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Taking physical rehabilitation after abdominal  
cancer surgery further  
– by enhanced recovery and physical activity

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# Taking physical rehabilitation after abdominal cancer surgery further - by enhanced recovery and physical activity

THESIS FOR DOCTORAL DEGREE (Ph.D.)

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## ABSTRACT

The overall aim with this thesis was to increase knowledge of standardised methods for individualised mobilisation and rehabilitation after abdominal cancer surgery. Concerning mobilisation, both effect, and patients' experiences of a method for postoperative mobilisation were evaluated, as well as the association between early mobilisation (daily steps) and complications. For rehabilitation, the feasibility of an exercise programme in primary care was evaluated.

This thesis includes four studies with four different designs: a nonrandomised controlled trial (study I), an observational study based on a secondary analysis of study I (study II), a qualitative interview study (study III), and a feasibility study (IV). The patients in the studies were recruited at Karolinska University Hospital before elective abdominal cancer surgery. The patients included in study I, and II (n = 133), and III (n = 15) were diagnosed with ovarian, colon, rectum, or urinary bladder cancer, while in study IV (n = 10) all the patients were diagnosed with urinary bladder cancer.

In study I, the effect of using the Activity Board as a standardised method to enhance mobilisation and postoperative recovery was evaluated. The Activity Board hangs in the patient's room with signs for different individually based exercises, and red/green magnets for the patient to turn when a goal is achieved. The level of mobilisation was objectively measured with an activity monitor. The results showed significantly higher levels of mobilisation as a mean level over the first three postoperative days, as well as a shorter time to first flatus and stool, and shorter length of hospital stay, compared to standard treatment. In study II, the association between early mobilisation (daily steps) and readmission, the severity of postoperative complications, and infectious complications was respectively evaluated. No significant association was seen between early mobilisation and any of the outcomes.

In study III, patients' experiences of using the Activity Board after abdominal cancer surgery was described. Individual interviews were conducted, and the overarching theme that emerged from the content analysis was "enabling participation facilitates empowerment over rehabilitation".

In study IV, the feasibility of an exercise intervention for patients who had undergone a robotic-assisted radical cystectomy was evaluated. The exercise programme was conducted in primary health care and included aerobic and muscle strengthening exercises, twice a week for 12 weeks. The results showed that the exercise intervention was feasible regarding safety and progression in the exercise programme.

The overall conclusion is that the Activity Board could be an effective method to enhance early mobilisation and postoperative recovery after abdominal cancer surgery. Patients experience the Activity Board as a facilitator for them to participate in postoperative care, which strengthens them in their rehabilitation. Also, a higher level of early mobilisation is not associated with more postoperative complications after discharge. This thesis also suggests that an exercise intervention in primary health care after a robotic-assisted radical cystectomy is feasible.

## SAMMANFATTNING

Det övergripande syftet med denna avhandling var att öka kunskapen om standardiserade metoder för individualiserad mobilisering och rehabilitering efter bukcanceroperation. För mobilisering utvärderades effekt och patienternas upplevelser av en metod för postoperativ mobilisering, liksom sambandet mellan tidig mobilisering (dagliga steg) och komplikationer. För rehabilitering utvärderades genomförbarheten av ett träningsprogram i primärvården.

Avhandlingen omfattar fyra studier med fyra olika designar: en icke-randomiserad kontrollerad studie (studie I), en observationsstudie baserad på sekundär analys av studie I (studie II), en kvalitativ intervjustudie (studie III) och en genomförbarhetsstudie (IV). Patienterna i studierna rekryterades vid Karolinska Universitetssjukhuset före planerad bukcanceroperation. De inkluderade patienterna i studie I och II (n = 133) samt III (n = 15) var diagnostiserade med cancer i äggstockar, kolon, rektum eller urinblåsa, och i studie IV (n = 10) var patienterna diagnostiserade med cancer i urinblåsan.

I studie I utvärderades effekten av att använda Träningsstavlan som en standardiserad metod för att öka mobilisering och postoperativ återhämtning. Träningsstavlan hänger i patientens rum med symboler för olika övningar baserade på individuella mål och röda/gröna magneter som patienten kan vända på när ett mål uppnåtts. Mobilisering mättes objektivt med en rörelsemätare. Resultaten visade signifikant mer mobilisering, mätt som medelvärde under de första tre postoperativa dagarna, kortare tid till första gasavgång och avföring, samt kortare vårdtid på sjukhus, jämfört med standardbehandling.

I studie II utvärderades sambandet mellan tidig mobilisering (dagliga steg) och återinläggning på sjukhus, svårighetsgraden av postoperativa komplikationer respektive infektiösa komplikationer. Inget samband sågs mellan tidig mobilisering och utfallen.

I studie III beskrevs patienters erfarenheter av att använda Träningsstavlan efter bukcanceroperation. Individuella intervjuer genomfördes och det övergripande temat som framkom från innehållsanalysen var "att möjliggöra deltagande underlättar till egenmakt över rehabilitering".

I studie IV utvärderades genomförbarheten av en träningsintervention för patienter som hade genomgått robotassisterad radikal cystektomi. Träningsprogrammet genomfördes inom primärvården och omfattade kondition och muskelstärkande träning, två gånger per vecka under 12 veckor. Resultaten visade att träningsinterventionen var genomförbar avseende säkerhet och progression i träningsprogrammet.

Den övergripande slutsatsen är att Träningsstavlan kan vara en effektiv metod för att förbättra tidig mobilisering och postoperativ återhämtning efter bukcanceroperation. Patienterna upplever Träningsstavlan som en facilitator för dem att delta i postoperativ vård, vilket stärker dem i deras rehabilitering. Vidare har högre nivå av tidig mobilisering inte något samband med fler postoperativa komplikationer efter utskrivning från sjukhus. Denna avhandling föreslår också att en träningsintervention i primärvården efter robotassisterad radikal cystektomi är genomförbar.

## LIST OF SCIENTIFIC PAPERS

- I. Porsrud A, Aly M, Nygren-Bonnier M, Hagströmer M.  
**Objectively measured mobilisation is enhanced by a new behaviour support tool in patients undergoing abdominal cancer surgery**  
European Journal of Surgical Oncology 2019;45(10):1847-1853
  
- II. Porsrud A, Aly M, Nygren-Bonnier M, Hagströmer M.  
**Association between daily step counts during inpatient recovery after abdominal cancer surgery and postoperative complications**  
Manuscript
  
- III. Porsrud A, Lundberg M, Eriksson J, Nygren-Bonnier M, Hagströmer M.  
***Like I said, I would not have likely gotten up otherwise: Patient experiences of using an Activity Board after abdominal cancer surgery***  
Disability and Rehabilitation. 2022;11:1-8
  
- IV. Porsrud A, Karlsson P, Nygren-Bonnier M, Aly M, Hagströmer M.  
**The feasibility of an exercise intervention after robotic-assisted radical cystectomy for urinary bladder cancer, prior to the CanMoRe-trial**  
Submitted manuscript

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## LIST OF ABBREVIATIONS

|       |  |
|-------|--|
| ASA   | American society of anaesthesiology                        |
| BCT   | Behavioural change technique                               |
| EORTC | European organisation for research and treatment of cancer |
| ERAS  | Enhanced recovery after surgery                            |
| FRC   | Functional residual capacity                               |
| HADS  | Hospital anxiety and depression scale                      |
| LOS   | Length of hospital stay                                    |
| nRCT  | Non-randomised controlled trial                            |
| NRS   | Numeric rating scale                                       |
| PHC   | Primary health care setting                                |
| POD   | Postoperative day  |
| PRP   | Postoperative recovery profile                             |
| RARC  | Robotic-assisted radical cystectomy                        |
| RCC   | Regional cancer centres                                    |
| RCT   | Randomised controlled trial                                |
| WHO   | World health organisation                                  |

# 1 INTRODUCTION

One out of three persons are diagnosed with cancer during their lifetime. Many of these persons are diagnosed with solid abdominal cancer tumours that need surgery. However, postoperative complications are common after abdominal cancer surgery (1-3). Early mobilisation is thought to have positive impact on the development of complications and is strongly recommended (4). Despite the presumed benefits of postoperative mobilisation, adherence to protocols for early mobilisation is poorly reported, and the existing evidence has shown low compliance to early mobilisation protocols (5, 6).

There is today strong evidence for the general benefits of regular aerobic physical activity and resistance exercise for patients with cancer disease (7, 8). During my years working as physiotherapist in a clinical postoperative setting at a university hospital, I observed that patients often receive standardised information on the importance of daily physical activity and avoiding lifting heavy objects, at discharge from hospital. This advice often results in daily walks, which is important. However, there ought to be many types of physical activity and exercise that the patients can perform, without jeopardising the surgical wounds. The restrictions of avoiding lifting heavy objects due to surgical wounds is not based on solid evidence, and thereby the restrictions differ (9, 10). These restrictions differ between hospitals and surgeons, and accordance with the diagnosis and surgical approach. Moreover, the period of restrictions differs between approximately three to eight weeks. It is therefore possible that the recommendations on physical activity and exercise with respect to postoperative abdominal cancer care continues to stay the same due to usual practice, and a lack of evidence in support of other methods.

Most studies that evaluate physical activity or exercise interventions for patients with cancer involve patients who are undergoing chemotherapy treatment or have finished treatment. Evidence for feasible and effective interventions that include physical activity or exercise after abdominal cancer surgery is lacking. This limited knowledge of how to support patients after abdominal cancer surgery with physical activity and exercise is also shown in the national guidelines for equal cancer care in Sweden. Here patients are advised to follow the general recommendations on physical activity, but not informed how they could access the recommendations, and many patients with cancer disease do not adhere to the recommendations on physical activity (11, 12).

## **2 BACKGROUND**

### **2.1 GUIDELINES FOR EQUAL CANCER CARE**

The Confederation of Regional Cancer Centres in Sweden (RCC) is the Swedish regions' organisation for knowledge within cancer. The regions and RCC work together towards a cancer care that is patient focused, available and equal. RCC is thereby also responsible for the national clinical cancer care guidelines. These guidelines contribute to equal care, regardless of place of residence, socio-economic status or sex, and they include recommendations on medical investigation, treatment, medical care, rehabilitation, and the follow-up of patients.

Apart from the specific guidelines on diagnosis, there are also national guidelines on cancer rehabilitation and pelvic cancer rehabilitation (11, 13). The different guidelines emphasise the importance of physical activity and exercise before, during and after cancer treatment. Cancer treatment is often unspecified, but most of the evidence that the guidelines refer to concerns research on chemotherapy treatment and physical activity/exercise.

Regarding surgery, for example abdominal cancer surgery, the guidelines state that it can take a while to recover after surgery but that patients should be encouraged postoperatively to return to their normal daily physical activity (11). However, because of specific restrictions due to surgical wounds, potentially decreased physical function and aerobic capacity, and postoperative complications, the patients could have difficulties returning to their normal daily physical activity. Instead, they might need support with their physical activity and exercise to recover after surgery.

Many patients are treated for cancer, and surgery is the most common treatment for solid cancer tumours. Moreover, physical activity has shown to be important to reduce cancer-related symptoms. Consequently, to reach an equal cancer care, recommendations on physical activity and exercise ought to be as specified as possible for different cancer treatments. Today, patients who have abdominal cancer surgery are advised to follow the general recommendations on physical activity and to contact a physiotherapist if necessary (11). The guidelines on physical activity and exercise after surgery are limited, and this is most likely due to the scarce amount of evidence on feasible and effective methods for these patients.

### **2.2 ABDOMINAL CANCER SURGERY**

Abdominal symptoms and diagnoses are often divided into upper or lower, depending on which organ or symptom the patient suffers off. This thesis focuses on patients treated for lower abdominal cancer, which includes cancer of the colon, rectum, ovaries, and bladder. A high number of patients are diagnosed with these specific cancer diseases in Sweden every year (Table 1) (14). Many of the patients with these diagnoses undergo surgery. Today the

most common treatment for solid cancer tumours is surgery, often in combination with chemo- and/or radiotherapy (15).

**Table 1.** Incidence by cancer site in Sweden, year 2020

| <b>Cancer</b>    | <b>Number</b> | <b>Rank</b> |
|------------------|---------------|-------------|
| Prostate         | 10 949        | 1           |
| Breast           | 7 534         | 2           |
| Lung             | 4 567         | 3           |
| Colon            | 4 423         | 4           |
| Melanoma of skin | 4 266         | 5           |
| Bladder          | 2 963         | 6           |
| Rectum           | 2 184         | 7           |
| Ovary            | 695           | 18          |

Ref. World health organisation (WHO): International Agency for Research on Cancer

Lower abdominal surgery is performed with a lower midline incision or laparoscopic technique. Many of the laparoscopic surgeries are performed with robotic assistance. Postoperatively at the ward, the patients often have drains, catheters, and pain relief administration devices attached to them. Some patients also have a gastro- or urinary stoma, which for most patients is a permanent solution. The different diagnoses have their own guidelines regarding chemo- and/or radiotherapy treatment. Many of the patients receive neoadjuvant chemotherapy before surgery, or adjuvant chemotherapy after surgery, or radiotherapy before or after surgery (16-18). Due to technical advancements, more elderly and frail patients may undergo surgery due to cancer today compared with historical cohorts. However, compared to younger or healthier patients, elderly patients do not always have the same capacity to cope with surgical and/or oncological treatment, making them more prone to complications (19).

### **2.2.1 Postoperative complications**

Abdominal surgery is considered high-risk due to the danger of postoperative complications (20). The surgical effect on the body is often described as similar to the effect of a traumatic injury. The body responds with stress and catabolic changes which has a major effect on the physiological systems and function of several organs, both during and after surgery, although the complex physiological phenomenon of a body in surgical stress is still not quite understood (21-23).

Endocrine and metabolic changes are thought to be involved in postoperative complications such as increased cardiac work, pain, ileus, impaired pulmonary function, and increased risk for thrombosis (21, 23). The most common complications after abdominal cancer surgery are venous thrombosis and pulmonary complications, such as pneumonia, atelectasis, and respiratory insufficiency (20, 24-26). Pulmonary complications have been shown to affect

surgical morbidity and mortality negatively, particularly within the first postoperative week (24, 25).

Several factors affect the intensity of surgical stress and complications, for example the surgical approach, type of anaesthesia, and duration of anaesthesia (22). The duration of abdominal cancer surgery is often long which could result in significant blood and fluid losses (27). It is essential to try to improve elements that might predict postoperative complications. Factors that have been suggested to predict major complications after abdominal cancer surgery are age; physical status according to a patient's American Society of Anaesthesiology (ASA) score, preoperative anaemia, intraoperative bleeding, the use of colloids, a higher amount of fluids and vasopressors (15).

Postoperative complications are difficult to define and grade due to the complications' complexity. Since 2004 the Clavien-Dindo classification has been used to classify the severity of the complications (28, 29). The classification is based on the treatment needed for the complication and range from Grade I; any deviation from the normal postoperative course to Grade V; the death of patient (Table 2). The Clavien-Dindo classification is widely used to grade outcomes after abdominal cancer surgery.

**Table 2.** Classification of Surgical Complications according to Clavien-Dindo

| Grade | Definition  |
|-------|---|
| I     | Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions. Acceptable therapeutic regimens are drugs as antiemetics, antipyretics, analgetics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside. |
| II    | Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.  |
| IIIa  | Requiring surgical, endoscopic, or radiological intervention not under general anaesthesia  |
| IIIb  | Requiring surgical, endoscopic, or radiological intervention under general anaesthesia  |
| IVa   | Life-threatening complication (including CNS complications) requiring IC/ICU-management single organ dysfunction (including dialysis)   |
| IVb   | Life-threatening complication (including CNS complications) requiring IC/ICU-management multi organ dysfunction   |
| V     | Death of a patient  |

Ref. Dindo D, Demartines N, Clavien P-A. *Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey.* Ann Surg. 2004;240(2):205-13

## **Complications after surgery for colorectal, ovarian, or urinary bladder cancer**

The rate of postoperative complications due to abdominal cancer surgery within the colon, rectum, ovaries, or urinary bladder is high (1-3). A common complication is an infection of different types, for example urinary, pulmonary, in surgical wounds, intraabdominal abscess, or sepsis (3, 30-33). Other types of complications are gastrointestinal for example ileus, anastomotic leakage, or stoma hernia (3, 31, 34). Renal complications, venous thrombosis, pulmonary complications, metabolic acidosis, urinary leakage in the abdomen, lymphocele, lymphoedema, strictures, and stones in upper urinary tract are also common complications for these patients (3, 30, 31, 35).

