performance, especially of the lower extremities, even at the beginning of the treatment [2]. Although the impairment in QoL seems less serious, the results of this investigation show the importance of an appropriate intervention to counteract such adverse effects already during therapy.

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#### **Yoga as adjunct intervention for chemotherapy-induced fatigue in breast cancer patients: a multicenter randomized controlled trial**

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#### **Background**

More than 80 % of breast cancer patients suffer from fatigue during adjuvant chemotherapy. The aim of this study is to evaluate the efficacy of an adjunct yoga intervention for chemotherapy-induced fatigue in breast cancer patients compared to aerobic walking exercise and no treatment.

#### **Methods**

Breast cancer patients with chemotherapy-induced fatigue ( $n=126$ ) will be randomized to yoga, walking, or waiting list control groups during adjuvant chemotherapy. Patients in yoga and walking groups will participate in a structured group program twice weekly for 60 min through 12 weeks. Primary outcome measure is chemotherapy-induced fatigue (Multidimensional Fatigue Inventory). Secondary outcome measures include disease-specific quality of life (Functional Assessment of Cancer Therapy-Breast), depression and anxiety (Hospital Anxiety and Depression Scale), perceived stress (Perceived Stress Scale), and post-traumatic distress (Impact of Event Scale). Salivary cortisol levels will be assessed. Outcome assessment will be conducted before the intervention, at 12 and 24 weeks after randomization. Statistical analysis will test the superiority of yoga in comparison to no treatment and non-inferiority of yoga towards exercise. In addition to the assessment of efficacy, predictors of intervention adherence will be assessed using variables of the transtheoretical model (stages of change, processes of change, decision balance, and self-efficacy).

#### **Conclusion**

Results of this study will help to evaluate the efficacy of yoga as an adjunct intervention for breast cancer patients suffering from chemotherapy-induced fatigue and to assess barriers to participation in yoga interventions.

#### **Meta-analysis of yoga for quality of life and psychological complaints in breast cancer patients**

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#### **Background**

The aim of this study was to systematically review the effectiveness of yoga in patients with breast cancer.

#### **Methods**

MEDLINE, PsycInfo, EMBASE, CAMBASE, and the Cochrane Library were screened. Randomized controlled trials (RCTs) that assessed quality of life and/or psychological health were analyzed. Safety was a secondary outcome measure. Risk of bias was assessed using the Cochrane risk of bias tool. For each outcome, standardized mean differences (SMD) and 95 % confidence intervals (CI) were calculated.

#### **Results**

Twelve RCTs with a total of 742 patients were included. Meta-analysis revealed evidence for short-term effects on global quality of life [SMD=0.62 (95 % CI 0.04, 1.21);  $P=0.04$ ], functional [SMD=0.30 (95 % CI 0.03, 0.57);  $P=0.03$ ], social [SMD=0.29 (95 % CI 0.08, 0.50);  $P<0.01$ ], and spiritual well-being [SMD=0.41 (95 % CI 0.08, 0.74);  $P=0.01$ ]. These effects were, however, only present in studies with unclear or high risk of selection bias. Short-term effects were also found for anxiety [SMD=-1.51 (95 % CI -2.47, -0.55);  $P<0.01$ ], depression [SMD=-1.59 (95 % CI -2.68, -0.51);  $P<0.01$ ], perceived stress [SMD=-1.14 (95 % CI -2.16, -0.12);  $P=0.03$ ], and psychological distress [SMD=-0.86 (95 % CI -1.50, -0.22);  $P<0.01$ ]. Subgroup analyses found effects only for yoga during chemotherapy or radiotherapy, but not after completion of active treatment. Yoga was not associated with severe adverse events.

#### **Discussion**

This meta-analysis found evidence for short-term effects of yoga on quality of life and psychological complaints in breast cancer patients. However, the short-term effects on quality of life could not be clearly distinguished from bias. Yoga can be recommended to breast cancer patients who suffer from psychological complaints during chemotherapy or radiotherapy.

#### **Physical activity and nutrition for cancer patients: an interdisciplinary project of the University of Leipzig, the Fitness Center Injoy in Werdau and the Flora-Apotheken Werdau**

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#### **Background**

Exercising has been underestimated in oncological therapy for a long time [e.g., Dimeo (Onkologie 14:31–37, 2008)]. Positive effects of physical activity during the therapy of cancer have been shown in recent years. Ninety percent of the studies using standardized measurement tools have proven positive effects regarding quality of life, endurance, physical performance, fatigue, depression, or pain [Fasching et al. (Onkologie 15:696–701, 2009)]. One aim of the concept used in this project is reducing barriers of entry for potential participants. Additionally, a cooperation of university (sports scientists), pharmacy (nutritionists), and fitness center (trainers) allows an interdisciplinary approach.

#### **Method**

Changes of the perceived quality of life and the state of depression through physical activity are investigated. The FACT-G scale for measuring the quality of life (Cella and Bonomi 1996) and the Self-Rating Depression Scale by Zung (1976) are used as standardized measurement tools. Participants ( $n=28$ ) take part in a specially designed intervention for 12 weeks, including a training once or twice a week in the fitness center and a nutrition counseling in addition. A pre-post design is used in this study.

#### **Discussion**

Persons of different cancer entities (average age, 57.9) in outpatient treatment take part in the study. As positive effects of physical activity have already been shown in recent studies, objective of this study is to investigate if frequency of physical activity has an influence on investigated parameters. At this point, we can say that the concept is well accepted by both genders. Regarding this, further intervention groups are planned.

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### Effects of the INOP intervention on physical activity and functional capabilities of breast cancer patients

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## Introduction

Based on the Health Action Process Approach, the intervention program Individuelle Nachsorge onkologischer Patienten (INOP) was developed to promote the beginning or maintenance of a physically active lifestyle after rehabilitation. The study investigates the effectiveness of INOP to change physical activity (PA) (exercise and movement on workaday) and functional capabilities (FC) of breast cancer patients over 6 months.

## Methods

Breast cancer patients ( $n=390$ ) were randomly assigned to the control (CG) or intervention group (IG) and were interviewed by questionnaires at the beginning and 6 months after the rehabilitation. While the CG received the conventional care, the IG additionally received the INOP intervention (group meeting, one-to-one counseling, and phone interview 3 months after discharge). Analysis of covariance was applied to investigate differences between CG and IG regarding PA and FC.

## Results

Six months after discharge, participants in the IG differed from those in the CG regarding exercise (difference 58 min/week;  $p<0.01$ ) and movement on workaday (difference 30 min/week;  $p<0.01$ ). Moreover, 83 % of the CG was physical active, but only 66 % of the CG ( $p<0.001$ ). Additionally, IG patients were also considerably less limited in their functional capabilities ( $p<0.05$ ) than CG patients.

## Conclusion

INOP is a useful intervention to enhance physical activity and functional capabilities of breast cancer patients at least 6 months after discharge. The INOP intervention is standardized and documented and can be implemented in clinical settings.

This study was supported by the Institut für Rehabilitationsforschung, Norderney.

### Evaluation of physical activity recommendations in the field of acute care of the paediatric oncology comparing theory and experience

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## Background

The improvement of treatment and recovery in the field of paediatric oncology allows us to direct attention to the patients' quality of life after

treatment. In order to prevent late sequela, the necessity of an early rehabilitation comes into focus. Scientists and movement therapists suggest physical activity in the initial stage of the therapy. However, this suggestion is met with insecurity due to a lack of uniform recommendations as well as contraindications.

## Method

A systematic analysis of literature as well as a qualitative survey of 15 experts from the field of movement therapy at cancer clinics for children has been conducted for the theoretical and practical evaluation of physical activity recommendations.

## Results

There are theoretical recommendations for a moderate strength and endurance training with additional elements of coordination and the functional mobilisation for all patients in the conservation period. In addition, practical experience shows that contents from the field of psychomotricity as well as offers in specific sport disciplines are possible. Peak loads, however, are contraindicated.

## Discussion/conclusion

With regards to the heterogeneity of symptoms within the paediatric oncology, an individual adaptation of movement exercise for the individual patient is necessary. Specific recommendations for children suffering from cancer can only be made on the basis of their respective condition and the stage of treatment. Experts working with these patients emphasize the necessity of taking into consideration the patient's mental state and individual needs. In order to establish and improve the offer of physical activity in the therapeutic acute phase, further investigations will be necessary which take into account the existing concepts.

### Status of physical activity and sports in pediatric oncological aftercare

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## Background

It has not been sufficiently investigated yet whether and when children and adolescents after cancer treatment return to the level of activity appropriate to their age and participate again in physical education (PE) and extramural activities (EMA). Therefore, the project aimed at analyzing the status of integration in PE and EMA and assessing daily physical activity.

## Methods

A standardized questionnaire of the KiGGS<sup>1</sup> study supplemented with questions related to specific aspects of disease and therapy was used. Applying this instrument enables comparison with a healthy reference population. Eighty-five patients (13.5±3.7 years) during aftercare of childhood cancer (4.6±3.6 years post-diagnosis) were included.

## Results

Overall, both the patients' subjective estimation of daily physical activity and the status of integration in EMA were comparable to the reference population. Nevertheless, patients diagnosed with brain tumours showed a considerably reduced level of physical activity and, as well as patients with bone tumours, a status of integration below average. The main problem in these groups was the significantly above-average amount of 25 % of full or partly exemptions from PE.

## Discussion

In general, the observed population showed an adequate status of integration in PE and EMA. However, this positive result should not mask the

<sup>1</sup> The Children and Adolescents Health Study in Germany of the Robert-Koch-Institute

problems of some entities with regard to their limited activities and insufficient integration in PE. Accordingly, this emphasizes the need of individually tailored support, especially regarding the reintegration in PE.

### **BEST study: progressive resistance training and progressive muscle relaxation during radiotherapy as therapy against cancer-related fatigue**

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#### Introduction

Cancer-related fatigue (CRF) is a multidimensional syndrome which occurs in the majority of cancer patients during anticancer treatment and potentially persists for many years after cure [1]. Because of its multidimensional etiology, CRF can be caused and influenced by several physical and psychological factors and also social factors. Recent reviews of the Cochrane Collaboration showed that exercise is a promising, but not yet proven intervention for the treatment of CRF in breast cancer patients [2].

#### Methods and design

The BEST study was designed to evaluate the potential benefits of progressive resistance training beyond group-related psychosocial effects with regard to CRF and the biologic mechanisms. BEST is a randomized controlled clinical trial, which compares two group-based intervention approaches during adjuvant radiotherapy in breast cancer patients: (1) high intensity, supervised resistance training vs (2) progressive muscle relaxation (PMR, Jacobson method). Recruitment started in February 2011 and is estimated to be completed at the end of 2012. During that time, 160 patients will be enrolled. The primary endpoint is CRF. Secondary endpoints are specific immunological and inflammatory parameters and other biomarkers. Additionally, quality of life, depression, physical performance, physical activity history, and cognitive capacity will be assessed. The interventions (frequency, two times per week) start at the same time as the radiotherapy and will end after 12 weeks. Randomization will be stratified for age and baseline fatigue levels. Data collection will take place at baseline; at the end of radiotherapy; the end of 12-week intervention; and 3, 6, and 12 months after end of intervention.

#### Results

Until the end of April 2012, the number of participants is 95. Of those, 93 participants completed the primary endpoint assessment after 12 weeks. Two dropped before primary endpoint for personal reasons. The reasons for nonparticipation were mainly too long distance to the training center or time problems. There have been no intervention-induced adverse events. The median participation in resistance exercise as well as in PMR sessions, currently, is about 75 %. This is a very good adherence for patients undergoing adjuvant cancer treatment.

#### Discussion and conclusion

The knowledge on exercise therapy in cancer patients, predominantly in breast cancer patients, is growing. However, most randomized trials in this field compared an exercise intervention with standard care. With regard to fatigue and quality of life, the results of such examinations might be biased due to group-related effects/higher social contact rates. Based on its design, the BEST study will be able to determine the pure effect of exercise training beyond group-related psychosocial effects and will lead to a better understanding of exercise-induced mechanism on CRF. Furthermore, the controlled and supervised resistance training intervention will contribute to urgently needed evidence-based exercise guidelines for cancer patients.

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### **Recruitment and compliance of a sport intervention with lymphoma patients during treatment**

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#### Background

Besides evidence-based methods, the success of sport interventions with cancer patients depends on patients' compliance and sufficient sample size. In our study, we evaluated the effects of an exercise program on side effects and quality of life in lymphoma patients undergoing chemotherapy.

#### Methods

We screened 365 lymphoma patients over 3.5 years, and 61 were randomized to an intervention group (IG;  $n=30$ ) and a control group (CG;  $n=31$ ). The IG participated in an exercise program consisting of endurance, resistance, and sensorimotor training two times per week over 36 weeks with four assessments: before chemotherapy (T0), after 12 weeks (T1), 24 weeks (T2), and 36 weeks (T3). We analyzed physical functioning as well as quality of life (EORTC-QLQ-C30 questionnaire).

#### Results

The recruitment rate was 16.7 % with main reasons "health status" (44 %) and "distance to residence" (22 %) for refusing the study. Exceeding 30-min travel time, the probability of patients' approval of the study decreased, while younger patients tolerated a longer travel time than the elderly—significant weak correlation between "age" and "distance" ( $r=-0.291$ ;  $p<0.05$ ). The median compliance (T0–T3) of IG was 45 % (0–94 %) and showed no correlation to disease-related factors or age, but a nonsignificant correlation to distance ( $r=-0.352$ ;  $p=0.078$ ).  $N=21$  patients of IG were analyzed per protocol (100–25 % compliance) and improved their quality of life (T0–T3) significantly ( $p<0.01$ ), compared to CG.

#### Discussion

Considering distance as an important factor for recruitment and compliance, there should be sports therapy offers close to patients' residence. Despite of compliance problems, lymphoma patients benefited from our program.