The occurrence of postoperative complications is associated with increased morbidity and mortality, and to further complicate matters, most of these patients are elderly and suffer from comorbidity already before surgery (31, 32). After abdominal cancer surgery it is crucial to avoid postoperative complications and postoperative care thereby includes many interventions to optimise care. Mobilisation is one intervention that is thought to affect the risk of developing postoperative complications.

## **2.3 MOBILISATION**

The medical definition of mobilisation is “to make something moveable”. In this thesis the definition of mobilisation is more specific: “for the patient to move from lying in bed to sitting, standing, or walking”. The importance of mobilisation has been acknowledged for a long time, and there is evidence that mobilisation has positive effects on the lung function including functional residual capacity (FRC) and oxygenation (36, 37). However, due to the scarce evidence of the benefits of mobilisation, the main reason to mobilise is the evidence that exists for negative effects on the body due to prolonged bedrest such as thromboses, orthostatic intolerance, insulin resistance, muscle loss and decreased physical function (21, 38-40).

### **2.3.1 Postoperative mobilisation**

Patients’ knowledge of their own care during a hospital stay has been shown to be poor (41). Also, patients’ knowledge regarding the importance of mobilisation is unknown. It is possible that patients are not always sure of what they are allowed to do, i.e., if they should mobilise or not (42). This possible lack of knowledge could be one reason why patients with acute medical or surgical conditions at hospital spend most of their time in bed, immobilised (43).

Evidence of how much patients mobilise in hospital after abdominal cancer surgery is limited. Already in 2012 it was stated that the objective measurement of mobilisation with an activity monitor was a responsive and meaningful outcome for surgery, chemotherapy, or radiotherapy (44). Still, in most studies, mobilisation has been evaluated subjectively. Fortunately, the use of activity monitors to measure mobilisation after abdominal surgery has

increased over time (45-47). So far, most studies have been small and focused on feasibility (47). Due to methodological differences between the studies, it still makes it difficult to summarise data on levels of mobilisation (48-51). Other types of studies have shown that patients want to regain control over their body and function after surgery, to restore their autonomy (42, 52, 53). In line with that, patients have suggested that support with mobilisation after abdominal surgery is essential (42).

There are, however, several factors that can complicate mobilisation after abdominal cancer surgery. The patient can suffer from postoperative pain, hypotension, respiratory insufficiency, motor block of legs if epidural analgesia is used, wound instability, or have an ongoing intravenous intake of fluids, catheters, and drainage advices (4, 21). They can also be frightened, have cognitive impairment, or perhaps feel unmotivated to mobilise (54). Many patients who undergo abdominal cancer surgery benefit from physiotherapy interventions. Preferably the patient sees the physiotherapist for a preoperative meeting that includes information, instructions and training of breathing exercises and postoperative mobilisation (55).

### **Mobilisation according to “The movement continuum theory of physical therapy”**

To optimise the patient’s experience of mobilisation, the first postoperative mobilisation should be conducted with the assistance of a physiotherapist together with the medical team, if possible. What interventions the physiotherapist uses are often the result of interaction and communication between patient and physiotherapist (56). As a result, the choice of physiotherapy interventions often differs between occasions. According to “The movement continuum theory of physical therapy”, the movement is affected by physical, psychological, social, and environmental factors, and they all depend on each other (57). Every patient has a maximum achievable movement potential, which is influenced by the different factors mentioned above (57). However, after abdominal cancer surgery the patient has a current movement capability, i.e., often immobilised in bed (57). With mobilisation, the patient could reach a preferred movement capability, far from the maximum potential but better for the patient’s body and mind (57). Consequently, the focus of the physiotherapy treatment is to minimise the difference between the patient’s current movement capability and the preferred capability. As an example, the physiotherapist sets goals for mobilisation with clear progression in mind, such as having the patient to walk longer distances with less assistance of a walking aid, or sitting up longer during the day. To enhance mobilisation the physiotherapist can for example use methods to reduce pain, improve balance and body awareness with exercises on the bed side or with different kind of walking aids. In summary, there is most likely a need to increase mobilisation levels after abdominal cancer surgery, and as it is considered important, mobilisation is included as a part of standardised postoperative care protocols.



## **2.4 STANDARDISED POSTOPERATIVE CARE**

Standardised care aim at improving health care quality, outcomes, and responsibility (58). Standardised care should work as a routine, and the parts included in the standardised protocols should be evidence based, as far as is possible. Due to standardised care all patients can be treated equally. In standardised postoperative care every step during the postoperative period is decided in advance, with the purpose that nothing should be missed for the individual patient. Already in 1997, Kehlet pointed out the need for a multimodal approach to minimise the risk of postoperative complications (23). After Kehlet, the concept of enhanced recovery after surgery (ERAS) followed, which is developed to maintain physical function and optimise recovery (4, 59). The ERAS protocol consists of multimodal interventions before, during and after surgery, for example pain relief, fluid balance, nutrition, and early mobilisation, which in a standardised way can decrease the total length of hospital stay (LOS) after abdominal surgery (60). ERAS was originally developed for patients undergoing colorectal surgery, but it is now established within most abdominal surgical disciplines, with modified protocols (3, 60-62).

That the ERAS concept has been effective in minimising complications and shortening hospital stays is important in today's hospital care (60). Besides the individual patient's suffering, a prolonged hospital stay also carries a cost to society. The positive outcomes of ERAS are based on following all the interventions within the protocol. A high adherence to the protocol has shown better outcomes (63, 64). However, studies of ERAS evaluations seldom report adherence to all the interventions in a satisfying way (59). Consequently, knowledge of which interventions in the protocol that have a high impact on the outcome is scarce. How the different interventions affect ERAS outcomes by themselves, or a few interventions together, is also not known.

### **2.4.1 Evaluation of early mobilisation**

The ERAS intervention early mobilisation is thought to be one of the key factors that minimise complications (4, 65). According to the original ERAS guidelines on early mobilisation the patient should be out of bed for two hours on the day of surgery, and six hours on the first day after surgery; this should be continued until discharge (40). The adherence to mobilisation protocols is however not completely known due to poor reporting (5). If the amount of mobilisation is reported, it is mainly subjectively estimated time that the patient or the medical team records per day. Objectively measured mobilisation with an activity monitor is limited. In a review 2016 it was stated that due to the lack of objectively measured mobilisation and incomplete descriptions of protocols for mobilisation there was insufficient evidence to support structured mobilisation protocols after abdominal surgery (66). However, the usage of activity monitors after abdominal surgery is increasing and potentially also objective adherence to ERAS mobilisation protocols (45-47).

In studies where adherence to mobilisation according to ERAS protocol has been reported, subjectively by patients or the medical team, it has shown a low adherence to the protocol (5,

6, 63, 65). The results raise questions whether the mobilisation goals in ERAS protocols are feasible and effective for the patients. For the individual patient it is not always clear how to reach the standardised goals of mobilisation. The goals could be perceived as unachievable, and for some patients the goals are unachievable. To facilitate for the patients and make them feel that they can achieve the mobilisation goals is important. Through communication and behavioural support, the standardised mobilisation could be adjusted to the individual patient.

## **2.5 INDIVIDUALISED MOBILISATION AND PHYSICAL ACTIVITY THROUGH BEHAVIOURAL SUPPORT**

It is likely that many patients need to increase their level of postoperative mobilisation and thereby need support to mobilise (5, 63, 65). One way to support mobilisation and physical activity is to individualise mobilisation and physical activity. In this way the patients can feel that the mobilisation goals are achievable and receive support to reach the goals. To individualise mobilisation and physical activity, there are different kinds of behavioural change techniques (BCT) that can be used as support. BCTs are the components of an intervention that affects an individual's behaviour; some examples of BCTs are self-monitoring, goal setting, graded tasks, and feedback (67).

A taxonomy that includes 93 different BCTs was developed by Michie et al. (67). The aim with the taxonomy was to standardise and define the existing BCTs to enhance the reporting of behaviour change interventions. For patients diagnosed with cancer, the recommendations of using BCTs within physical activity interventions are strong (68-70). However, depending on the study aim, the BCTs that are recommended for use within interventions that include patients with cancer differ accordingly:

- To promote habitual exercise: goal setting, instruction for how to perform a behaviour, and graded tasks (68)
- To increase physical activity levels: prompts (pedometer) or cues to perform the physical activity (telephone calls), graded tasks, and rewards (70)
- To maintain physical activity behaviour change: action planning, graded tasks, and social support (69)

Also, it is worth noting that most physical activity interventions for patients with cancer are conducted with relatively young women diagnosed with breast cancer.

## **2.6 PHYSICAL ACTIVITY AND EXERCISE**

There is strong evidence that regular aerobic physical activity and resistance exercise have a positive impact on health and quality of life (71). For the following seven types of cancer there is strong evidence that physical activity lowers the risk of a cancer diagnosis: breast, bladder, colon, kidney, endometrium, stomach, and oesophageal (71, 72). The association

between physical activity and decreased risk of premature death is suggested to be primarily due to a decreased risk of mortality due to cardiovascular disease, diabetes, and cancer (71). Evidence on the immediate effects of physical activity has also been presented. Research shows that one single occasion of physical activity reduces blood pressure, and anxiety problems, and improves insulin sensitivity, sleep, and cognition for the specific day (71, 73, 74). Lately, evidence of health risks caused by sedentary behaviour has increased. Associations have been shown to exist between sedentary time and increased risk of hypertension, heart and vascular disease, and premature death (75).

Physical activity is a complex behaviour that has been defined physiologically as all movement of the body that requires more energy expenditure than resting (76). It includes all sorts of activities that are performed during the day, for example during work, playing, travelling or when taking care of household chores (77). Also, physical activity can be performed at different levels of relative intensity, where the intensity of the physical activity is set in relation to the persons' maximum capacity. One way to express relative intensity is as a percentage of the maximum heart rate (71). Low intensity is defined as 40 - 59 % of the maximum heart rate and perceived as light exertion, 8 - 11 on Borg's RPE-scale, while moderate intensity is defined as 60 - 74 % and perceived as somewhat hard, 12 - 13 on Borg's RPE-scale (71, 78). Vigorous intensity is defined as 75 - 94 % of maximum heart rate and perceived as hard exertion, 14 - 17 on Borg's RPE-scale (71, 78).

To summarise the dose of physical activity that affects the body, the components intensity, frequency, and duration of the physical activity performed are used (71). A higher dose of physical activity is associated with better health outcomes. The association between physical activity and health can be described as a curve-linear dose-response relation, where the largest health benefits occur if inactive people become somewhat active (79). Moreover, exercise is not the same as physical activity. Exercise is a subcategory of physical activity and is defined as planned, structured and repetitive physical activity that aims to improve or maintain physical fitness (76).

### **2.6.1 Measuring physical activity**

Physical activity can be measured in different ways. Questionnaires, interviews, diaries, and observations are all subjective measurement (80, 81). Questionnaires are the most common way to measure physical activity, and there are numerous questionnaires (80, 82). Hence, questionnaires are often hampered by limitations when reporting the dose of physical activity and recall bias such as social desirability (83). The recall bias in questionnaires often results in over-estimation of physical activity.

Examples of objective ways to measure physical activity are pedometers, activity monitors, heart rate monitors and indirect calorimetry (81). A pedometer measures the numbers of steps, but the measurement of intensity is lacking. There are different kinds of pedometers, but the quality of measuring the numbers of steps differs (80, 84). An activity monitor, in comparison, registers body movement, i.e., the acceleration, which is an assessment of the

intensity that the body moves (81). The small electronic device is usually placed on the midline of the patient's thigh, on the hip or on the back, depending on which type is used. Several activity monitors can also register the numbers of steps and include inclinometers that register body posture (81).

## **2.6.2 Recommendations on physical activity and exercise**

The general recommendations on physical activity suggests that adults, including the elderly, should be regularly physical active and decrease sedentary time (71, 77). Adults are recommended to engage in 150 – 300 minutes of moderately intense physical activity per week, or 75 minutes of vigorous activity, or to combine the two intensities (71, 77). Total sedentary time is recommended to be reduced and replaced with physical activity (71, 77). The recommendations also suggests that adults, including elderly, perform resistance exercise, involving major muscle groups, twice a week (71, 77). Persons over 65 years are also recommended to do balance training two to three times a week. Unfortunately, a large proportion of the global population do not achieve the recommendations and are insufficiently physically active (85).

For adults with chronic disease physical activity could reduce the risk of premature mortality, disease progression or additional diagnosis (71, 86). It is also considered to be safe and can improve physical function and health-related quality of life for patients with chronic disease (71, 86). Physical activity is consequently important for the individual patient, and for society due to the increased costs of medical care. It is also likely that adults with chronic disease would benefit from exercise to prevent the decline of functional capacity and improve capacity further (87). It has been suggested that half of the global population suffer from at least one chronic disease and are thereby at risk of reduced functional capacity (88, 89). For these patients with multimorbidity exercise appears to have positive effect on physical and psychological health and to be associated with a reduced risk of adverse events (90).

## **2.7 PHYSICAL ACTIVITY AND EXERCISE FOR PATIENTS WITH CANCER**

Patients who are treated for cancer, which is a chronic disease, suffer from a variety of different symptoms. Physical activity and exercise have been shown to be strong components that manage the symptoms. The symptoms are due to cancer itself or the cancer treatment, i.e., during treatment, close to the treatment but also in the long-term (Table 3) (91, 92). Some of the most frequent symptoms are fatigue and negatively affected physical function, aerobic capacity, muscle strength, and health-related quality of life (91, 93, 94). Cancer is also more common in the elderly, thus approximately half of the patients are older than 70 years which could result in more comorbidity (92).

**Table 3.** Persistent changes resulting from three of the most commonly used curative therapies

|   | Surgery | Chemotherapy | Radiation |
|---|---------|--------------|-----------|
| Second cancers  |         | ✓            | ✓         |
| Fatigue   | ✓       | ✓            | ✓         |
| Pain  | ✓       | ✓            | ✓         |
| Cardiovascular changes: damages or increased CVD risk |         | ✓            | ✓         |
| Pulmonary changes                                     | ✓       | ✓            | ✓         |
| Neurological changes                                  |         |              |           |
| Peripheral neuropathy                                 |         | ✓            |           |
| Cognitive changes                                     | ✓       | ✓            | ✓         |
| Endocrine changes                                     |         |              |           |
| Reproductive changes                                  | ✓       | ✓            | ✓         |
| Body weight changes                                   | ✓       | ✓            |           |
| Fat mass increases                                    | ✓       | ✓            |           |
| Lean mass losses                                      | ✓       | ✓            |           |
| Worsened bone health                                  |         | ✓            | ✓         |
| Musculoskeletal soft tissue: changes or damage        | ✓       |              | ✓         |
| Immune system   |         |              |           |
| Impaired immune function and/or anemia                |         | ✓            | ✓         |
| Lymphedema  | ✓       |              | ✓         |
| Gastrointestinal system: changes or impaired function | ✓       | ✓            | ✓         |
| Organ function changes                                | ✓       |              |           |
| Skin changes  |         |              | ✓         |

Ref. Schmitz KH, et al. *American College of Sports Medicine roundtable on exercise guidelines for cancer survivors*. Med Sci Sports Exerc. 2010;42(7):1409-26.

With an increasing number of patients who are diagnosed and treated for cancer, the importance of finding ways to decrease the burden of symptoms has been stressed (7). Today there is evidence that it is safe and beneficial to exercise both during and after cancer treatment (7, 8). Also, the knowledge of which cancer-related symptoms that can benefit from regular physical activity and exercise is constantly increasing. So far, there is a high level of evidence for the beneficial effects on fatigue (7, 95), anxiety (96-98), depression (7, 99, 100), health-related quality of life (96, 97, 101, 102), and physical function (101-103). However, most of the patients included in these systematic reviews and meta-analyses were diagnosed with breast cancer. Exercise interventions that include patients with other cancer diagnoses are still scarce.