### The PETRA study: physical exercise training and relaxation in allogeneic stem cell transplantation

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#### Rationale

Allogeneic hematopoietic stem cell transplantation (allo-HSCT) is associated with high treatment-related mortality and innumerable complications. This leads to a reduced quality of life, not only during and after transplantation but also in the long term [1]. Exercise interventions have already been shown to be beneficial in allo-HSCT patients. However, to date, no study has focused on long-term effects and survival [2–3].

#### Methods

The PETRA study is a randomized, controlled trial designed to examine the effects of a 1-year exercise intervention on side effects, complications, and prognosis after allo-HSCT. We will include 180 patients within 3 years. The experimental group will participate in a mixed type exercise intervention, consisting of resistance and endurance exercise three to five times per week. The control group will participate in a relaxation program 3–5 days/week. Outcomes are overall survival after 1 and 2 years, clinically relevant symptoms, such as fatigue, quality of life, physical performance, severity of treatment-related side effects (e.g., GvHD, infections, and nausea), and hematological and immunological reconstruction. Outcomes will be assessed at baseline (week prior to hospital admission) and at other five time points during the entire year. Within 1 year, we have successfully recruited 62 patients.

#### Discussion

Strengths of the PETRA study are its randomized controlled design with appropriate sample size and control group and exclusive focus on allo-HSCT patients. Further, this will be the first study, with a year-long intervention period.

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### Study protocol: randomized controlled prospective trial on the influence of a supervised systematic 6-month endurance training on selected metabolic markers, therapy-induced side effects and quality of life of cancer patients (CoVital study)

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#### Background

Many patients with colorectal carcinoma suffer from postoperative side effects, such as tumor fatigue, cachexia, or decreased physical fitness. The present study aims to verify whether physical activity can decrease tumor-related fatigue and increase quality of life and physical performance in postoperative therapy for colorectal cancer.

#### Methods

Randomized controlled prospective trial was used. Eighty colorectal patients (aged 18–90) will be randomized in each of two exercise groups (I1 and I2) and two usual care control groups (C1 and C2), 6 weeks after surgery (I1 and C1, with adjuvant chemotherapy; I2 and C2, without adjuvant chemotherapy). The intervention consists of a supervised 6-month walking exercise (two times per week for 60 min at 66 % of HR<sub>max</sub>) and a home-based cycling exercise (one time per week for 60 min). The investigations (exercise ECG, laboratory examinations, and questionnaire) will take place at baseline, 6 weeks after surgery (0 week), mid-intervention (12 weeks), post-intervention (24 weeks), and at a 6-month follow-up (48 weeks). Outcome measures are quality of life (EORTC-QLQ-30 and EORTC-QLQ-CR-29), cancer-related fatigue (MFI-20), and physical performance (IPAQ).

#### Discussion

The present trial will provide valuable insights into the role of physical activity as part of cancer rehabilitation. Based on the results, training recommendations for the treatment of patients after recovery from colorectal carcinoma should be developed.

### AKTIVA: an exercise program in order to activate HSCT patients in the acute phase

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#### Background

An isolated accommodation of HSCT patients in a one-bed room, often necessary during the inpatient acute phase, increases inactive behavior of patients and promotes immobility and fatigue (Baumann and Schüle 2008). Thus, the use of motion and sport therapy programs taking into account the special situation of HSCT patients become more and more important. The small number of present reference studies and their lack of comparability still offer no uniform and final picture regarding specific training recommendations. The AKTIVA program is characterized by content diversity, program stages for burden dosage, and individualized training regulation and control.

#### Method

The AKTIVA program was developed and tested in a clinical study in order to evaluate a somatic-psychosocial care concept for oncologic patients after hematopoietic stem cell transplantation. A total of 37 patients participated in the sports program during their inpatient stay. The average age of the study group members was 51.8 years (min 19; max 70; SD=11.3), and 65 % of them

were male. In order to verify feasibility, the following data were collected: duration of hospital stay, use of motion offer, and type and intensity of physical and sport activities. The diaries of motion kept by the patients and the sports therapist's protocols were used for evaluation. The descriptive data analysis was carried out using the standard methods of applied statistics. Group comparisons have been assessed, depending on scale level, by using *t* tests and Chi-squared tests.

#### AKTIVA program

This activation program combines ergometer training with targeted strengthening, stretching, and relaxation exercises. This variety of exercises allows to respond to patient needs and to develop an individualized program. Objective of the program was to motivate patients toward sporting activities and, by structuring of performance levels, to enable them to independently carry out and regulate training units to a great extent. An individual training recommendation was made after a detailed anamnesis, taking into account existing secondary diseases as well as the individual sporting experience of a patient. Training of patients was supervised in regular intervals and efficiently and continuously adapted to changed individual performance. The participants were also instructed to keep a motion book (BWT) in order to document the activities during the acute phase, and when to return it to the study center upon their release from hospital.

#### Results

During the average 21 days of clinic stay, the patients were on average 9.4 days active in the fields of endurance, strengthening, and/or relaxation training which correspond with an average training load of 45 %. Only three patients were unable to train at all for health-related reasons. The relaxation training, with an average of 2.4 days, was performed much less frequently by patients than the endurance or strength training units. The majority of patients had a health-related constitution which enabled them to train between 5 and 15 min in the recommended training heart rate range (OwnZone®). Two patients could even perform 40 min of ergometer training. Exercises for strength were performed with a maximum repetition number of 20 in three sets. None of the patients reached the higher levels of performance in the strength training. From the additional content analysis of the 31 sports therapists' protocols, common obstacles were identified with regard to the implementation of the recommended motion program.

#### Discussion

The results show that upon commencement of the inpatient phase, the AKTIVA program could be implemented easily in the hospital daily routine, and they underline the high level of acceptance achieved. With the possibilities of individual adaptation to the patient's health situation through a variety of training units and program stages, we have been able to achieve the anticipated activation. Intensity control based on heart rate offers the patient the possibility of self-control and safety. Experience of sports therapists and the patient's reports emphasize the need for continued support by sports medicine or motion therapy offered by qualified personnel.

#### Keywords

Hematopoietic stem cell transplantation (HSCT)

Exercise program

Motion activation

Acute phase

#### References

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#### How does exercise improve cancer survivors' quality of life?

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#### Introduction

We aimed to examine mediators of a 12-week exercise intervention explaining its beneficial effect on cancer survivors' quality of life (QoL). Knowledge of mediators provides information for further improvements of interventions.

#### Methods

A total of 209 cancer patients (57 % breast cancer) aged 49.5 (±10.4) were assigned to physical training (*n*=147) or wait-list control (*n*=62) ≥3 months of posttreatment. QoL, fatigue, emotional distress, physical activity (PA), self-efficacy, and mastery were assessed using valid questionnaires. Path analysis was conducted using Mplus. In the model, we hypothesized the intervention to improve PA, self-efficacy, and mastery, thereby reducing fatigue and distress and consequently improving QoL.