In the epidemiological research, studies that include patients with more rare cancer diagnoses are also lacking. In observational studies, which include mainly patients with breast, prostate, or colon cancer, physical activity has been shown to have a protective effect against cancer recurrence, cancer-specific mortality, and all-cause mortality (8, 72, 104). For other cancer diagnoses the research on the association between physical activity and mortality is more limited.

Patients who are diagnosed with cancer are recommended to avoid inactivity, participate in at least 150 minutes of moderately intense physical activity per week, and perform resistance

exercise twice a week, which is in line with general recommendations (105). Despite the positive effects that physical activity has, most patients with cancer do not achieve the recommendations on physical activity and exercise (12, 104). The recommendations are based on Physical Activity Guidelines for adults with chronic conditions from 2008. The limitation in the guidelines regarding some specific recommendations for patients with cancer is due to the limited evidence that existed at the time (7).

Today, the recommendations for patients with cancer are still the same, but in the exercise guidelines for cancer survivors 2019, specified exercise prescriptions have been added for six cancer-related symptoms/outcomes; anxiety, depression, fatigue, health-related quality of life, lymphedema, and physical function (7). Also, specific recommendations regarding exercise have been developed for certain groups of patients with cancer, adapted from the National comprehensive cancer network (7). Patients with gastro- or urinary stoma are recommended to

- Empty their stoma bag before starting exercise
- Due to possible risk of stoma hernia, start with a resistance exercise with low resistance and progress slowly, with the guidance of exercise professionals
- Use the correct lifting technique by regulating intra-abdominal pressure
- Modify core exercises that cause excessive intra-abdominal pressure (7)

## **2.8 PHYSICAL REHABILITATION AFTER ABDOMINAL CANCER SURGERY**

Most studies that evaluate exercise interventions in patients with cancer disease include patients who either undergo active chemo- or radiotherapy, or those who have completed treatment. However, recently, two studies evaluated exercise after abdominal cancer surgery. Frawley et al. investigated the feasibility of conducting a rehabilitation programme after surgery due to colorectal, prostate, or gynaecological cancer (106). The patients exercised bi-weekly for eight weeks, and the study was considered feasible to conduct.

The second study was a pilot study of a multicentre randomised controlled trial (RCT) with the aim to assess the clinical- and cost-effectiveness of pre- and postoperative exercise after colorectal cancer surgery (107). Preoperatively, one group of patients conducted a home-based exercise, another group exercised at a hospital, and a third group was assigned to treatment as usual. Postoperatively, the patients were encouraged to achieve the general recommendations on physical activity. The encouragement was conducted once per month for 12 months by telephone call to the home-based group or at a meeting at the hospital for the other group. The feasibility outcomes of the pilot study were positive, and a full-power study was initiated. The reporting of these two feasibility studies is promising; however, the postoperative exercise periods started earliest at a mean of (sd) 78 (70) days after surgery and six weeks after surgery, respectively.

In a pilot RCT we tested a model for physical rehabilitation after a radical cystectomy due to urinary bladder cancer (108). The aim was to evaluate early physical rehabilitation after surgery. The model consisted of 12 weeks individually tailored exercise, twice per week, after discharge from the hospital, led by a physiotherapist, including a mix of aerobic and strengthening exercises with focus on function. The results showed both a short (3 months) and long-term (1 year) effect on physical function and health related quality of life. The exercise was held at the hospital and the study had many dropouts and withdrawals, due to long travel distance to the hospital. The LOS had a median (range) of 13.5 (10 - 25) days, and the postoperative exercise period started with a median (range) of 25 (19 - 139) days after surgery, to compare with the two feasibility studies.

As stated earlier, adherence to recommendations on physical activity is low among patients with a cancer diagnosis (12, 104). There could be several reasons why patients who have abdominal cancer surgery are not physically active enough. Potentially, multimodal cancer treatment (surgery, radiation, chemotherapy) could be associated with levels of physical activity for these patients, which has been shown for patients with breast cancer (109). Another reason could be that they are asked to follow restrictions after surgery, primarily to avoid heavy lifting (9, 10). Hopefully the patients are also instructed to take daily walks, but it is not certain that these patients receive further exercise instructions after abdominal cancer surgery.

Regarding rehabilitation for patients with cancer, it is today a self-standing discipline (11). Even though there is a high grade of evidence that supports physical activity and exercise for patients with cancer, a well-structured rehabilitation path is missing. At discharge, there is no clear path for patients who have undergone abdominal cancer surgery to receive continued physical rehabilitation. Patients with special needs are offered a few days at a rehabilitation hospital, but the continued physical rehabilitation is limited. In theory, the patients have the possibility to contact primary care. However, since the patients are feeble due to surgery, that path is underused.

### 3 RATIONALE

Postoperative mobilisation after abdominal cancer surgery is often standardised according to the ERAS protocol. Standardised mobilisation is above all positive since it should result in equal postoperative care. However, adherence to standardised mobilisation after abdominal cancer surgery is low (5, 6). It is crucial to find ways to enhance mobilisation for these patients. Enabling an individualisation of the standardised mobilisation protocol could result in patients who are more engaged in their care. When individualising mobilisation, it is important to evaluate the patients' experiences of the new method. To identify barriers or prerequisites for the patients to use the method after surgery is essential. The patients' perceptions are crucial to know if the method needs improvements, or if the method can be implemented in usual postoperative care.

Mobilisation is thought to affect the development of postoperative complications (4, 65). The recommendations on mobilisation are strong, although they are primarily based on the effects of prolonged bedrest (21, 38). Evidence of associations between postoperative mobilisation and complications is today scarce. To increase knowledge regarding mobilisation as an element which could affect the degree of complications is important.

There is strong evidence that aerobic physical activity and resistance exercise is beneficial for health (71). For patients with cancer, physical activity and exercise have shown positive effects on several cancer-related symptoms, for example fatigue (7, 95), health-related quality of life (96, 97), and physical function (101-103). Adherence to the guidelines could also be associated with a protective effect against cancer recurrence and mortality (8, 72, 104). Despite the high level of evidence, the possible impact of physical activity does not reach the patients who undergo abdominal cancer surgery. After discharge from the hospital, patients who have had abdominal cancer surgery are recommended to follow the guidelines on physical activity (7). Because of restrictions due to surgical wounds, decreased physical function and postoperative complications, the patients might have difficulties returning to daily physical activity. At discharge, there is no structure in the healthcare for the patients to receive continued rehabilitation.

There is a need to standardise and individualise mobilisation and rehabilitation for patients who undergo abdominal cancer surgery. Due to more successful cancer treatments, more patients live with a cancer diagnosis and cancer-related symptoms. To enhance their physical function and health-related quality of life through physical activity is therefore important. In summary, a development of mobilisation at the hospital ward and physical rehabilitation after abdominal cancer surgery could benefit the patients. Mobilisation and physical rehabilitation after abdominal cancer surgery has the possibility to be equal, standardised, and individualised.



## **4 AIM**

### **Overall aim**

This thesis aims to increase knowledge of standardised methods for individualised mobilisation and rehabilitation after abdominal cancer surgery. For mobilisation, effect and patients' experiences of a method for postoperative mobilisation are evaluated, as well as the association between early mobilisation (daily steps) and complications. For rehabilitation, feasibility of an exercise programme in primary care is evaluated.

### **4.1 SPECIFIC AIMS**

- I** To evaluate the Activity Board as a standardised method to enhance mobilisation and postoperative recovery after abdominal surgery due to cancer.
- II** To evaluate the association between daily steps over the first three days after abdominal cancer surgery and readmission to hospital due to postoperative complications. Also, to investigate the association between daily steps over the first three postoperative days and severity of postoperative complications, and different categories of complications.
- III** To describe patients' experiences of using the Activity Board after surgery for abdominal cancer.
- IV** To evaluate the feasibility of an exercise intervention for patients who have undergone robotic-assisted radical cystectomy due to urinary bladder cancer.

## 5 MATERIALS AND METHODS

### 5.1 STUDY DESIGNS

This thesis consists of four studies which are presented in Table 4. Study I is a non-randomised controlled trial (nRCT). Study II is an observational study based on a secondary analysis of study I. Study III is a qualitative interview study, including participants from study I. Studies I, II and III were performed at Karolinska University Hospital. Study IV is a prospective one-group feasibility study where the intervention was conducted at one primary health care setting (PHC) in Stockholm.

**Table 4.** Overview of designs, materials, and methods for included studies in the thesis

|                         | <b>I</b>   | <b>II</b>   | <b>III</b>   | <b>IV</b>  |
|-------------------------|--|---|--|--|
| <b>Study design</b>     | Non-randomised controlled trial  | Observational study, secondary analysis of study I  | Qualitative interview study                        | Prospective one-group feasibility study  |
| <b>Inclusion period</b> | Jan 2017 – May 2018  | Jan 2017 – May 2018   | Mars – April 2018                                  | Feb – May 2019   |
| <b>Participants</b>     | - n = 133<br>- Adults<br>- Abdominal cancer surgery  | - n = 133<br>- Adults<br>- Abdominal cancer surgery   | - n = 15<br>- Adults<br>- Abdominal cancer surgery | - n = 10<br>- Adults<br>- Robotic-assisted radical cystectomy  |
| <b>Intervention</b>     | Activity Board or standard treatment   |   | All participants were allocated to Activity Board  | Exercise programme in primary health care  |
| <b>Exposure</b>         |  | Daily step counts first three postoperative days  |  |  |
| <b>Data collection</b>  | - Mobilisation with activity monitor<br>- Postoperative outcomes from medical records<br>- Questionnaire | - Step counts with activity monitor<br>- Readmission and complications from medical records | Individual interviews                              | - Clinical assessments<br>- Questionnaires<br>- Physical activity with activity monitor<br>- Postoperative outcomes from medical records<br>- Feasibility measurements |
| <b>Outcomes</b>         | - Mobilisation levels<br>- Postoperative outcomes  | - Readmission within 30 days<br>- Postoperative complications                               | From transcripts to overarching theme              | - Process feasibility<br>- Scientific feasibility  |

## **5.2 ETHICS**

The studies included in the thesis were conducted according to the ethical principles of the Declaration of Helsinki, and approved by the regional ethical review board in Stockholm and the Swedish Ethical Review Authority, accordingly (110, 111):

Original ethical approval: 2012/2214-31/4

Study I, amendment: 2016/484-32

Study II, amendments: 2016/484-32, and 2020-06249

Study III, amendments: 2016/484-32, and 2017/2349-32

Study IV, amendment: 2020-01356

## **5.3 PARTICIPANTS AND CONTEXT**

Study I, study II and study III were conducted at Karolinska University Hospital in Solna, regarding screening, recruitment of participants, intervention, data collection and interviews for study III. All three studies included patients from three different wards. Study IV was conducted at one ward at Karolinska University Hospital in Solna regarding the screening, recruitment of participants and data collection, but the intervention was conducted at one PHC in Stockholm.

For study I, study II, and study III patients who were adults; scheduled for open or robotic-assisted abdominal surgery due to colorectal, ovarian, or urinary bladder cancer, awaiting for at least three days of hospital care, and able to walk and understand Swedish were eligible. Preoperative exclusion criteria were palliative surgery, a pacemaker, a neurological disorder, or cognitive impairment. Also, the postoperative exclusion criteria were restrictions on sitting, no activity monitor attached to the patient, hospital stay at a ward that was not included in the study, a prolonged stay at the postoperative unit or intensive care unit, and for study I and II a hospital stay that was longer than 14 days. In study III only patients who were allocated to the group with the Activity Board were included and interviewed. For study IV, patients who were adults, scheduled for a robotic-assisted radical cystectomy (RARC) due to urinary bladder cancer, able to walk and understand Swedish, and living in Region Stockholm were eligible. Exclusion criterion was planned palliative surgery.

## **5.4 DATA COLLECTION**

For all four studies included in the thesis, demographic and clinical characteristics were obtained from the patients' medical records at Karolinska University Hospital.

## 5.4.1 Procedures

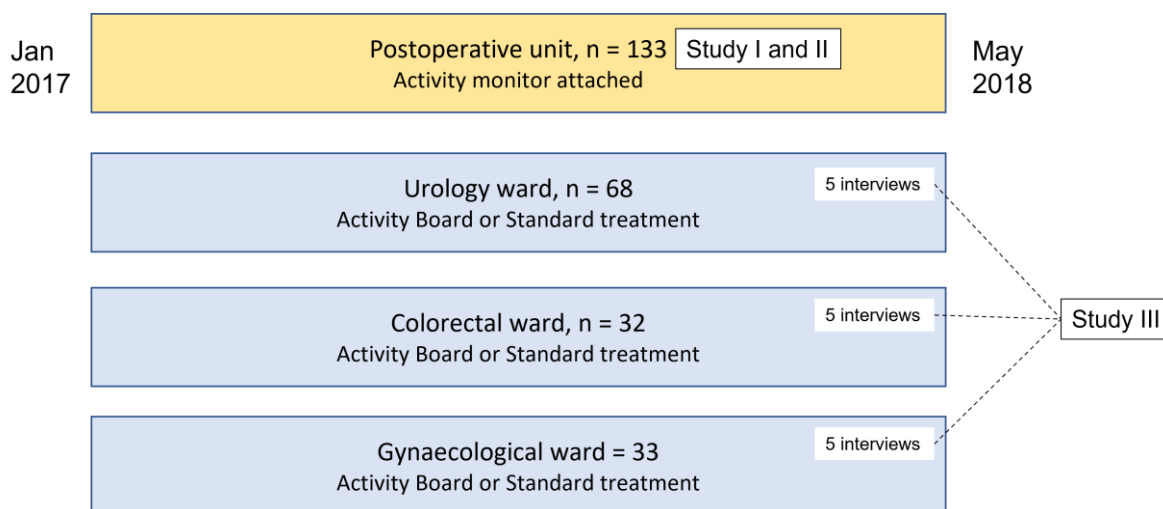
### Study I and Study II

The screening of eligible patients for the nRCT at three different wards at Karolinska University Hospital in Solna was conducted by the first author. The eligible patients were given written information about the study from a nurse at a preoperative meeting, and more information through a phone call from the first author. The patients gave signed informed consent the day before surgery. All patients received postoperative individualised standard treatment. The patients who were allocated to the Activity Board had standard treatment plus the board.

The three hospital wards used one of the methods for one month and then switched to the other method. In this way the patients were allocated to the different methods depending on the date for surgery. The activity monitors were attached to the patients by physiotherapist or nurse at the postoperative unit to establish that data was collected from postoperative day one. The patients were introduced to the Activity Board by the physiotherapist that worked at the ward the patient was admitted to. The physiotherapists that were responsible for the three wards had received education in working with the Activity Board. They were instructed to add the Activity Board to the usual postoperative treatment when the patient was allocated to the group with the Activity Board. Figure 1 presents the procedures at the hospital wards that participated in study I, study II, and study III.

### Study III

For study III a purposive sampling of participants was conducted among the patients who were allocated to the Activity Board. To achieve a variation regarding diagnosis, age, and sex was important to increase possibilities for the transferability of the results (Figure 1). The patients had given signed informed consent to also participate in the interview study when they accepted participation in the nRCT. The interviews were conducted when the patient was soon to be discharged from the hospital.

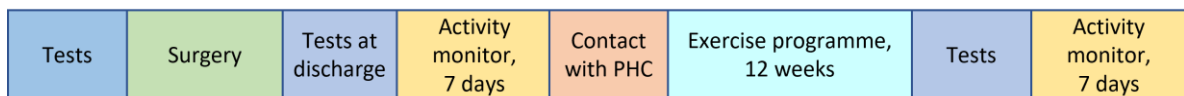


**Figure 1.** Procedures at the participating hospital wards for study I, study II, and study III

## Study IV

For study IV three physiotherapists at one PHC received information and instructions regarding the study process and the exercise programme. Screening of eligible patients at Karolinska University Hospital was conducted by the first and second author who were physiotherapists. The eligible patients were given written information about the study from a nurse at a preoperative meeting, and the researchers gave more information via telephone. The patients gave their signed informed consent the day before surgery, and the physiotherapists at the PHC were informed about the upcoming patient.

When the patient was discharged from hospital, the researchers sent a referral to the PHC. The patient was then contacted by the physiotherapists at the PHC to book an appointment for the first exercise session within the third week after discharge from hospital. The patients paid for their visits at the PHC. The patients also performed clinical assessments and filled out questionnaires on the day before surgery, at discharge from the hospital and four months after surgery (Figure 2). The researchers were responsible for the measurements which were all at the hospital. The patients also wore an activity monitor for seven consecutive days after discharge from hospital and after the four month tests.



**Figure 2.** Timeline for procedures included in study IV

## 5.4.2 Outcomes

An overview of the different measures that were used in study I, study II, and study IV is presented in table 5.

**Table 5.** Measures used in study I, study II, and study IV

| Measures                              | Study I | Study II | Study IV |
|---------------------------------------|---------|----------|----------|
| activPAL                              | ✓       | ✓        | ✓        |
| Six-minute walk test                  |         |          | ✓        |
| Jamar handheld dynamometer            |         |          | ✓        |
| 30-seconds chair stand test           |         |          | ✓        |
| Postoperative Recovery Profile        | ✓       |          |          |
| EORTC QLQ-C30                         |         |          | ✓        |
| EORTC BLM-30                          |         |          | ✓        |
| Piper Fatigue Scale                   |         |          | ✓        |
| Hospital Anxiety and Depression Scale |         |          | ✓        |
| Numeric Rating Scale                  |         |          | ✓        |
| Postoperative measures*               | ✓       |          |          |
| Length of hospital stay               | ✓       |          | ✓        |
| Readmission to hospital               |         | ✓        | ✓        |
| Complications                         |         | ✓        | ✓        |
| Feasibility measures                  |         |          | ✓        |

\*Defined in the section “Other outcomes”

### Clinically assessed outcomes

In study I, study II, and study IV, the validated *activity monitor activPAL*® was used to measure *physical activity* (112-114). The activity monitor is attached to the patient’s thigh and collects information about the body’s posture and acceleration. The activPAL3™ data are then downloaded from the device using PAL software Suite (PAL Technologies Ltd, version 7, Glasgow, UK). By proprietary algorithms variables, e.g., step count, time spent lying/sitting, standing, and walking were calculated.

In study I it was important to separate time lying down from sitting due to the differential effects on the body when a patient after surgery sits up compared to lies down. Therefore, the patients were equipped with one activity monitor on the thigh and one below the collarbone. The activPAL on the thigh indicates standing instead of sitting/lying when it is elevated 20°. After assessments in the clinical setting, we concluded that an activPAL attached below the collarbone on a person in a hospital bed indicates standing, i.e., 20°, when the backrest of the bed is elevated 60°. This difference is mainly due to the thorax anatomy. Hence, sitting in study I was defined as an at least 60° elevation of the upper body. To be able to summarise data on sitting and lying separately, the following equation for sitting was applied:

Daily wear time

- (time standing thigh worn + time stepping thigh worn + time sitting/lying collarbone worn)  
= time sitting

Also, a valid day of activPAL to be included in the analysis was decided to be a wear time of activPAL for at least 12 hours per day. The first three postoperative days were included in the analysis.

In study II the variable step counts from study I were used as exposure when the association between daily step count, as a measure of early mobilisation, and postoperative complications was analysed. In study IV the patients had one activPAL attached to the thigh for seven consecutive days, on two different occasions, and the variable step count was used in the analysis.

In study IV the patients' *submaximal physical function* was evaluated with the *six-minute walk test* (115, 116). The patient is asked to walk as far as possible for six minutes. The test is conducted indoors over a 30-meter distance, thus the patient walks back and forth for six minutes. Distance in meters, heart rate and oxygen saturation measured with a pulse oximeter were registered according to standard procedures. The choice to evaluate the submaximal physical function is based on the theory that most elderly people are physically active on a submaximal level in everyday life (117). Consequently, the six-minute walk test shows how the patient's physical capacity can limit normal life activities, like going to the grocery store. Also, for frail elderly patients a submaximal test has fewer risks than a test of maximal capacity. The six-minute walk test has shown high validity in patients with cancer disease (116).

In study IV *hand grip strength* was assessed with the validated *Jamar handheld dynamometer* (118). The patient sits in a chair with a 90° flexion of the elbow and makes three assessments with the right hand and three with the left hand. The average result per hand is registered in kilograms. Hand grip strength shows the maximal strength of hand and forearm and is associated with general muscle strength and mortality (119).

In study IV, the *30-seconds chair stand test* was used to measure the patient's *functional leg strength* (120). The patient is asked to rise as many times as possible from an ordinary chair for 30 seconds, without support from the arms.

## Questionnaires

In study I *postoperative recovery* was partly evaluated by the questionnaire *Postoperative Recovery Profile (PRP)* (121). The patients answered the questionnaire at discharge from the hospital. The in-hospital version consists of 17 items, which are covered by five dimensions (physical symptoms, physical function, psychological, social, and activity). The 17 items are answered with a four-graded scale that range between "none" and "severe". It is only the "none" answers that are registered in the global recovery scale. Consequently, if the response

is 17 “none”, the patient is fully recovered. The PRP has shown good validity and reliability (121, 122).

In study IV the European Organisation for Research and Treatment of Cancer (*EORTC QLQ-C30*) was used to evaluate **health-related quality of life** (123). The QLQ-C30 consists of 30 questions, which are covered by five functional scales (physical, role, cognitive, emotional, and social), three symptom scales (fatigue, pain, and nausea), one scale for global health status and quality of life, and six single items (dyspnoea, insomnia, loss of appetite, diarrhoea, constipation, and financial difficulties).

Two questions on global health status and quality of life are answered with a seven-graded scale that range between “very bad” to “excellent”. The other twenty-eight questions are answered with a four-graded scale (not at all, a little, quite a bit, or very much). In the scoring process the scales and single items range from 0 to 100. A high score on the functional scales and the scale for global health and quality of life represents a high level of functioning and high level of global health and quality of life, respectively. However, for the symptom scales a high score represents a high level of symptoms. The EORTC QLQ-C30 has good validity and reliability for use in the clinical setting for patients with cancer (123).

In addition, in study IV the *EORTC BLM-30* was used, which is a questionnaire for health-related quality of life specific for muscle-invasive urinary bladder cancer (123, 124). The BLM-30 consists of 30 questions, which are covered by four different scales (urinary symptoms and problems, urostomy problems, future perspective, and body image) and single items (catheter use problem, abdominal bloating or flatulence, and sexuality). The patients only answer the questions that are relevant for them, for example if they have a urostomy or not, if they are women/men, or if they have been sexually active. The questions are answered on a four-graded scale (not at all, a little, quite a bit, or very much). In the scoring process the scales and single items range from 0 to 100, and for most scales or single items a high score represents the worse. However, for some of the single items regarding sexuality a high score represents a high level of problems and for other items a high score represents a low level of problem.

In study IV the revised *Piper Fatigue Scale* was used to measure **fatigue** (125, 126). The questionnaire consists of 22 questions that are covered by four dimensions of subjective fatigue (behavioural/severity, affective meaning, sensory, and cognitive/mood). The questions are answered with an eleven-graded scale from 0 (the best) to 10 (the worst). The 22 items can be used to calculate the four sub-scales of fatigue, and the overall fatigue, by calculating the mean value of the items included in the analysis. A higher mean value represents a higher level of fatigue (0 = none, 1 - 3 = mild, 4 - 6 = moderate, 7 - 10 = severe). The revised Piper Fatigue Scale has shown good reliability and validity in measuring subjective perceptions of cancer related fatigue in Swedish cancer populations (127).

In study IV the *Hospital Anxiety and Depression Scale (HADS)* was used to measure **psychological well-being** (128). The questionnaire consists of 14 questions, seven that are



covered by level of anxiety and seven that are covered by level of depression. The questions are answered on a four-graded scale. In the scoring process the answers range from 0 to 3, and the questions on anxiety and depression, respectively, results in two different total scores. A higher score represents a higher level of anxiety (0 - 6 = no bothersome anxiety, 7 - 10 = mild to moderate anxiety, >10 = possible anxiety disorder), or depression (0 - 6 = no depression, 7 - 10 = melancholy, >10 = risk of depression). HADS has shown a high validity and reliability among heterogenous cancer populations (129).

In study IV the *Numeric Rating Scale (NRS)* was used to measure *pain*. The NRS is a scale that ranges from 0 (no pain) to 10 (worst pain). The patients were asked to answer the question “Can you tell me a number of how much pain you are in right now? If 0 is no pain and 10 is the worst possible pain?” The patients delivered the answer verbally. The NRS is a valid and reliable instrument and is recommended for use in clinical practice (130).

### **Other outcomes**

In study I several postoperative outcomes were obtained from the medical records, for example *body temperature over 38,5°C, ventricle drain, abdominal drain, pulmonary drain, nephrostomy post-surgery, time to first flatus, time to first stool, and reoperation*. Time to first flatus and stool were defined as the numbers of days from day of surgery until and including the day for first flatus or stool, respectively.

In study I and study IV *length of hospital stay* was obtained from the medical records. It was defined as from the day of surgery until and including the day at discharge from the hospital.

In study II and study IV, *readmission to hospital* was obtained from the medical records. Readmission within 30 and 90 days after discharge to any hospital was registered. The registration was primarily based on notifications in the medical records that the patient had been admitted to an emergency ward. It was also registered if there was a notification that the patient had been admitted to a hospital that was not included in the computerised medical record system of which Karolinska University Hospital is part.

In study II and study IV, *complications* were obtained from the medical records. All complications were registered, and the most severe on each occasion was used to classify the severity of complication according to *Clavien-Dindo* (28, 29).

In study IV feasibility was evaluated according to guidelines from *Thabanet et al.* (131). *Process feasibility* was evaluated with the variables eligibility criteria, adherence, acceptability of the physical tests, exercise period, questionnaires, and activity monitoring, as well as acceptability by PHC physiotherapists. Also, *scientific feasibility* was evaluated with the variables ability of the physical tests, questionnaires, and activity monitoring to indicate change, the safety of the exercise programme and physical tests, and the possibility of progression in the exercise programme.

### 5.4.3 Interventions

#### Study I

The patients who were allocated to standard treatment plus the Activity Board were postoperatively introduced to the Activity Board by the physiotherapist at the ward. The Activity Board (Träningsstavlan® Phystec) is a white board that hangs in the patient's room, (Figure 3). It has prefabricated signs for different exercises. The board is also equipped with red/green magnets, which the patient turns from red to green after achieving an exercise.

The physiotherapist and the patient together set daily goals, mainly regarding mobilisation and breathing exercises. The patient then has the primary responsibility to perform the exercises and turn the magnets from red to green, with support from physiotherapists and the rest of the medical team. If all goals are achieved for one day, a gold star, as a reward, is added to the Activity Board. The intervention was ongoing until discharge from hospital.

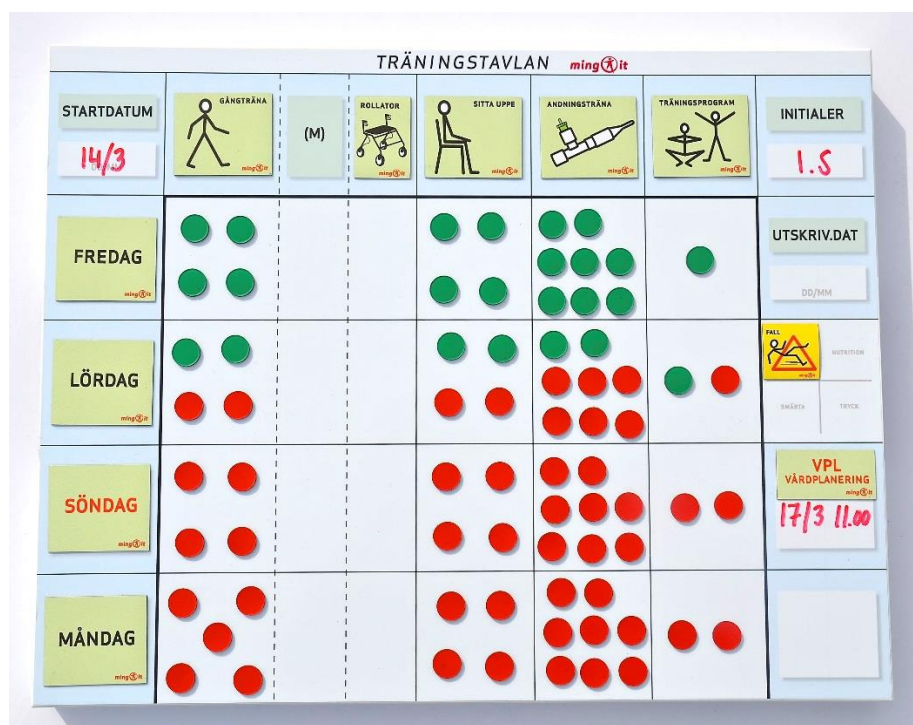


Figure 3. The Activity Board, photo by Phystec

#### Study IV

The patients received preoperative information on how important early mobilisation is. After surgery they had individual postoperative physiotherapy treatment, mainly including mobilisation and breathing exercises. At discharge the patients received information about avoiding lifting heavy objects for six weeks, and about physical activity at home. The third week after discharge from hospital the patients should start the exercise programme at the PHC, twice a week, for twelve weeks.

The exercise programme was individualised but based on recommendations for persons with cancer. It included aerobic exercise at moderate intensity, muscle strengthening exercises aiming at endurance, and specific abdominal muscle exercises (Appendix 1). Responsible urologists had approved the exercise programme. The patients were also instructed to take daily walks. Weekly goalsetting, self-monitoring with a step count, and feedback were used by the physiotherapists and the patients together to support the daily walks.

#### 5.4.4 Interview

In study III semi-structured interviews were conducted with patients who had been allocated to the Activity Board in study I. The interviews were held when the patient was soon to be discharged from hospital. The setting was the patient's room, in privacy, with the Activity Board hanging on the wall. An interview guide was developed in the research group and tested in three pilot interviews (Appendix 2). The person who interviewed the patients were not involved in the patients' care. The interviews were recorded and then transcribed verbatim.

### 5.5 ANALYSIS

The descriptive statistics and analyses that were used in study I, study II, and study IV are presented in Table 6. All the statistical analyses were performed with IBM SPSS statistics version 24 and 28.

**Table 6.** Overview of statistical analyses used in study I, study II, and study IV

| Statistics                | Study I | Study II | Study IV |
|---------------------------|---------|----------|----------|
| <i>Descriptive</i>        |         |          |          |
| Counts                    | ✓       | ✓        | ✓        |
| Percentage                | ✓       | ✓        | ✓        |
| Mean (sd)                 | ✓       | ✓        |          |
| Median (min-max)          | ✓       | ✓        | ✓        |
| <i>Quantitative</i>       |         |          |          |
| Pearson's chi square test | ✓       |          |          |
| T-test                    | ✓       |          |          |
| Mann-Whitney U test       | ✓       |          |          |
| Spearman correlation test | ✓       |          |          |
| Logistic regression       |         | ✓        |          |
| Effect size               | ✓       |          |          |

#### 5.5.1 Study I

To compare clinical characteristics between the two groups, the Pearson's chi square test or Fischer's exact test, when relevant, were used for the categorical variables. For the

continuous variables the independent t-test was used. To evaluate mobilisation level as an outcome, the mean level over the first three postoperative days of the different mobilisation variables was calculated. After that, the mean levels of mobilisation for the first three days were compared between the two groups using the Mann-Whitney U test due to non-normally distributed data. To understand the magnitude of the differences found, effect size was calculated after the Mann-Whitney U test according to Cohen (132).

For comparison of the postoperative outcomes between the groups, Pearson's chi square test or Fischer's exact test were used for categorical variables, and the Mann-Whitney U test for continuous variables. The Mann-Whitney U test was also followed by calculation of effect size. A p-value of  $< 0.05$  was considered statistically significant. Also, the Spearman correlation test was conducted to evaluate the relationship between the level of mobilisation and postoperative outcomes.