#### Results

The intervention effect on QoL was indeed mediated by the hypothesized path. We found an effect of the intervention on PA (*p*=0.001), self-efficacy (*p*=0.029), and mastery (*p*=0.001). Further, the intervention had both a direct effect on fatigue (*p*=0.04) and an indirect effect via PA (*p*=0.04) and self-efficacy (*p*=0.06). The intervention had a borderline significant direct effect on reduced distress (*p*=0.06) and a significant indirect effect via improved self-efficacy and mastery (*p*=0.006). Reductions in fatigue (*p*<0.001) and distress (*p*<0.001) were associated with improved QoL. Further, improved PA was directly associated with improved QoL (*p*=0.002).

#### Conclusion

The beneficial effect of exercise on QoL was mediated by improved PA, self-efficacy, and mastery, and subsequent reductions in fatigue and distress. Future interventions should incorporate increasing PA, self-efficacy, and mastery, since this may lead to reduced distress and fatigue, and consequently improved QoL of cancer survivors.

#### Physical Activity Navigator

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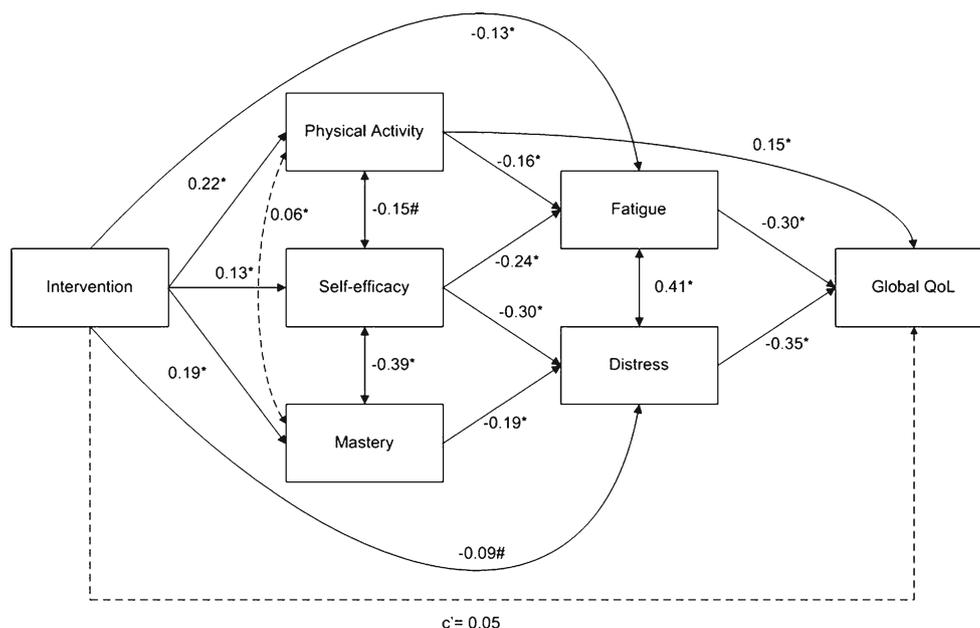
#### Introduction

We want to present a patient-centered care project, called Physical Activity Navigator. Hereby, we want to describe the relevant interfaces for this care pathway, show the stage specific methodology, and introduce the stakeholders. The foundation, Leben mit Krebs (living with cancer) has enabled us to appoint a sports therapist designing activity programs and coordinating physical activities for in- and outpatients with cancer diagnosis.

The Physical Activity Navigator supports patients (1) in the hospital "Ruppiner Kliniken," (2) in our rehabilitation center, and (3) in special outpatient follow-up programs.

#### Methods

We have established a personalized sports therapy, offering patients in our cancer wards to practice sports during primary treatment in the clinic. The benefits of positive physical experience through individualized motor activity are part of our treatment concept during ongoing inpatient chemotherapy or radiotherapy. Following the hospitalization, we offer established outpatient exercise schemes for endurance training, adapted strength training, or gymnastics. These motor activity offers are recommended by our ambulatory cancer healthcare center. Patients are able to participate in such exercise programs, if a "receipt for motion" has been issued. The rehabilitation center with its specific possibilities for physical activity and sports links up all parts of the program, from acute therapy to aftercare. We support patients to continue physical activities with rehabilitation programs funded by health



insurance. In addition, we encourage individual medical fitness training, advise recreational sports activities in sport clubs, and introduce patients to an active daily living.

#### Results

We started the project Physical Activity Navigator in January 2011. A total of 280 in- and outpatients have been supervised in our program up to date. Currently, 30 outpatients per week are participating in the special motor activity offers. We succeeded to integrate patients in our care project, starting at the time of cancer diagnosis until follow-up sports activities. This early intervention is the key to success of our physical activity pathway for cancer patients.

#### The influence of a long hike on fitness and quality of life of patients after breast care treatment

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#### Background

After finishing the acute therapy, the quality of life of breast cancer patients is still low. For this reason, it is important to come up with a strategy that will enable these women to improve their physiological fitness and quality of life on their own.

#### Methods

Women diagnosed with breast cancer ( $n=22$ , aged  $53\pm 7$  years, post-diagnosis  $1.8\pm 1$  year, BMI  $23.5\pm 3.58$  kg/m<sup>2</sup>), whose acute treatment had been completed by hiking along the Way of St. James (810 km) for a period of 6 weeks, were recruited. Test subjects were free to choose their own speed and resting periods (22 km/day). They had to carry their own backpacks of 10.4 kg. Women were observed in relation to quality of life (EORTC QLQ C-30 and BR-23) and fitness (lactate). Tests were fulfilled 2-months pre- and post-hiking and 6 months post.

#### Results

The results show significant improvement in global health status ( $p<0.001$ ). The improvement of body image is to be highlighted ( $p=0.04$ ). The endurance significantly improved by 2.2 m/s ( $p=0.05$ ), measured with the aid of lactate. A clear drift to the left of the lactate curve can be observed in this case.

#### Discussion

Even though the quality of life was improved, there is almost no increase of physical fitness. It is necessary to discuss whether the fitness level at

baseline was relatively high or if the stimulus of hiking was too low for a physiological adaptation. However, this result clearly shows the significant influence exercise has on the psychological status. Limitations are caused due to missing analysis of the 12-year post-impact study and control group.

#### Physical and functional effects in prostate cancer patients: impact of an inpatient urological rehabilitation program

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#### Background

A multimodal therapeutic approach has been established in the field of urological and urooncological rehabilitation. Aim of this investigation was to evaluate the effects of a special urooncological rehabilitation program on urinary incontinence and physical performance after radical prostatectomy.

#### Methods

A total of 254 patients were investigated during their inpatient rehabilitation (21 days). We measured the physical performance by the use of a 6-min walking test (6-MWT) and urinary incontinence by 24-h pad test at the beginning (T0) and end (T1) of their stay. We calculated individual reference values for the 6-MWT based on the formula of Enright and Sherill (1998). All patients took part in a special multimodal rehabilitation program (sports/exercise therapy, continence training, balneological therapies, psychological interventions, seminars for education, and individual prescribed therapies).