### **5.5.2 Study II**

In study II demographic and clinical characteristics were presented as counts, as well as mean (sd) when normally distributed data, and a median (min – max) when data was non-normally distributed. Numbers of step counts as a mean number over the first three postoperative days were described as median (min – max) due to non-normally distributed data. To evaluate the association between the number of steps and readmission, the severity of complications and different sorts of complications, logistic regression was conducted. Clinically relevant variables were used as covariates. Also, to determine which other independent variables should be included as covariates in the regression analyses, univariate analyses were performed. Except for the clinically relevant variables of age, sex, and allocation to the Activity Board, the variables body mass index, surgical technique, and duration of anaesthesia with  $p \leq 0.2$  were also used in the regression analyses. Among these variables, there could possibly be a risk of covariance between body mass index and surgical technique and duration of anaesthesia, respectively. Also, because of the small sample size the variables were dichotomised, and the number of variables were limited to not over- or underestimate the association (133).

### **5.5.3 Study III, Qualitative**

The transcribed interviews that were conducted in study III were analysed using content analysis according to Graneheim and Lundman (134). The conventional inductive approach was used with categories that originate directly from the text (134, 135). The analysis included the manifest analysis (describe what the patients' experiences were), and the latent analysis (understand how they were affected by the experiences) (134, 136, 137). The interviews were read several times, followed by the identification of meaning units in the transcripts. When meaning units had been established, coding of those were performed, followed by categorisation. All authors took part in discussions and identifying categories, followed by subcategories and finally the overarching theme.

#### **5.5.4 Study IV**

In study IV demographic and clinical characteristics were presented as counts, along with the median (min – max) due to small sample size. Also, the process feasibility outcomes and scientific feasibility outcomes were presented as counts, as was the median (min – max) when it was relevant to describe the outcomes in numbers.

## 6 RESULTS

This section summarises the main findings of each study included in the thesis. An overview of the patients' characteristics is presented in Table 7.

**Table 7.** Demographic and clinical characteristics for patients included in study I, II, III, and IV

|                                     | Study I                    |                                   | Study II    | Study III               | Study IV                      |
|-------------------------------------|----------------------------|-----------------------------------|-------------|-------------------------|-------------------------------|
|                                     | Activity Board<br>(n = 67) | Standard<br>treatment<br>(n = 66) | n = 133     | n = 15                  | n = 10                        |
| Sex, n (%)                          |                            |                                   |             |                         |                               |
| <i>Women</i>                        | 32 (47.8)                  | 34 (51.5)                         | 66 (49.6)   | 8 (44.4)                | 2 (20)                        |
| Age (years), mean (sd)              | 69.3 (11.4)                | 67.0 (13.1)                       | 68.1 (12.3) | 67 (min 40 –<br>max 86) | 70 (min 53 –<br>max 86)       |
| BMI (kg/m <sup>2</sup> ), mean (sd) | 24.7 (3.5)                 | 26.1 (5.2)                        | 25.4 (4.5)  |                         | 23.9 (min 19.1<br>– max 26.6) |
| ASA-score, n (%)                    |                            |                                   |             |                         |                               |
| 1                                   | 6 (9.0)                    | 15 (22.7)                         | 21 (15.8)   |                         |                               |
| 2                                   | 43 (62.4)                  | 28 (42.4)                         | 71 (53.4)   |                         | 8 (80)                        |
| 3                                   | 17 (25.4)                  | 23 (34.8)                         | 40 (30.0)   |                         | 2 (20)                        |
| 4                                   | 1 (1.5)                    | 0 (0)                             | 1 (0.8)     |                         |                               |
| Diagnosis, n (%)                    |                            |                                   |             |                         |                               |
| <i>Urinary bladder</i>              | 35 (52.2)                  | 33 (50.0)                         | 68 (51.1)   | 5 (33.3)                | 10 (100)                      |
| <i>Colorectal cancer</i>            | 18 (26.9)                  | 16 (24.2)                         | 32 (24.1)   | 5 (33.3)                |                               |
| <i>Ovarian cancer</i>               | 14 (20.9)                  | 17 (25.8)                         | 33 (24.8)   | 5 (33.3)                |                               |
| Type of surgery, n (%)              |                            |                                   |             |                         |                               |
| <i>Open</i>                         | 29 (43.3)                  | 30 (45.5)                         | 59 (44.4)   |                         |                               |
| <i>Robotic</i>                      | 38 (56.7)                  | 36 (54.5)                         | 74 (55.6)   |                         | 10 (100)                      |

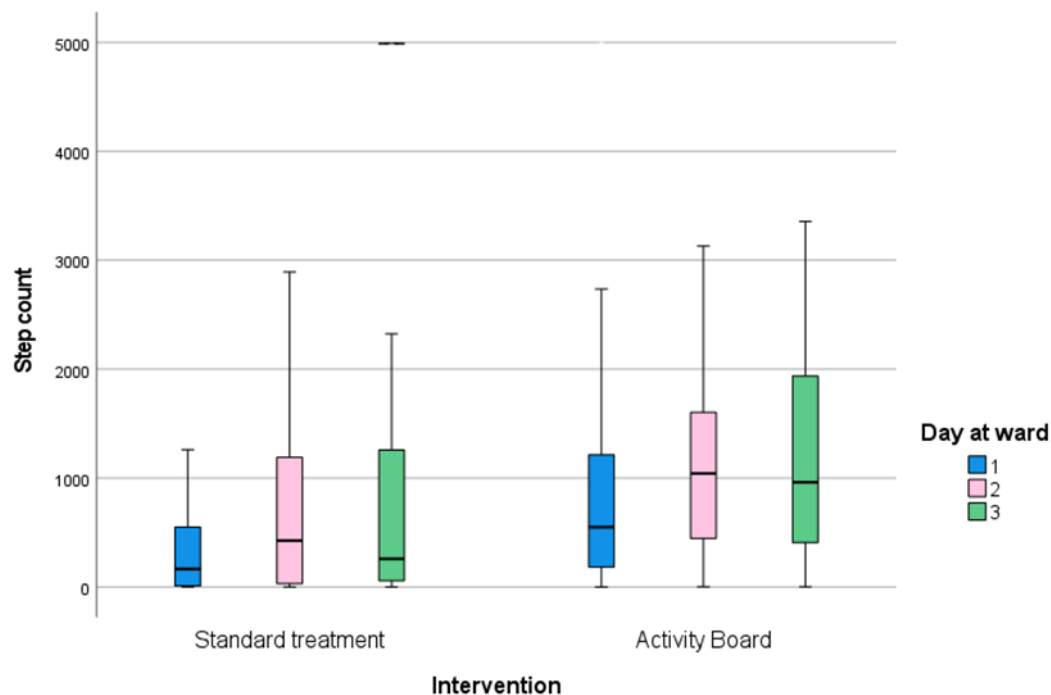
### 6.1 STUDY I – EFFECTS OF USING THE ACTIVITY BOARD

In study I, 133 patients were included with a mean (sd) age of 68.1 (12.3) years. The most common diagnosis and surgery were urinary bladder cancer (51.1 %) and RARC (47.4 %). There were no differences between the groups regarding preoperative characteristics, except for ASA score which was higher in the group with the Activity Board. See Table 7, and paper I, Table 1 for demographic and clinical characteristics.

For 118 of the 133 patients, the first three postoperative days were valid regarding activPAL data. All variables of mobilisation except for sitting resulted in significant higher levels for patients allocated to the Activity Board compared to the group with standard treatment. Some examples of mobilisation variables as a mean level over the first three postoperative days, presented as median (min - max) for Activity Board and standard treatment were: number of steps 1057 (3 - 10433) and 360 (0 - 6546), respectively (p-value = 0.001), upright time of 282 (60 - 774) and 234 (12 - 1074) minutes, respectively (p-value = 0.048), sitting time of 198

(30 - 606) and 150 (6 - 942) minutes, respectively and (p-value = 0.098). See paper I, Table 2 for results of other mobilisation variables, and here Figure 4 for steps presented for each day.

Regarding the postoperative outcomes, presented as median (min – max), the patients with the Activity Board had a shorter time to first flatus, 2 (0 - 5) days compared to patients with standard treatment, 2 (1- 6) days (p-value = 0.006), shorter time to first stool, 3 (0 - 7) days compared to 4 (1 - 11) days (p-value = 0.003), and shorter LOS, 6 (3 - 13) compared to 7 (3 - 14) (p-value = 0.027). No other postoperative outcomes showed significant differences between the groups, see paper I, Table 3 for other postoperative outcomes. A significant correlation was shown between more step counts and shorter length of stay.

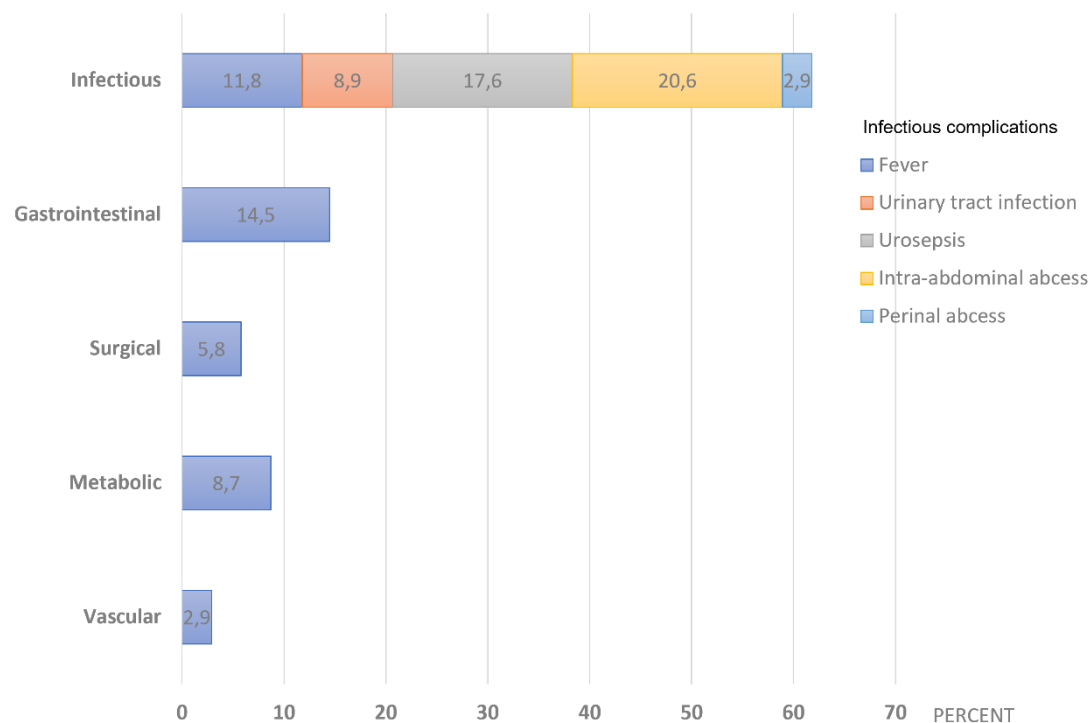


**Figure 4.** Description of daily steps for the first three postoperative days

## 6.2 STUDY II – ASSOCIATION BETWEEN EARLY MOBILISATION AND COMPLICATIONS

In study II, the same 133 patients from study I were included. They had a median length of hospital stay of 6 (min 3 - max 14) days. Of the 133 patients, 25 were readmitted to hospital within 30 days after discharge from hospital. The most common category of postoperative complications was infection which more than 60 % of the patients were diagnosed with, (Figure 5). The mean number of step counts over the first three postoperative days for 108 patients who were not readmitted was a median of 591 (min 0 - max 10433) steps, and for 25 readmitted patients it was a median of 927 (min 22 - max 3207) steps. The mean number of step counts over the first three postoperative days per severity of complication and infectious complication are presented in paper II, Table 3. The logistic regressions, crude or adjusted,

showed no association between the mean number of step counts, as a measure of early mobilisation, over the first three postoperative days and readmission, severity of complication or infectious complication, see paper II, Table 4.

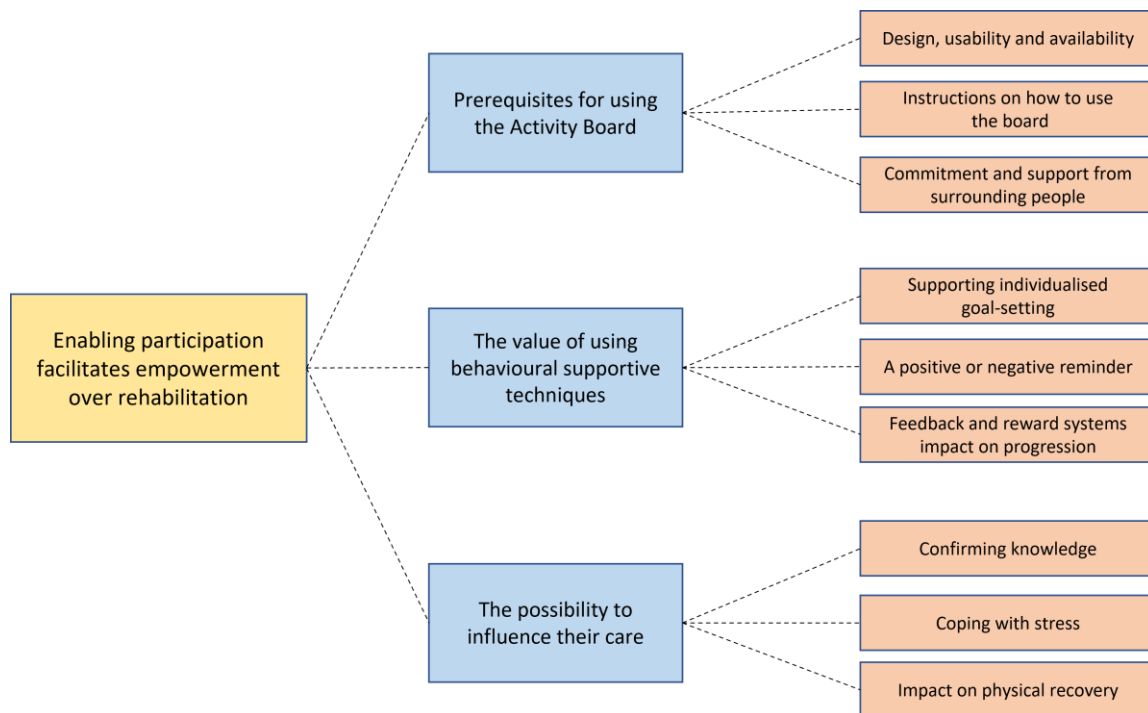


**Figure 5.** Distribution of complications among the readmitted patients

### 6.3 STUDY III – EXPERIENCES OF USING THE ACTIVITY BOARD

In study III, 15 patients who participated in study I and were allocated to the Activity Board were included; demographic characteristics are presented in Table 7. From the interviews with the participants the overarching theme “*Enabling participation facilitates empowerment over rehabilitation*” emerged, which was supported by the three categories “*Prerequisites for using the Activity Board*”, “*The value of using supportive behavioural techniques*”, and “*The possibility to influence their care*”, as well as nine subcategories, see Figure 6. The patients expressed that the design of the Activity Board and support from the medical team facilitated usage of the board. Supportive behavioural techniques as part of the board were experienced to enhance the patients’ participation in postoperative care. Also, the patients felt that the Activity Board strengthened them in their care, by helping them with a stressful situation, and impacting physical recovery.





**Figure 6.** Overview of the overarching theme, categories, and subcategories

### 6.3.1 Prerequisites for using the Activity Board

Participants described that the simplicity of the board with its large pictures, made it easily visible, and that this was important to supporting usage of the board, along with its being located close to the bed. Clear instructions on how to use the board were also expressed as important, for example, in highlighting which activities counted on the Activity Board. That surrounding people also supported the participants in using the board was experienced as something that enhanced usage, such as, when the board was used during medical rounds as a dialogue tool.

*“And so now when the doctor was here and said no but you have to get up now, you have to get up, but then I said yes that but look, I was up one kilometre the other day.”*

(P15: woman, 53 y)

### 6.3.2 The value of using supportive behavioural techniques

Individualised goal setting was perceived by the participants as affecting their activity levels. Having clear goals encouraged the participants to take responsibility in being physical active; however, it was important that the goals were daily revised according to how the patient was feeling. Some participants experienced that the Activity Board was a positive reminder since it was constantly in their visual field, along with the red magnets. Nevertheless, the reminding was also sometimes perceived as stressful. To turn the red magnets to green, and just to look

at the Activity Board, were experienced as positive feedback and encouragement. The participants also referred to how more green magnets clarified their progression of recovery. However, some participants thought that the reward system was childish.