#### Results

The results showed a significant increased walking performance (525 m ( $\pm 69.5$ ) to 579 m ( $\pm 76.0$ );  $p<0.001$ ). At the beginning of their stay, the distances were significant less compared with their individual reference values (525 m ( $\pm 69.5$ ) to 537 m ( $\pm 59.8$ );  $p<0.05$ ). After completing

rehabilitation, their performances were significant higher than their references (579 m ( $\pm 76.0$ ) to 537 m ( $\pm 59.8$ );  $p < 0.001$ ). By analyzing the postoperative incontinence ( $n = 186$ ), a significant decrease could be found (388 ml ( $\pm 494$ ) to 218 ml ( $\pm 356$ );  $p < 0.001$ ).

#### Conclusion

A multimodal urooncological rehabilitation program is able to increase physical performance and decrease incontinence after radical prostatectomy. So with a specialized inpatient rehabilitation program, this contributes to a contemporary reintegration in social and all-day life.

#### Case-control study of physical activity and breast cancer risk in pre- and postmenopausal women in Southwestern Germany

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#### Background

There is strong evidence that physical activity (PA) is inversely associated with breast cancer risk. Lifestyle, nutritional habits, and PA differ between communities, and it is important to examine the influence of physical activity on breast cancer risk in different populations.

#### Methods

We analyzed the association of PA with breast cancer risk in 301 cases and 401 controls from a hospital-based case-control study on breast cancer risk factors conducted in Southwestern Germany. PA including sports and leisure time activities was assessed in the age periods 10–20 and 20+ years.

#### Results

In multivariate unconditional logistic regression analysis, strenuous sport activities during adolescence, i.e., 1 to 2.5 h running per week outside school hours, were associated with a significant breast cancer risk reduction of 57 % [odds ratio (OR)=0.43; 95 % confidence interval (CI)=0.25–0.73;  $p$  value=0.0019]. After stratification by menopausal status, the protective effect persisted for postmenopausal women only. Combined lifetime intensive sports and recreational activities from age 10 years on led to a statistically significant breast cancer risk reduction of 61 % (adjusted OR=0.39; 95 % CI=0.19–0.82;  $p$  value=0.0128) in postmenopausal women.

#### Conclusions

Our data suggest that lifetime sports and strenuous recreational PA are inversely associated with postmenopausal breast cancer risk in a German population. Increased PA outside school hours during adolescence provided the most protection.

#### Impact of a 4-day hike on quality of life in cancer patients

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#### Background

This is a prospective study in 15 cancer patients who underwent controlled endurance training in preparation for a guided 4-day hike of 15–20 km walking per day in average. Objectives were to assess the feasibility and to evaluate emotional and physical effects and the impact on the quality of life.

#### Methods

Patients were advised on a specific endurance training program based on their individual performance status. They exercised alone and/or in groups. Quality of life was measured by European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ)-30 as defined: 6 weeks before (time point (TP)=1), 1 week before (TP 2), directly after (TP 3), and 4 weeks after the hike (TP 4). Disease-related and

demographic data as well as body mass index (BMI) development were collected in each patient.

#### Results

All patients completed the physical exercise program and the hike. Evaluation of the EORTC QLQ-30 items showed significant improvement in global health status ( $p = 0.0121$ ) and emotional ( $p = 0.0018$ ) and social function ( $p = 0.0049$ ) scales over the whole observation period. Most significant effects were measured between TPs 1 and 3. Median BMI increased in all patients continuously between 23.5 and 23.9 from TPs 1 to 4.

#### Interpretation

Intensive endurance training in preparation for a 4-day hike is feasible in cancer patients treated in a palliative setting. Significant and sustained improvement of global health, emotional, and social functions was timely related to the training skills and the hiking tour and not to other disease or treatment-related aspects. Increase of BMI underlines the improvement of the nutritional and, therefore, general condition of the patients. These results encourage to design training programs and sports events for cancer patients in palliative treatment settings.

#### Effects of a 12-week walking intervention on status of lymphedema and aerobic fitness in patients with breast cancer-related lymphedema

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#### Background

Physical activity has been shown to be safe for patients suffering from breast cancer-related lymphedema (BCRL). Because of the wide range of interventions, it is not possible to give specific, evidence-based training advice to this group of patients. Concerning the status of lymphedema, endurance training could be one effective method in order to reduce the volume of the concerned arm.

#### Method

The purpose of this study was to investigate the effects of a 12-week walking intervention. The main outcome was the status of lymphedema (circumference measurement; subjective symptoms: pain, feeling of heaviness, or tightness). Additionally, aerobic capacity was investigated by using the 6-min walk test (6MWT). Training consisted of two sessions weekly with a duration of 30–60 min. One session was supervised; the second one had to be conducted unsupervised by the participants.

#### Results

Concerning arm circumferences, there is no significant difference between baseline measurement and measurement at the end of the intervention. A reduction of the upper arm circumference in the walking group (WG) does not reach significance ( $p = 0.055$ ). Regarding subjective symptoms, the WG shows a significant reduction in sensation of tightness and heaviness ( $p = 0.024–0.034$ ). Aerobic capacity evaluated by the 6MWT increased during the intervention ( $p = 0.018$ ).

#### Discussion

Walking can be recommended as a safe form of physical activity in the field of BCRL. Concerning subjective symptoms and aerobic capacity, it may be one method to improve the situation of patients with BCRL.

#### Aerobic capacity and exercise-related change in cancer patients

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## Background

Observational studies indicate that physical activity levels decrease after a cancer diagnosis. In addition to cancer- and treatment-related side effects, this may substantially diminish exercise capacity. Surprisingly, up to date, there is relatively few quantitative information available regarding exercise capacity with respect to cancer site and patient status. The present study evaluated aerobic capacity and exercise-related changes in cancer patients taking into account age- and sex-adjusted reference values (ACSM), time since diagnosis, cancer site, and type of treatment.

## Methods

A total of 183 cancer patients (55.5±10.6 years, during (71 %) or off (29 %) treatment; breast cancer 33 %, colorectal cancer 25 %, lung cancer 8 %, and prostate cancer 8 %) participated in a group- and/or home-based exercise program following initial sports medical examination and exercise counseling. Aerobic capacity (VO<sub>2</sub> peak) was assessed by cardiopulmonary exercise testing (cycle ergometer) at study inclusion, after 4–6 and 16–20 weeks.

## Results

The average VO<sub>2</sub> peak (22.1±5.8 mlmin<sup>-1</sup>kg<sup>-1</sup>) in all cancer patients corresponded to 69±16 % of age- and sex-adjusted reference values of unimpaired subjects (ACSM). Aerobic capacity was significantly lower in patients with lung cancer (17.7±4.1 mlmin<sup>-1</sup>kg<sup>-1</sup>) compared to other cancer sites ( $p<0.05$ ). Patients in the group with the greatest time interval between cancer diagnosis and study inclusion (>12 months) had a significantly lower VO<sub>2</sub> peak in comparison to the group with the shortest time interval (<3 months) (20.6±5.4 vs 24.1±6.5 mlmin<sup>-1</sup>kg<sup>-1</sup>) ( $p<0.05$ ). Study participants improved their VO<sub>2</sub> peak significantly after 4–6 and 16–20 weeks (5.4±11.7 and 9.3±15.4 %;  $p<0.001$ ). There were no group differences in the amount of VO<sub>2</sub> peak enhancement for cancer site, type of treatment, or time interval between diagnosis and study inclusion ( $p>0.05$ ).