*“...there’s a good deal of negative emotions... You feel bad and you have cancer, and you know ... it’s not fun at all ... hi hi and then you see that ... then you see that you have walked a hundred meters ... it’s good ... So it has maintained to a... .it’s almost like you get a bouquet of flowers or a bag of sweets ... you understand...?”* (P1: woman, 46 y)

*“And when I started to feel bad and I could not do it during that particular time ... when I got almost 39 degrees fever and I felt really bad. Then I just lay and looked at those coloured dots and thought that, that I was a very bad person who could not be out running in the corridor.”* (P8: woman, 56 y)

### **6.3.3 The possibility to influence their care**

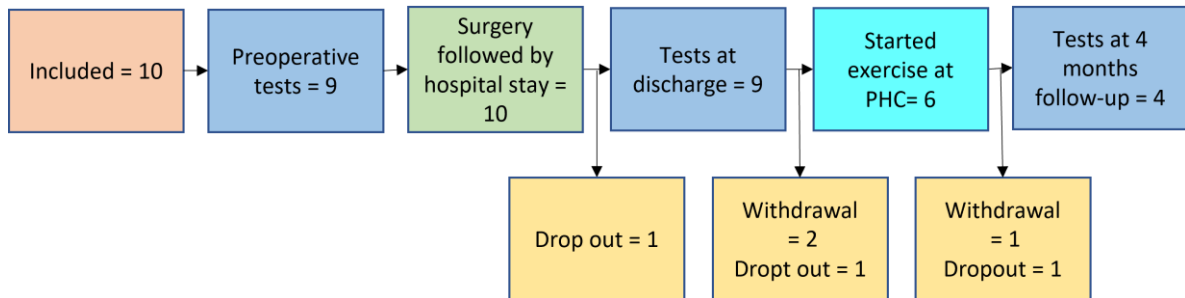
The participants described how the Activity Board could assist them in their recovery after surgery. They reported that the offer to use the board confirmed their previous knowledge of mobilisation and breathing exercises. If the knowledge was new for the participant, as instructed by the physiotherapist, they experienced that the Activity Board clarified the importance of mobilisation and breathing exercises. Moreover, the participants expressed that the board was something to focus on in stressful situations, and that it could assist them in taking responsibility for their care. The Activity Board was also experienced as a tool that helped the patients be more physically active, which they thought affected when they could be discharged from the ward. Patients also expressed that the Activity Board should be a standardised routine, from which all patients should receive support.

*“Yes absolutely. Otherwise, I do not think I would have been as active. I do not think so, but then you have to fight like that. Because you know that it shouts at you and you know that if I’m good, I might get, well that I might be able to come home tomorrow.”* (P10: man, 65 y)

*“Well, it was a bit like I said before, I think it would rather be like the hospital management, department head decision, in line with what the employees think, I mean we wash hands before we put on plastic wrap, we do lots of things before we handle a patient. It could be just as obvious then that. As a routine, yes.”* (P9: man, 71 y)

## 6.4 STUDY IV – FEASIBILITY OF AN EXERCISE PROGRAMME AFTER A ROBOTIC-ASSISTED RADICAL CYSTECTOMY

Ten patients were included in study IV, and their median age was 70 years (min 53 - max 86); clinical and demographic characteristics are presented in Table 7. Six patients dropped out or withdrew their participation, mainly due to postoperative complications, see Figure 7.



**Figure 7.** Flow chart of study IV

### 6.4.1 Process feasibility

#### *Eligibility criteria*

For one patient it was clear that the eligibility criteria were not specific enough, which was noticed the first time the researcher met the patient the day before surgery.

#### *Adherence*

Six patients started the exercise programme and the median number of sessions they attended was 12 (min 2 - max 22) of 24 planned sessions.

#### *Acceptability of the exercise period*

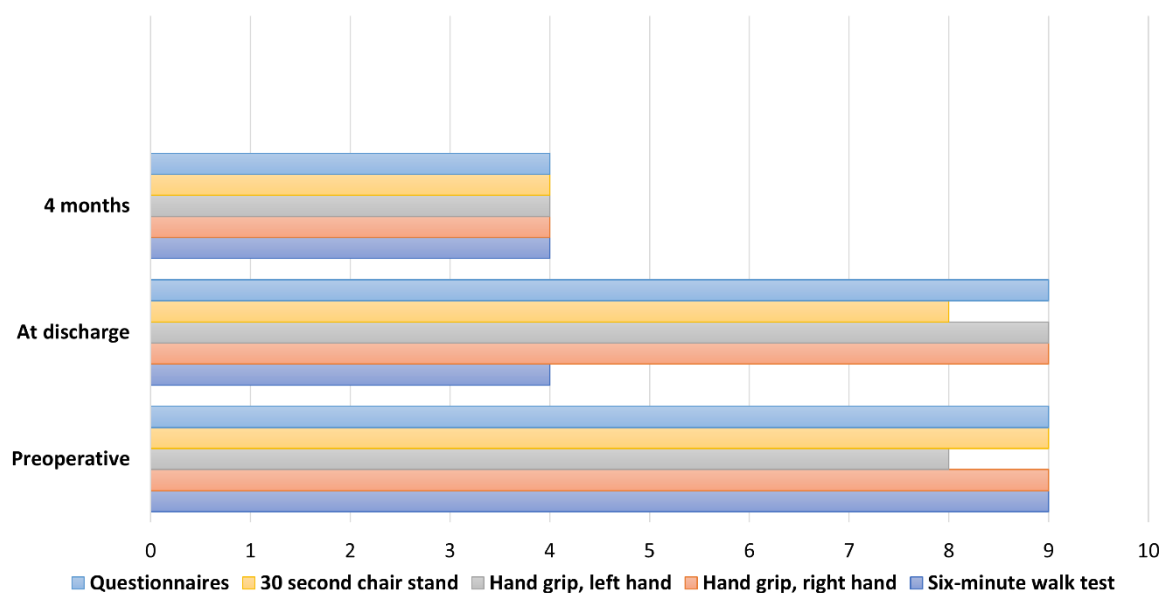
Two patients had pauses during the exercise period, due to medical reasons, and later dropped out or withdrew, respectively, from the study. Three patients did not exercise for the entire exercise period of twelve weeks.

#### *Acceptability of physical tests, questionnaires, and activity monitoring*

A presentation of numbers of conducted physical tests, and questionnaires is shown in Figure 8. Most tests and questionnaires were performed if the patient still participated in the study. However, the six-minute walk test at discharge was not feasible for all patients. Also, seven patients wore the activity monitor after discharge, and at four months did three patients wear the activity monitor.

#### *Acceptability by physiotherapists*

The physiotherapists at the PHC experienced the process with referrals and considered starting the exercise programme within the third week after discharge as feasible, excluding patients with early postoperative complications. It was considered also feasible to achieve a progression in the exercise programme.



**Figure 8.** Physical tests and questionnaires that were performed, max = 10

### 6.4.2 Scientific feasibility

#### *Ability of the physical tests, questionnaires, and activity monitoring to indicate change*

The physical tests, questionnaires and activity monitoring showed changes in measurements between test occasions, see paper 4, figure 2, figure 3, and table 3.

#### *Safety of the exercise programme and physical tests*

No adverse events during the exercise or physical tests were registered.

#### *Possibility of progression in the exercise programme*

It was feasible for the patients who exercised for at least 10 sessions to achieve progression in the exercise programme, measured by higher intensity of aerobic exercise and heavier weights.

## **7 DISCUSSION**

### **7.1 SUMMARY AND DISCUSSION OF MAIN FINDINGS**

This thesis intended to increase knowledge of standardised methods for individualised mobilisation and rehabilitation after abdominal cancer surgery. For mobilisation, effect and patients' experiences of a method for postoperative mobilisation were evaluated, as well as the association between early mobilisation (daily steps) and complications. For rehabilitation, the feasibility of an exercise programme in primary care was evaluated.

For patients who underwent abdominal cancer surgery, usage of the Activity Board postoperatively resulted in higher levels of mobilisation over the first three postoperative days compared to standard treatment. Patients with the Activity Board also had shorter time to first flatus, shorter time to first stool, and shorter LOS compared to standard treatment. Patients' experiences of using the Activity Board were that the board enabled participation and thereby facilitated empowerment over rehabilitation. The patients shared their experiences of which factors affected how they could use the Activity Board in the best way. They also expressed how different BCTs as parts of the board affected their compliance to the Activity Board, and how the board gave them a possibility to influence their care.

There were no associations between early mobilisation, measured as daily steps, over the first three postoperative days, and readmission, severity of complications, or infectious complication after abdominal cancer surgery. The regression analyses showed no association, in the crude or adjusted analyses. Regarding the rehabilitation at one PHC, an exercise programme after RARC due to urinary bladder cancer was found feasible regarding safety and progression in the exercise programme. Also, acceptability by the physiotherapists at the PHC for the process with referrals and the exercise programme was found feasible. The six-minute walk test at discharge from hospital was, however, not feasible to conduct with the patients. That the six-minute walk test was unfeasible resulted in a few changes prior to the RCT, namely instructions for the patients were revised and a 10-meter walk test was added.

#### **7.1.1 Effects of using the Activity Board**

The results from study I show significantly higher levels of mobilisation over the first three postoperative days for the group allocated to the Activity Board, compared to the group with standard treatment, except for time in sitting. The patients with the Activity Board also had a significantly shorter time to first flatus and first stool, and a shorter LOS compared to the group with standard treatment.

The group with the Activity Board and the group with standard treatment took a mean number of steps over the first three postoperative days, as a median of 1057 (min 3 - max 10433) and 360 (min 0 - max 6546) steps, respectively. These results can be compared with a study where an activity tracking wristband was evaluated with the aim to increase

postoperative mobilisation (49). After open or laparoscopic abdominal surgery (many with cancer diagnosis), patients were randomised to continuous feedback or just monitoring from the wristband over the first five postoperative days. The patients who had laparoscopic surgery took a mean number of steps over the first five days, as a mean (sd) of 2227 (2038) and 1372 (1252) steps, for the intervention and control groups, respectively (49). There was no significant difference between the groups. For the patients with open surgery, there was a significant difference in the number of steps between the groups, but in favour of the control group, potentially due to higher morbidity in the intervention group (49). The age difference and surgical approach could be a potential explanation for the differences in results between the studies. The patients in the study with wristbands had a mean (sd) age of 59 (11) years compared to study I where the mean (sd) age was 68.1 (12.3) years (49). The younger patients with laparoscopic surgery in the study evaluating the wristband perhaps managed to walk on their own. In contrast, the control group in study I with older patients who had undergone open or laparoscopic surgery needed more support.

In another study with patients undergoing elective colorectal surgery, an activity tracking wristband with five alarms per day to remind patients to mobilise versus an activity tracker without alarms, did not result in significant differences regarding steps postoperatively (138). The patients took a mean number of steps over the hospital stay as a mean (sd) number of 1468 (3962) steps and 1645 (2639), for the intervention and control groups, respectively (138). The mean (sd) LOS at hospital was 4 (2) days. Also in this study, the age difference compared to the patients included in study I could be an explanation to the studies' contrasting results. Patients included in the study evaluating activity trackers with alarms were younger than patients in study I, with a mean (sd) age of 54 (13) and 53 (18) years in the intervention and control groups, respectively (138).

Moreover, although usage of activity monitors after abdominal surgery is increasing, knowledge regarding step counts after abdominal cancer surgery is still limited. A few small studies have objectively assessed daily steps in the postoperative setting after abdominal surgery, without evaluating an intervention. The four studies showed that during the postoperative hospital stay, patients took a mean value of 968, 483, 1183, and 2775 (only laparoscopic surgery) steps per day, respectively, in each study (48, 51, 139, 140). Another study presented daily steps for the first three postoperative days as a median of 497, 565, and 566 for days one, two and three, respectively (50). Except for the study that only included patients who underwent laparoscopic surgery, the mean value of steps should be compared with the steps in study I, albeit with caution. There are many factors that differs between the studies, like diagnoses, severity of diagnoses, comorbidities, LOS, and various procedures with mobilisation in the different hospitals, all of which can limit comparison between the studies.

However, the difference in age between the participants is interesting. The mean age of the participants in these four studies ranged between 44 and 57 years, but in study I the mean age was 68 years. Despite a much older study sample in study I, the level of daily step counts is

comparative with the other studies, and possibly also higher in the group with the Activity Board. Another possible difficulty with comparison of the studies is due to the different activity trackers that have been used (48, 50, 51, 139). However, several reviews have shown the consumer-grade activity trackers to be valid and reliable, and comparison should therefore be feasible (141, 142).

Apart from the few studies that have evaluated daily step counts objectively after abdominal cancer surgery, level of mobilisation has mostly been assessed with the main aim to evaluate adherence to the ERAS mobilisation protocol. Both smaller prospective studies and larger retrospective studies have reported low adherence to mobilisation according to the ERAS protocol (5, 6, 63). The assessment of mobilisation level has been subjective and registered by the patient, medical staff, or study investigator. Subjective registration of mobilisation is probably hampered by recall bias and would thereby potentially result in over-estimation of mobilisation (83).

Fewer than 50 % have been reported to mobilise for two hours on the day of surgery, and fewer than 30 - 40 % mobilise six hours on the first postoperative day, as the protocol recommends (5, 6, 63). In study I, the patients had a mean level of upright time of approximately four to five hours over the first three postoperative days, with significantly more time in the group with the Activity Board. As mentioned earlier, according to the limited research, there is low adherence to the ERAS mobilisation protocol (5, 6, 63). However, whether the level of mobilisation is also low for these patients after surgery can be discussed. Current research in this area is limited, and to determine whether the level of mobilisation is low, more research on which dose of mobilisation is feasible and effective for this patient group is crucial.

The patients in study I that were allocated to the Activity Board had shorter time to first flatus and first stool compared to the group with standard treatment. The incidence of postoperative ileus for patients who undergo abdominal surgery is high and results in patients' discomfort and increased morbidity (143). Preventing ileus is therefore important. The higher level of mobilisation in the group with the Activity Board could have resulted in shorter time to first flatus and stool. Early mobilisation has been suggested to be an independent risk factor of developing ileus after RARC (about 50 % of participants in study I) (144). However, the many studies on postoperative ileus show contradictory results concerning prevention and treatments of manifest ileus (143). The multimodal approach in ERAS seems to have a preventive effect, and within ERAS potentially also the intervention of early mobilisation (143).

The patients allocated to Activity Board also had a shorter LOS compared to the group with standard treatment. There was also a significant correlation between a higher number of step counts and shorter LOS. This correlation between higher levels of mobilisation and shorter LOS has also been shown in other studies with patients who undergo abdominal cancer surgery (49, 145). Since both definitions of mobilisation and the mobilisation protocols for patients who have abdominal cancer surgery differ between studies, comparison between

studies becomes difficult (66). Also, descriptions of how mobilisation is measured, by direct observation, self-reported by patients, or through an activity monitor, is not always clear. These major limitations resulted in the statement in 2016 that said the evidence for early mobilisation protocol is too low to be recommended (66). The use of activity monitors in the postoperative setting is, however, constantly growing, but with severe limitations of the methodological reporting in research studies (45, 46). Including the activity monitors in the clinical setting could potentially improve patient safety and reduce health care costs (45).

### **7.1.2 Early mobilisation and complications**

The results from study II showed no association between the number of steps, as a measure of early mobilisation over the first three postoperative days, and readmission, severity of complications, or infectious complications, respectively.

Higher levels of mobilisation early after abdominal cancer surgery did not show an association to less complications after discharge from hospital. However, higher levels of mobilisation did not lead to more complications after discharge, which is also important to acknowledge. Study I and other studies have shown that higher levels of early mobilisation after abdominal cancer surgery could be correlated to shorter LOS (49, 145). It is also important to establish that the effect of early mobilisation does not affect the patients negatively after discharge, via postoperative complications at home.

In contrast to the results in study II, two recent studies with patients undergoing major abdominal surgery showed that higher number of step counts early after surgery was associated with a reduced risk of readmission after discharge (146, 147). One of the studies showed that low number of step counts on postoperative day (POD) 1 and POD 2 was associated with higher incidence of readmission (147). The other study showed that a high percentage of patients' preoperative step counts, on the day before discharge, was associated with lower risk of readmission to hospital (146). These results are interesting to compare with the results in study II, where the mean number of steps over the first three postoperative days were used as exposure. To define when during the postoperative care it is most crucial for patients to achieve a high number of step counts, to reduce risk of readmission calls for more research.