## Discussion/conclusion

Cancer patients demonstrate a comparatively low aerobic capacity compared to healthy unimpaired controls. The findings underline necessity and the benefit of an early integration of physical activity and exercise regimes in the control continuum after a cancer diagnosis.

## Influence of strength and endurance training on the immune system, lipid metabolism and the circulating tumor cells in breast cancer patients during chemotherapy

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## Background

Through an alteration of the humoral and cellular portions of the immune system, a physical activity impacts the immune system in different ways. It seems that a physical activity of medium dose intensity positively influences the cytotoxic T cells, natural killer cells and macrophages. Circulating tumour cells are said to be surrogate markers for tumour-free surviving and can be discovered in 10–80 % of all breast cancer patients. Proofs of circulating tumour cells are unfavorable prognostic factors. Leptin and adiponectin have different effects on the proliferation of tumour cells. While leptin is causing a proliferation of tumour cells, it seems like adiponectin has a repressive influence on the proliferation of tumour cells. The influence of a physical activity on this cell population, on the circulating tumour cells and the immune status has not been examined sufficiently yet.

## Method

The prospectively randomised and controlled study involves 60 female breast cancer patients, who are receiving chemotherapy. Twenty patients each are randomised into a strength training group, a cardio training group

or a control group that gets physiotherapy. The immunologic parameters (CD4, CD8 and T Reg cells) (FACS analysis), the number of the circulating tumour cells (density gradient centrifugation) and also the concentration of leptin and adiponectin (ELISA) are being measured through the taking of blood samples at the beginning and after 12 weeks.

## Results

At the moment, patients for the study are being screened, recruited and randomised. The final evaluation of the results is planned for the end of 2012 or beginning of 2013.

## Discussion

Knowledge about the effects of a physical activity on the circulating tumour cells as well as the positive alteration of immunologic parameters under chemotherapy would be a big advance for a targeted therapy.

## Gentle strength training in the rehabilitation of breast cancer patients compared to conventional gymnastic exercises

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## Introduction

Movement therapy during the rehabilitation of breast cancer becomes more important in the last years. There are less appropriate recommendations published.

## Methods

In a randomized controlled study, the feasibility of gentle strength training was compared to conventional gymnastic exercises during rehabilitation of female breast cancer patients. The aim of this study was to identify alternative sports intervention in the treatment of breast cancer patients. The intervention group (IG) was lifting standardized weights weekly (50 % of 1RM), while the control group (CG) received conventional gymnastic exercises. A bicycle ergometry adjusted to the WHO system was performed with all participants at study entry (T0), after 3 months (T1), and 6 months (T2). Quality of life was measured by standardized report forms (EORTC QLQ C30 version 3 and BR23).

## Results

Both methods show a slight improvement in submaximal endurance performance and a significant improvement in the subjective feeling of effort (IG 75<0.01 W, CG 75<0.01 W) and in psychosocial and psychological parameters like quality of life (IG, <0.01; CG, <0.01) and fatigue (IG, <0.01; CG, <0.01).

## Discussion

This study shows positive effects for gentle strength lifting in the rehabilitation of breast cancer patients and turned out to be a probate alternative to gymnastic exercises.

## Evaluation of a 12-week strength and endurance training on selected physical, psychological and cognitive parameters in breast cancer patients during chemotherapy

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## Background

Reduced quality of life, limited performance and fatigue during daily tasks are the observed effects of breast cancer and treatment of the disease. These

signs are concomitant diseases that often prolong the actual period of treatment. Lately, several studies in the field of strength training in oncology have shown that specific conditioning training in different phases offers an opportunity to treat tumor cachexia; however, they base their argument on only few studies. The aim of this study is to analyse the implications of individual interventions in exercise therapy on endurance, muscle strength, fatigue and quality of life for breast cancer patients during chemotherapy. This is done by means of comparing several methods.

#### Method

This study is prospectively randomised and controlled. It includes 60 breast cancer patients who are, at the time of the study, exposed to chemotherapy. Twenty persons each are randomly pooled into a strength training group, an endurance training group or a control group. The latter is exposed to physiotherapy treatment in case it is indexed. At the beginning and after 12 weeks, the following tests are undertaken: isometric maximum strength test and a PWC 150 test to determine the endurance of patients. The standardised questionnaire EORTC QLQ C30 including module BR23 measures the quality of life of patients, and the questionnaire MFI-20 ought to determine symptoms of fatigue. Questionnaire D2 measures the ability to focus of patients.

#### Results

Currently, patients are screened, recruited and randomised for the study. Overall evaluation of results is expected to be finished by the end of 2012 or early 2013.

#### Discussion

The purpose of this study is to show the value added of strength or endurance training for patients undergoing chemotherapy. Stabilisation or improvement of the maximum strength and endurance during chemotherapy, as well as increase of quality of life and reduction of symptoms of fatigue would, furthermore, be a great step.

### Impact of participating in a running event on selected parameters in the rehabilitation of breast cancer patients: a pilot study

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#### Background

Detrimental physiological, psychological, and social consequences of breast cancer often persist for many years after diagnosis and therapy. Although the current literature describes the positive influence of sports and physical activity, relatively little is known about the therapeutic effect of sports in cancer patients. The purpose of this pilot study is to evaluate an endurance training program that could be used in future ambulatory sport therapy care for breast cancer patients.

#### Methods

The study examined the impact on the physical condition and endurance of breast cancer patients participating in a public 6-km fun run. Before the fun run, the patients ( $n=9$ , age= $56\pm 7$  years, post-diagnosis  $3\pm 2$  years) participated in a twice-weekly endurance training program for a period of 6 months. A questionnaire (SF-12) was used to determine their physical condition at the start of program and after the fun run. To evaluate their endurance, a 2-km walking test was used at the start of the program and shortly before the fun run.

#### Results

The post-run tests showed an improvement in both physical condition and endurance of these breast cancer patients. Significant improvements were seen in the psychological weighting factor ( $p=0.038$ ) and in endurance ( $p=0.005$ ). An improving tendency in the physical weighting factor ( $p=0.525$ ) was also observed. During training and fun run, no complications or adverse effects were detected in patients.

#### Discussion

Due to medical progress in breast cancer therapy, there is a need for reshaping sport therapy exercise programs for rehabilitation and ambulatory follow-up patient care. This pilot study suggests that the investigated endurance training program may be effective; however, there is insufficient explanatory data. Future research should include an increased number of participants, as well as a control group.

### Evaluation of the neuromuscular activation of the pelvic floor muscle under different exercise conditions

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One target of rehab sports programs after prostatic cancer is the recovery of continence. Exercises are not evaluated, and there is a lack of information concerning the intramuscular coordination under different exercise conditions as well as the involvement of the pelvic floor muscle (PFM) in physiological activities. So the target of this study is the evaluation of the neuromuscular activation of the PFM under different exercise conditions. The participants are healthy men ( $N=8$ ), aged between 25 and 40 years. Following muscles were detected via superficial EMG: PFM (probe and superficial, musculus (M) obliquus internus, M rectus abdominis, M gluteus maximus, Mm adductores, M multifidus, and M erector spinae. The raw EMG was sampled with 1,500 Hz in a band of 10–500 Hz. Data analysis which is full wave rectified, smoothed (RMS 100 ms), and MVC and time normalized was used. Analyzed activities were “activities of daily living,” functional gymnastics,” and “apparative-based exercises.” Apparative-based exercises lead to the highest neuromuscular activation. An additional voluntary contraction of the PFM tends to a significant higher EMG level. There is a close intermuscular coordination between the PFM and postural trunk muscles. It is unclear, up to now, if complex exercises are able to reach the activation of continence-saving parts of the PFM. Because of the unexplained effectiveness of complex exercises on the activation of the continence-saving parts of the PFM, so far, the initial activation should start the exercises.

### Lymphoma patients benefit from exercise concomitant to therapy

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Lymphoma patients (pts) receiving therapy often suffer from severe side effects that not only influence their quality of life but also the dosage and schedule of therapy. In a prospective, randomized study, we performed an exercise program in order to address the restrictions and improve pts' quality of life. Forty pts [age 46 (19–75)] were randomized either to an intervention group (IG,  $n=20$ ) or a control group (CG,  $n=20$ ). The IG participated in an exercise program (aerobic endurance, strength, and sensorimotor training) two times per week. Pts were evaluated four times (T0–T3), every 12 weeks, starting before therapy. Aerobic performance level was analyzed with a lactate threshold test, balance control (static and dynamic on force plate GKS 1000/perturbed on oscillating measuring plate Posturomed®) by analyzing sway paths and failed attempts. Status of peripheral deep sensibility was evaluated by tuning fork and medical reports, quality of life assessed with the EORTC-QLQ-C-30. Significant group differences were found concerning the aerobic performance level, cumulative sway paths, failure rates, the extent of Polyneuropathy (PNP) and quality of life ( $p=0.008$ ). The

IG showed lower lactate levels at equal capacity ( $p=0.013$ ), which was able to improve balance control ( $p=0.010$ ) and reduce the number of failed attempts ( $p=0.001$  T3, IG 100 %/CG 55 %), while the CG steadily declined. The extent and diversification of PNP correlated with these results (T0, IG 15 %/CG 10 %; T3, IG 5 %/CG 40 %). Our exercise program is a feasible and very promising method to support cancer pts during therapy and help preserve their functionality for activities of daily living.

### Development of a sport and exercise programme alongside medical treatment for cancer patients: implementation and acceptance study in the region of Schwäbisch Gmünd

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#### Background

Due to their positive effect on the treatment of cancer patients, physical activity schemes should be implemented not only in or after rehabilitation but also alongside hospital care. The level of demand for so-called “treatment-associated sports schemes” has been examined with patients of the Staufer Hospital in a first implementation and acceptance study. The following questions were investigated: (1) How should the offers and the communication of such schemes be designed? (2) Which barriers do the patients face? (3) What are the patients’ opinions towards the range of activities offered and how high is the willingness to participate?

#### Realization

A questionnaire was used to collect data, specifying personal details, medical history, physical activity, attitude towards an exercise program, willingness to participate, social support and structural conditions of a potential exercise program. The survey was conducted at the hospital; 120 patients of the oncology clinic, internal oncology and gynecological oncology responded the questionnaire.

#### Results

Above all, patients desire an exercise program with participants of a similar age. Regarding gender composition, women would prefer to be in exclusively female groups. In regard to participation barriers, the distance to the location where the exercises were offered, rather than physical fitness, was seen to be a hindrance. Longer journeys (>2 km) to an exercise programme would prevent many patients from participating. Analyses showed that a positive attitude towards an exercise programme and physical fitness increase the willingness of patients to travel a further distance.

#### Conclusion

The implementation of concomitant therapy for physical activity is generally welcomed by patients. To overcome barriers, however, a strengthening of the personal resources and the improvement of structural conditions ought to be considered.

### Cancer patients’ interest and willingness to engage in physical activity.

#### Motivation good: implementation needs improvement

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#### Background

Physical activity during cancer treatment has positive effects on various health outcomes. But are patients, who are not sufficiently active, willing to change their lifestyle? To answer this question, the Precaution Adoption Process Model (PAPM) by Weinstein was used to assess the motivational stage of the patients. A further aim of the study was to examine whether motivation to exercise leads to an acceptance of supportive measures.

#### Methods

A total of 193 mostly inactive (<150 min/week) patients ( $w=101$ ,  $m=92$ ;  $M=58$  years) of different cancer entities and different outpatient therapy regimes were recruited in the National Center for Tumor Diseases in Heidelberg. A questionnaire assessed the stage according to the PAPM. At the end of the survey, patients were offered four different supportive measures to help them increase their physical activity: an information booklet, training material, an information session, and supervised exercise/counseling. Finally, the acceptance of these supportive measures was assessed.

#### Results

Patients responded very positively to the recommendation to exercise 150 min/week; more than half stated that they want to exercise 150 min in the future; only 6 % have decided not to do so, and 16 % did not know before that exercise is recommended. Looking at the supportive measures, you see a different picture: the information booklet was most popular (>50 %), but only 14 % were interested in participating in the exercise program/counseling, and even fewer actually attended.

#### Discussion

In general, cancer patients seem to be motivated to exercise regularly. But, it is seems less easy to get patients to participate in supportive measures.

### The influence of different stages in therapy on the level of activity of daily living and on selected aspects of sensomotoric status in pediatric oncology patients

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Seventy percent of all malignant neoplasm in childhood and adolescence can be treated successfully. The concomitant and secondary diseases of cancer and cancer therapy lead to reduction in physical fitness and activity. Forty-one pediatric oncology patients (female  $n=14$ ,  $13.8\pm 4.9$  years; male  $n=27$ ,  $14.2\pm 5.1$  years) were included in a controlled cross-sectional study regarding ADL level (StepWatch activity monitors) in and out hospital therapy phases and in breaks of therapy. In a subgroup of 12 patients, the sensomotoric status was measured by motor function testing additionally. The mean ADL level in patients was consistently below the 50 % borderline of the healthy controls (in hospital 27 %, out hospital 42 %, breaks in therapy 48 %). There was no difference between weekdays and weekend. Ninety percent of the activity level of the patients accorded in the lowest activity level. Health-enhancing physical activity could be observed in 14 % of the controls and in 5–6 % of the patients. The sensomotoric status of patients was only slightly below the level of controls. The disease itself and, primarily, the side effects of the therapeutic intervention are the pulse generators of the physical activity in cancer

patients. The illness and the therapeutic-associated reduction of physical capacity do not course the decrease in activity, and it is more an associated and subsequent phenomenon. Because of the well-documented advantage of physical activity also in cancer patients, interventional models should be developed to implement compensatory physical activity in and out hospital therapy phases.