A study including patients who had abdominal surgery for metastatic peritoneal cancer showed an association between a higher number of steps and less readmission to hospital after discharge (48). That study also suggested that a higher number of steps could predict lower readmission (48). However, differences in severity of diagnosis and LOS took up to 34 days in the study with metastatic pancreatic surgery, makes it difficult comparing the results with results of study II.

The most common postoperative complication and reason for readmission in study II was infectious complications. Common early complications after abdominal surgery due to cancer



within the ovaries, colon, rectum, or urinary bladder are cardiovascular, pulmonary, gastrointestinal, or infectious complications (3, 30-34, 148, 149). Early complications are often defined as complications within 30 days after surgery. Of these early complications, cardiovascular and pulmonary complications seem to primarily occur during the first days or week after surgery (45, 150, 151). Depending on LOS, they potentially affect patients most often during the hospital stay. Infectious complications, on the other hand, have been suggested to debut approximately at POD three or four, and after that they are common during the first 30 days (45, 150, 151). Consequently, to reduce the frequency of infectious complications after discharge from hospital would be crucial for patients' postoperative outcomes. During recent decades the evidence of association between higher levels of physical activity and less infection has increased (152, 153). Therefore, facilitating for higher levels of mobilisation at the hospital and after discharge would possibly hinder the development of infectious complications.

In study II, preoperative physical activity levels were not measured, and could be a possible confounder to the association between early mobilisation and postoperative complications. Other studies have measured physical activity levels preoperative abdominal surgery and showing low levels of physical activity (146, 154, 155). Patients' physical activity levels after discharge from hospital could also be a possible confounder to association between early mobilisation at hospital and postoperative complications. One study with patients who underwent abdominal surgery showed that patients who at POD 28 took less than 50 % of their preoperative number of steps, had an increased risk of readmission to hospital (154). Moreover, in a study with patients who underwent cancer surgery, it was impossible to know if changes in the levels of physical activity after discharge could predict the postoperative complications, or if the changes were a result of the postoperative event (156).

### **7.1.3 Experiences of using the Activity Board**

The results from study III show that the Activity Board could enable the patients' empowerment over rehabilitation after abdominal cancer surgery by participating in the medical care. This overarching theme was supported by the three categories: prerequisites to use the Activity Board, the value of using BCTs, and the possibility to influence their care.

The design of the Activity Board was experienced by the participants as clear with pictures that were easy to see and understand. This could be compared with studies on different cell phone applications for physical activity behaviour, where study participants have expressed the importance of the application being user-friendly (157-160). For patients in hospital the simplicity is perhaps even more important; some participants expressed that they preferred the simplicity with the Activity Board compared to the cell phone.

To feel supported by the medical team to use the Activity Board was also considered as important. The nurses were perceived as encouraging, in contrast to a study with older patients at a rehabilitation centre where the participants perceived the nurses as discouraging

mobilisation (161). However, despite feeling support from the nurses, the participants expressed that they did not want to stress the nurses by asking for their assistance. That the Activity Board was used as a communication tool on medical rounds with the doctors was also expressed as positive. It was suggested by participants that usage of the Activity Board should be a standardised routine at the ward, which is in line with experiences of patients who evaluated an exercise programme after cancer surgery (162).

The participants also described how they used different aspects of the Activity Board, aspects that could relate to BCTs, which has been shown to positively affect physical activity among patients with cancer (68, 70). Goal setting was mentioned by the participants as important, which has also been shown in other studies. Patients who evaluated an exercise programme after cancer surgery expressed that goal setting increased motivation, and that it was important that goal setting was individualised (162). Also, patients who had taken part in the ERAS procedure were positive towards the concept with standardised care, but they also expressed a need for individualised goal setting depending on how they were feeling, to be able to achieve the demanding ERAS procedure (163). Participants in study III also experienced that they were reminded by the board itself and the red/green magnets, because the board was in their visual field. To have the board in front of you as a reminder could be a contrast to an application in a cell phone, or even an activity tracking wristband which have also been shown to be feasible reminders after abdominal surgery (49, 51, 145, 157).

The Activity Board was experienced as a tool that could assist the participants in taking responsibility for their care. Earlier research has shown that patients want to take their own initiatives regarding mobilisation but are not sure of what to do, perhaps that information has been given early in the postoperative period and then forgotten (52). Also, taking responsibility to regain normal physical activity after surgery have been considered important by patients. Pushing oneself, willpower, and stubbornness has been described as empowering factors that enable postoperative mobilisation (52). The postoperative care affects the patients' autonomy, with loss of bodily integrity (164). To mobilise after surgery has been suggested as regaining autonomy for patients, regaining one-self (53, 161, 162). Patients who had colorectal surgery expressed that regaining control over the body was the most important after surgery (52).

During the postoperative period after abdominal cancer surgery, it is common to have anxiety and depression, which leads to worse postoperative outcomes (165, 166). Patients are often occupied with thoughts about surgery, cancer, prognosis, and future treatments (52, 164, 167). On the one hand, the patients are stressed and anxious, and on the other they try to be a good patient and follow the postoperative recommendations from the medical team (164). One coping strategy for this stressful situation is the problem-focused strategies of, for example, collecting information, making assessments, or completing certain tasks (168). Another example could be patients who after cancer surgery expressed that an exercise programme was helpful for recovery (162). Perhaps a problem-focused strategy can also be applied to usage of the Activity Board after abdominal cancer surgery.

#### **7.1.4 Feasibility of an exercise programme after robotic-assisted radical cystectomy**

In study IV the results showed that an exercise programme after RARC at a PHC was feasible regarding safety and progression in the exercise programme. Acceptability by the physiotherapists at the PHC for the process with referrals, and for the exercise programme, was also feasible.

Adherence to physical activity and exercise has been shown to be challenging for patients with urinary bladder cancer, mainly due to age and comorbidity (169, 170). Also, patients with urinary bladder cancer who undergo RARC are often affected by postoperative complications, which was the case for patients in study IV as well (1, 171, 172). The complications had a negative impact on when the patients started the exercise programme at the PHC, as well as adherence to the exercise programme and the acceptability of the exercise period.

Two patients started the exercise programme two weeks after discharge from hospital according to the study protocol, which was feasible for them. Because of the prolonged stay at the rehabilitation hospital and postoperative complications, respectively, three patients did not start their exercise period until six weeks after discharge. Also, the acceptability of the exercise period and thereby also adherence to the exercise programme were negatively affected by the patients' postoperative complications. Due to complications some patients needed to take pauses during the 12 weeks of exercise.

One could argue that a later start with the exercise programme at the PHC would be better for the patients. Hopefully the results of future studies, including the RCT that follow study IV, will present an answer. As for now, the evidence for rehabilitation after radical cystectomy is very limited (169). However, in one study, patients' stay at a rehabilitation facility early after a radical cystectomy was evaluated and thereby the starting time of rehabilitation can be discussed (173). The patients had an LOS at a median of 21 days, and thereafter experienced a median of 8 (IQR 4 – 16) days between discharge from hospital and admission to the rehabilitation facility (173). However, 24 % of the patients were admitted to the facility 14 days or more after hospital discharge (173). The median stay at the facility was 21 (IQR 21–28) days, and during that period 28 % of the patients were treated with antibiotics and 15 % had acidosis (173). The study did not report adherence to exercise; however, at the in-patient rehabilitation facility the patients could potentially continue their rehabilitation stay despite postoperative complications. The patients may also have been treated for postoperative complications during their hospital stay of 21 days before admission to the rehabilitation facility. This could be put in contrast to the patients in study IV who had LOS at a median of seven days, and potentially suffered more complications after discharge. Also, in the model for physical rehabilitation after radical cystectomy in a hospital setting, which we previously evaluated, the patients were also affected by postoperative complications (108).

One of the secondary aims of the RCT that follow on this feasibility study is to evaluate whether the exercise programme can affect postoperative complications and readmissions to hospital. Because of the potential positive effects that the exercise programme could have on the development of complications, the ambition is to support the patients with exercise soon after discharge from hospital. Knowledge of physical activity levels for patients who have undergone RARC are limited. For other groups of patients who have had lower abdominal cancer surgery, a decline in physical function at discharge has been shown (174). Also, time to recover to preoperative levels of physical activity has been shown to be extended until six to twelve months after surgery (175-178). Potentially, the time to recover physically could be the same for patients who undergo RARC. Also, both patients who have had colorectal cancer surgery or RARC have expressed feelings of insecurity in performing physical activity due to a new stoma (52, 175, 179).

Because of the evidence that exists on effects of physical activity and exercise for patients with cancer, as a chronic disease, it is crucial to find ways to support patients who undergo RARC. Due to difficulties with comorbidities and postoperative complications in this patient group, it is important to find feasible ways to exercise and what dose of exercise that is effective. Further physical activity/exercise studies for patients with RARC are needed to understand how to incorporate exercise guidelines recommendations (180).

### **7.1.5 Equal, standardised, and individualised mobilisation and rehabilitation**

Most patients in Sweden who undergo abdominal cancer surgery are treated within the standardised concept of ERAS, which has been shown to be effective concerning postoperative outcomes and LOS (3, 60-62). However, there is room for improvements. The intervention early mobilisation within ERAS is standardised, but the mobilisation goals are presumably not feasible or effective for the patients. As suggested by patients in this thesis, the Activity Board could be incorporated as a standardised method. With the individualised mobilisation goals of the Activity Board within the ERAS concept, patients' possibilities for feasible and effective mobilisation could be enhanced.

For physical rehabilitation after abdominal cancer surgery, this thesis only presents a feasibility study. The exercise programme at the PHC was shown to be feasible regarding the safety and progression of the exercise programme. Despite limited results within this thesis, a discussion regarding a structure for rehabilitation after discharge for these patients is crucial. According to the national guidelines on cancer rehabilitation, primary health care has the main responsibility for cancer rehabilitation (11). The guidelines also state that the knowledge on cancer and cancer rehabilitation in the primary care may need to be strengthened (11). Through more research, a suggestion for a feasible and effective method for physical rehabilitation after abdominal cancer surgery could strengthen the physiotherapists in primary health care. Hopefully, the method with a standardised exercise

programme could be established within primary health care and individualised for the patients.

Also, if referrals are sent from the surgical wards at the hospitals to the patient's primary health care setting, the aspects of standardised care, as well as equal cancer care, are acknowledged. Because of individual differences between the patients, for example sex, age, comorbidities, and social network, a coherent referral system would enable a more equal cancer rehabilitation.

## 7.2 ETHICAL CONSIDERATIONS

All through the studies that are included in this thesis, ethical considerations have been undertaken. During study planning, data collection, analyses, and presentation of results, the four ethical principles *beneficence*, *nonmaleficence*, *autonomy*, and *justice* were present (181).

During the planning of the different studies, there was an awareness regarding exclusion criteria. A study's exclusion criteria might have an impact on the ethical principle of *justice* (181). If the amount of exclusion criteria results in a study sample that is very narrow and not representative for the studied population, justice can be negatively affected. Justice is not served if the possibility for patients to participate in research studies is not as equal as possible. To be aware of not excluding patients from research studies, if possible, is good research practice according to the justice principle.

For patients in the included studies, it was clearly stated that participation was voluntarily. It was also stated that the patients may withdraw their participation without any reason, according to the *autonomy* principle (181). Also, the patients' decision would not affect their medical care in any way. However, the patients in this thesis were all persons who underwent abdominal cancer surgery. At the time they were asked to participate, most of them had recently received information on the planned surgery. That the patients needed to consider whether they wanted to participate in research while simultaneously experiencing stress over the upcoming surgery was an ethical difficulty. Also, many of the patients suffered from comorbidity and long-term lack of exercise and could have been even more stressed by research studies concerning physical activity. However, other patients could have seen the mobilisation or rehabilitation methods as a potential way for them to increase their responsibility and improve their care.

Patients who undergo abdominal surgery are always given restrictions concerning physical activity and exercise due to healing of the surgical incisions, in line with the ethical principle of *beneficence* (181). With the purpose to increase physical activity with higher levels of mobilisation and rehabilitation after abdominal surgery, the surgical incisions always must be considered. Consequently, there is always a risk that patients overload the incisions and thereby risk developing a rupture of the incisions or a hernia. The patients that were included

in the studies within this thesis received information on restrictions regarding heavy lifting. Furthermore, the medically responsible urologists had approved to the exercise programme included in study IV. The exercise program at the PHC started with low intensity. After a few weeks when the postoperative restrictions regarding surgical incisions were no longer a concern, the intensity of the programme increased. In contrast to the risk of developing a hernia, controlled abdominal exercises were included in the exercise intervention with the purpose of minimising development of a hernia.

For the studies included in this thesis that showed positive results, the knowledge could benefit patients who in the future will undergo abdominal cancer surgery. If studies would not have resulted in positive outcomes, the impact of increased physical activity level for the participants included in the thesis presumably outweighed any possible impairments caused by physical activity or exercise. The benefits for the patients of participating in the studies were thereby weighed against burdens, as they were for the ethical principle of *normaleficence* (181). The collected data in the studies was coded, and the key code was stored, only available to the responsible persons in the research group. All data in the medical journals was handled according to General Data Protection Regulation (GDPR) and according to the laws and ethical considerations at Karolinska University Hospital.

## **7.3 METHODOLOGICAL CONSIDERATIONS**

### **7.3.1 Internal and external validity**

Internal validity concerns the methods in the study, if the study has been conducted in a way where the cause-and-effect relationship between treatment and outcome can be established (182). The internal validity affects the external validity; how the results can be transferred to other patients, to the same population the sample was drawn from or other populations; generalisability; and applicability (183).

#### **Study I and II**

Study I was not an RCT which could be a limitation. The decision to not conduct an RCT was primarily due to possible contamination bias, which is common in complex rehabilitation studies (184). The group with standard treatment could be contaminated, both from patients at the same ward and from the medical team that should work according to two methods at the same time. Hence the patients were instead allocated to method depending on date of surgery and the method that was in use that month at the ward.

The screening of eligible patients was conducted by the first author. That one person is responsible for screening could reduce selection bias because there is no discrepancy in how the inclusion criteria are interpreted (185). On the other hand, if another person validates the screening, it could reduce the selection bias even more.

In study I and II patients with neurological disorders were not eligible. Since surgery often affects mobilisation levels for patients with neurological disorders much more than for other patients, these patients were not invited to the study. The risk for these patients to be allocated to the same group, without an RCT- design, could have resulted in differences between groups and thereby difficulties in evaluating the effects of the intervention. To exclude this group of patients could be considered a selection bias, which also reflects on the generalisability since the real population of patients includes patients with neurological disorders who have abdominal cancer surgery (183).

There could also be a selection bias if we only included patients that had high levels of physical activity preoperatively. Unfortunately, we do not know the included patients' preoperative physical activity levels. The patients' preoperative physical status, i.e., ASA-score, however, reveals several patients with possible comorbidity.

A strength of study I and II was that mobilisation and step counts, were respectively measured with the validated activity monitor activPAL (114). Because of the physiological effects that sitting has for postoperative patients compared to lying down, there was a need to create a new variable, "time in sitting". We used two monitors, one on the thigh and one caudal of the collarbone. Several other studies have used a method with two monitors, and it has been shown to provide valid measures of sitting and lying (114, 186-189). Although, since a new variable was created for this study, measurement errors must be considered. To increase validity and reliability it was standardised where the activPALs' should be attached to the patients (190).

The postoperative outcomes in study I were standardised in the best possible way to strengthen validity. Some outcomes, for example drains, are distinctly measured with yes or no, thereby ensuring good validity. Other outcomes such as time to first flatus, time to first stool, and LOS are more difficult to measure. Although the outcomes were standardised, the documentation of time to first flatus and stool in the medical records, where data was collected from, varied. That the information for some patients was missing, or potentially documented too soon or too late, or that the patients did not recall correctly, are all factors that increase the risk of information bias and threaten validity. LOS is also difficult to use as a measure of recovery. Differences between doctors with respect to determining when the medical treatment is completed, and whether there are available beds at the rehabilitation hospital, are factors that affect LOS for the patients. These factors could also threaten the validity due to difficulties in completely standardising LOS. However, time to first flatus, time to first stool, and LOS are postoperative outcomes that indicate recovery, and by the best possible standardisation, validity is strengthened.