### Endurance training vs resistance training: impact of physical activity in leukaemia patients during chemotherapy

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#### Background

In recent years, some clinical trials have demonstrated that physical activity is feasible and has positive physical and psychological effects on patients with haematological diseases undergoing intensive chemotherapy. But there is little known about the contributions of strength and endurance training to the results found. Therefore, the aim of this ongoing study is to investigate and compare the effects of two exercise varieties—strength and endurance training with patients diagnosed with acute leukaemia.

#### Methods

Overall, 36 patients, diagnosed with acute leukaemia, are to be included in the study. Prior to induction of chemotherapy, the patients will be randomly assigned to one of three training groups: endurance, resistance or stretching (control condition) and will perform a 30-min program (three per week) for the duration of their hospitalisation (4–6 weeks). Physical capacity (maximal isometric knee extension/flexion force, individual anaerobic threshold), body composition (bioelectrical impedance analysis) and quality of life (EORTC QLQ-C30) were compared to pre- and post-exercise interventions and after a follow up of 24 weeks.

#### Results

So far, we were able to recruit 22 patients, including two patients who are in treatment at the moment. Six patients dropped out, due to insufficient physical and/ or mental condition.

#### Discussion

After treating 14 patients, no adverse events (i.e. bleeding, fracture) occurred. The results, so far, give an indication that these patients benefit from our exercise programs, especially from resistance training. However, a larger sample size is needed to confirm this existing trend.

### Impact of an individualized training program on physical activity in breast cancer patients

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#### Background

Physical activity is one of the modifiable risk factors in breast cancer, and even after a diagnosis of breast cancer, physical training can improve survival. However, breast cancer patients tend towards inactivity after treatment.

#### Methods

Patients with non-metastatic breast cancer and a first diagnosis not more than 5 years ago were eligible for the study. In the intervention group (Klinik Am Kurpark, Bad Kissingen;  $n=50$ ), they received an individualized physical training, additional to an oncological inpatient rehabilitation program according to current German guidelines. Training was planned jointly by patients and physiotherapists with patients being able to choose their favorite kinds of sports. Before discharge, a home training program was developed. Patients in the control group (Klinik Ob der Tauber, Bad Mergentheim;  $n=50$ ) received a usual oncological inpatient rehabilitation program only, according to current guidelines without individualized physical training. After 4 months, physical activity was assessed by questionnaire in both groups.

#### Results

At the beginning, the amount of physical training per week did not differ significantly between both groups with 1.3 h in the intervention group and 1.2 h in the control group ( $p=0.39$ ). After 4 months, the duration of training had increased significantly to 4.4 h/week in the intervention group, but only marginally to 1.9 h/week in the control group ( $p=0.22$ ). This difference was highly significant ( $p<0.001$ ).

#### Discussion

An individualized physical training could significantly increase physical activity in breast cancer patients compared to a usual oncological rehabilitation program, which applied also after 4 months. Possibly, preferred kinds of sports and an individual support increase motivation and, hence, can raise physical activity at least medium term. Therefore, it seems to be important to account for individual desires and requirements, if lifestyle should be modified in the long run.

### Impact of a 3-month strength training on muscular strength, oxidative stress, fatigue and quality of life of breast cancer patients undergoing chemotherapy

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#### Introduction

Many studies provide evidence that physical activity can have positive effects on quality of life (QOL), fatigue, and physical fitness after and during therapy (Courmeya et al. 2007). Nevertheless, there is little data on possible effects on oxidative stress and immune parameters (Gago-Dominguez 2007). Only few studies examined the feasibility and efficiency of resistance training interventions on breast cancer patients undergoing adjuvant chemotherapy (Galvao et al. 2007).

#### Methods

In total, 40 breast cancer patients undergoing adjuvant chemotherapy are to be randomized by preference into a 12-week resistance training program or control group. The following parameters are analyzed at the beginning and after the program: muscular strength and EMG measurements, oxidative stress, fatigue, and QOL.

## Results

Until now, 25 women completed the program. Results show a significant increase of strength in lower and upper extremities and a better innervation of various muscles in the intervention group. The reduction of fatigue and systemic therapy side effect outcomes are evidence for an improvement of QOL. Oxidative stress does not seem to be influenced by the program.

## Discussion

These first results show that integrating resistance training can be beneficial for breast cancer patients already during chemotherapy. Fatigue, quality of life, and muscular strength could be preserved or even be improved through regular resistance training.

## Physical activity and sports participation in long-term survivors of Ewing sarcoma

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## Background

Improving the treatment of Ewing sarcomas, survival rates could significantly be improved. However, the functional late effects of treatment have, so far, rarely been investigated. The present cross-sectional study aimed at objectively quantifying physical activity in survivors of Ewing sarcoma and at recording patients' participation in sports activities.

## Methods

In the present study, former patients with a minimum follow-up of 5 years from diagnosis as well as an age- and gender-matched control cohort were investigated. Physical activity was measured by accelerometry for seven consecutive days.

## Results

Two hundred former patients and 100 control individuals were included into the study. Approximately 50 % of former patients and 75 % of the control cohort could be classified as active (>10,000 steps per day;  $p < 0.002$ ). Both groups showed little activity on a moderate to high-intensity level of activity. Seventy percent of former patients and 81 % of control individuals stated that they participated in sports activities on a regular basis (patients  $3.8 \pm 3.3$  h/week and controls  $3.7 \pm 0.8$  h/week).

## Discussion

A surprisingly high percentage of former patients reached a good level of activity and regularly participated in sports activities. Not reaching a sufficiently high intensity of activity is apparently a general problem not attributable to the disease. Restrictions were mainly found in former patients that were affected in the lower extremity. In the future, a more

detailed look at tumor location and treatment regimes are needed to identify possible risk groups.

## Effects of a supervised physical exercise intervention on physical fitness in colorectal cancer patients undergoing ambulatory chemotherapy: study protocol and feasibility of the CoAktiv Study

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## Background

Even though current data suggest a positive influence of physical exercise on mortality risk, aerobic fitness, and physical functioning in colorectal cancer survivors, only very few controlled randomized trials have been conducted in this field.

## Methods

The CoAktiv study is a preference randomized controlled trial which examines the effects of supervised aerobic training in colorectal cancer patients undergoing curative treatment. Sixty patients with resected colorectal cancer (UICC Stadium II–III) who are scheduled to receive adjuvant chemotherapy will be included in this study. Patients in the intervention group exercise five times per week (two times, supervised; three times, home-based) for 6 months. Next to physical fitness (primary outcome), quality of life, treatment-related side effects, and event-free survival, molecular mechanisms are examined.

## Results

By March 2012, 23 patients (17 in the intervention and 6 in the control group) were included in the study. Of these 23 patients, only five dropped out of the study (three in intervention and two in control group), indicating that the intervention is feasible.

## Discussion

Colorectal cancer patients significantly decline physical activity levels during adjuvant treatment, mostly due to severe disease- and treatment-related side effects and lack of physical exercise guidelines. A supervised exercise intervention during adjuvant treatment may improve quality of life and disease outcomes in colorectal cancer survivors and counteract the consequences of inactivity.