The most important type of information bias is misclassification bias (185). In study II, the first author obtained readmissions, postoperative complications, and treatments from the medical records. There-after, the first author classified them according to the Clavien-Dindo classification system for postoperative complications (28, 29). There is always a risk of bias

in first obtaining correct information from the medical records and then the classification. To reduce the risk of bias, one co-author validated the Clavien-Dindo classification.

Regarding transferability of the results, as mentioned above, some of the patients that agreed to participate in the study had an impaired physical status, classified with an ASA-score. However, those who accept participation in research studies are often healthier than those who decline participation, as is probably the case in this study. This recruitment bias together with a small sample negatively affects the external validity (183). The studied sample was a heterogeneous group with different diagnoses, surgical approaches, sexes, and ages. The variation within the group could enhance generalisability to other hospital wards in Sweden where these patients are treated. Transferability of the results to Swedish hospitals would probably be possible since postoperative mobilisation is standard and regarded as important. However, transferability to non-western countries would likely be more difficult due to other cultures of working with postoperative mobilisation.

#### **Study IV**

One of the main reasons for feasibility studies is the reduction in threats to the internal validity of the planned main study (191). The main objective with study IV was to evaluate the feasibility of an exercise intervention prior to an RCT.

In study IV, appropriate feasibility outcomes defined by Thabanet et al. were used (131). The feasibility model from Thabanet et al. was part of a conceptual framework on feasibility and pilot studies, developed by Eldrige et al. (192). The framework defined feasibility to be an overarching concept of both feasibility studies and pilot studies, where a feasibility study considers whether the future study can be done, should be done, and how. A pilot study, according to the framework, is a type of feasibility study with the same questions, but the planned main study is also conducted on a smaller scale (192). A pilot study can be randomised or non-randomised (192). That is, not all feasibility studies are pilot studies, which results in alternative designs and outcomes (193). In this study it was a conscious choice to not include a control group, since the objectives were to evaluate the possibility to conduct an exercise programme regarding progression and safety, and to evaluate the procedure.

In this study two physiotherapists, the first and second author, conducted the physical tests and assisted with questionnaires. The patients performed tests and filled in questionnaires on the day before surgery, the day before discharge and after the intervention period in primary care. Although the tests were standardised to improve validity and reliability, there is always a risk for assessment bias when two persons conduct measurements (190). On the other hand, because of the feasibility objective, discussions between the physiotherapists enhanced the evaluation of the physical tests' and questionnaires' acceptability.

At discharge from hospital several patients did not want to perform the six-minute walk test. For this study it meant that the six-minute walk test was not feasible to conduct at discharge,



and it resulted in changes prior to the main study. The instructions were changed so the patients would understand that they were not expected to walk the same distance as they did before surgery. However, for the main study there was a risk of incomplete data concerning the six-minute walk test, the primary outcome. Missing outcomes in an RCT are not unusual, and this is handled by performing both intentions to treat analysis with all included participants and a per protocol analysis with participants without missing data (194). Due to the risk of data loss concerning the six-minute walk test, a gait-speed test with a 10-meter walk test was added to the study protocol for the main study (117, 195).

This study was small and therefore the possibilities to transfer results to other populations are limited. However, the difficulties with collecting data from the six-minute walk test at discharge from hospital is a feasibility outcome that could be generalised to other study populations with patients who undergo radical cystectomy (183). Recently, it was stated that there is room for improvements for pilot and feasibility studies within rehabilitation research (193). This study would possibly have had more detailed results to present if we had planned for and included more patients, considering the frequency of dropouts. The results are presented with descriptive statistics which is recommended, and eventually complemented with qualitative analysis which could have been of interest in this study (191).

### **7.3.2 Trustworthiness**

#### **Study III**

In qualitative content analysis the quality of the research procedure and findings are validated through trustworthiness. Three parts are included in the concept of trustworthiness according to Graneheim et al.: credibility (if data and analysis address the research aim), dependability (the stability of data over time), and transferability (if the findings can be transferred to other groups or settings) (134).

To ensure a good credibility and dependability of the data analysis, a procedure was established before study start. A purposeful sampling of patients with variation in age, sex, and diagnosis was chosen to increase the diversity of experiences of the Activity Board and enrich the data (196). The interviews were held in the patients' room at the hospital with the Activity Board on the wall. This context probably ensured a higher credibility compared to whether the patients would have been interviewed after discharge, with recall bias as a barrier for credibility. To further enhance credibility, the authors had an ongoing discussion with the interviewer and could thereby decide when to terminate the study. The study was closed when nothing notably new emerged from the interviews, and the information power to reach the aim of the study was enough (197, 198).

To explore both obvious components and the underlying meaning of the patients' experiences, i.e., how the Activity Board affected them, both manifest and latent analysis of the interviews were performed (134, 136, 137, 199, 200). The manifest content was described, and the latent content of the experiences was interpreted (137). To include both manifest and latent analysis would also strengthen credibility.

Several techniques were used during the analysis process to establish a solid credibility and dependability. Categories and subcategories were created in an iterative process with all authors, until consensus was reached. Through peer-debriefing and triangulation, all authors discussed, reorganised, and analysed categories and subcategories until an overarching theme was agreed (137, 196, 201). To enable the reader to see the connection between the interviews and the result, quotations were used to support the categories, which facilitate for credibility (134).

Preconception is a challenge to the overall trustworthiness all through the process, to ensure that the patients' voices are heard, and not the researchers' (137). In this study all the authors were physiotherapists, and all had preconception of physical activity, but fewer had a preconception of mobilisation. To handle preconception in qualitative research could be difficult, but it is important (134). If the researcher has knowledge within the research field, it could facilitate interviews and the analysis process. However, it is important to be aware of the preconception and not let it hamper the analysis. In this study credibility could have been affected with the consequence that the result mainly reflected the physiotherapists' perspective (134).

As mentioned earlier, purposive sampling was used in this study. To include patients with different sex, age, diagnosis, and from different hospital wards with different cultures regarding mobilisation, could possibly increase transferability of the results (196). However, some patients declined participation in the study; the reason for not wanting to participate is not known. They could have been severely affected by postoperative complications, which in turn could have affected the use of the Activity Board. The absence of these patients' experiences of using the Activity Board could affect transferability (134, 137, 202). It is for the authors to report clearly on the process and the results, so the readers can decide whether the results are transferable to their populations and settings (134).

## **7.4 CLINICAL IMPLICATIONS**

Enhancing mobilisation after abdominal cancer surgery is highly recommended but could be difficult. Using the Activity Board could facilitate mobilisation with higher levels of mobilisation, with shorter time to first flatus and stool and shorter LOS as results. That the goals for mobilisation are individualised could enable mobilisation, since it is perceived as achievable for the individual patient. Hence, the Activity Board also seems to be an adequate method for frail patients. That usage of the Activity Board has the potential to result in shorter LOS is important for both the individual patient and society, as well as an important aspect of future clinical implications.

The Activity Board could be experienced as a method that clarifies for the patients how they can and should mobilise after abdominal cancer surgery. A method that can facilitate the patients actively participating in their care seems to be important, as patients can thereby feel strengthened by taking control over their postoperative care. The importance of involving the

patients in their postoperative care is considered general knowledge by the medical team. However, the lack of methods for involving the patients can sometimes hamper postoperative care ambitions. Moreover, as stated before, enhanced mobilisation could result in shorter LOS. This thesis also suggests that higher levels of early mobilisation do not result in more postoperative complications at home for the patients, which is important for the clinical setting.

For patients who undergo RARC for urinary bladder cancer, postoperative complications are common, something shown in this thesis. However, physiotherapists in the clinical setting are possibly not always aware of how the complications could affect postoperative rehabilitation. This thesis could potentially increase physiotherapists' knowledge and thereby enable postoperative rehabilitation plans that are adapted to patients who undergo RARC.

## **7.5 FUTURE RESEARCH**

As stated in this thesis, research that includes objectively measured mobilisation or physical activity for patients who are diagnosed with cancer within the ovaries, colon, rectum, or urinary bladder is limited. With more evidence of the potential beneficial effects of postoperative mobilisation, the most effective, and feasible, dose of mobilisation can be established. Cost-effectiveness studies also need to be undertaken to establish the economic value of effective mobilisation.

The promising results from using the Activity Board to facilitate mobilisation in patients who have undergone abdominal cancer surgery may guide future studies to evaluate use of the board in other patient groups within hospital, and perhaps also in other settings. To evaluate the Activity Board within care for the elderly and children would add important knowledge with which to compare this thesis' results. Evaluation of the board in a non-western country with, perhaps, different postoperative mobilisation routines would also be valuable. The medical team's experience of working with the Activity Board would bring further knowledge that is crucial to have before implementing it on a larger scale.

To increase knowledge regarding levels of physical activity for these patients, habitual physical activity before surgery could be evaluated. During a hospital stay, other interventions to enhance early mobilisation, besides the Activity Board, would increase knowledge of different methods that can be applied for this patient group. One intervention that could enhance mobilisation and need further evaluation is a commercial activity tracker, offered by different brands. By using data from the activity trackers continuously in the postoperative setting, patients at risk for complications can be detected. Incorporating data from the activity trackers into the computerised medical records at the hospital could be a promising way forward. Future research on studies that evaluate the association between early mobilisation and postoperative complications at home could increase knowledge of mobilisation as possible a predictor of complications. Furthermore, measuring physical

activity at home after discharge would add crucial knowledge in understanding the recovery process for these patients.

The research on physical rehabilitation after discharge for patients who undergo abdominal cancer surgery is scarce. More evidence of what type of exercise, and which setting, is optimal for this group, and subgroups, of patients is needed. Also, what dose of exercise is safe, feasible and effective for these patients, and when the exercise should start after discharge, concerns knowledge that is lacking.

## 8 CONCLUSION

Patients who underwent open or robotic-assisted abdominal cancer surgery and used the Activity Board postoperatively in the hospital setting had higher levels of mobilisation compared to patients with standard care. The patients who were allocated to the Activity Board spent more time mobilised and took more steps during the first three postoperative days, compared to patients with standard care. Also, using the Activity Board could result in shorter time to first flatus, shorter time to first stool, and a shorter LOS.

After patients are discharged from hospital after abdominal cancer surgery postoperative complications at home are common. Research on the association between early mobilisation after surgery and postoperative complications at home is limited. In this thesis, no association between early mobilisation after abdominal cancer surgery and readmission, severity of complications, or infectious complications was seen. On the one hand, more mobilisation was not associated with fewer complications. On the other hand, more mobilisation was not associated with more complications, which is also an important result.

The patients who used the Activity Board after abdominal cancer surgery experienced the Activity Board as a method that could help them to take active part in their postoperative recovery. Also, by their participation the patients felt strengthened in the possibility to impact their rehabilitation. The patients' experience of using the Activity Board postoperatively resulted in the overarching theme: "enabling participation facilitates empowerment over rehabilitation".

For patients who underwent RARC due to urinary bladder cancer, an exercise intervention at one PHC was found to be feasible. The intervention was feasible regarding safety and progression in the exercise programme. The process was also found feasible by the physiotherapists at the PHC. Outcomes for the main RCT showed differences between test occasions. However, the patients suffered from postoperative complications, which affected adherence to the programme. Some changes were also made to the intervention before starting the RCT.

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# 11 APPENDIX

## Träningsprogram

Appendix 1

### Tillfälle 1

- Kort anamnes
- Instruktion av träningsprogram för bäckenbotten och magmuskler (Se nästa sida). Detta ska sedan utföras dagligen som hemträning och följas upp efter 2 veckor
- Demonstration av gymmet inför nästa träningstillfälle

### Tillfälle 2 och framåt

#### Uppvärmning

- 5 minuter
- Rehabcykel (stor sadel) alternativt gåband eller crosstrainer

#### Styrketräning 1: träningsvecka 1 och 2

**Lätt belastning:** 2 x 15 reps, det vill säga ca 50 - 70 % av 1RM

- Knäböj med stor boll mellan rygg och vägg
- Latsdrag med Theraband
- Theraband, brösttrygg
- Armhävning mot vägg
- Tåhävningar

#### Styrketräning 2: från träningsvecka 3

**Ökad belastning:** 2 x 10 reps, det vill säga ca 65 – 75 % av 1RM

- Benpress, sekvensapparat
- Latsdrag/Pulldown, sekvensapparat
- Rodd, sekvensapparat
- Bröstpress, sekvensapparat
- Tåhävningar

#### Konditionsträning: intervaller

- Rehabcykel (stor sadel) eller crosstrainer
- Ansträngning skattas med BORGs RPE-skala.
- Träningsvecka 1-5:
  - 3 stycken 5 - 10 min intervaller
  - måttlig intensitet 40-59 % VO<sub>2</sub>max, BORG 12-13
  - 2-5 minuters vila mellan intervaller
- Träningsvecka 6-12:
  - 3 stycken 5 - 10 min intervaller
  - måttlig-hög intensitet, 40-80 % VO<sub>2</sub>max, BORG 12-15
- 2-5 minuters vila mellan intervaller

#### Rörelseträning: individuellt efter behov

## Träningsprogram för bäckenbotten- och magmuskler

Vi rekommenderar att du gör detta program vid ett tillfälle per dag.

Du som har ett ortotopt blåssubstitut gör de bäckenbottenövningar **A, B, C** du fått information om av uroterapeuten fyra gånger per dag, och vid ett tillfälle per dag lägger du till övning **D, E, F**.

Bäckenbotten som består av muskulatur och fibrös vävnad, utgör "golvet" i bukhålan. Den sträcker sig från blygdbenet till svanskotan och fäster även på sittbensknölnarna. Muskulaturens funktion är bland annat att reglera avföring, gas- och urinavgång. Bäckenbotten består av små tunna muskler. En sammandragning av bäckenbottenmuskulaturen är därför aldrig stor och kraftig.

Om du har kateter i urinröret, avvakta med magträning till katetern är borttagen.

Ligg bekvämt på rygg. Slappna av och ta fem djupa lugna andetag innan du börjar med träningsprogrammet.

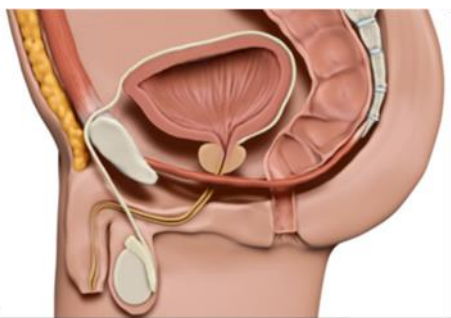


Bild från Karolinska Universitetssjukhuset

Bäckenbotten omsluter ändtarmsöppningen och urinröret

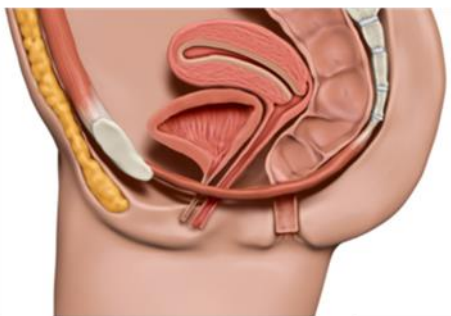


Bild från Karolinska Universitetssjukhuset

Bäckenbotten omsluter ändtarmsöppningen, slidan och urinröret

### A "Hitta rätt" /uppvärmningsknip

- 1 Ligg bekvämt t.ex. på rygg med böjda ben, gärna med en kudde under knäna.
- 2 Knip med musklerna som om du vill hindra gasavgång eller som att hålla dig då du är kissnödig.
- 3 Knip med lätt till måttlig kraft i 3 sekunder - vila i 3 sekunder.
- 4 Upprepa övningen 10-15 gånger.

### B Styrkeknip

- 1 Knip på samma sätt som i övningen ovan, men knip nu **så hårt** du kan.
- 2 Håll knipet i 5-6 sekunder - slappna av i 10 sekunder.
- 3 Upprepa övningen 5-10 gånger.

### C Uthållighetsknip

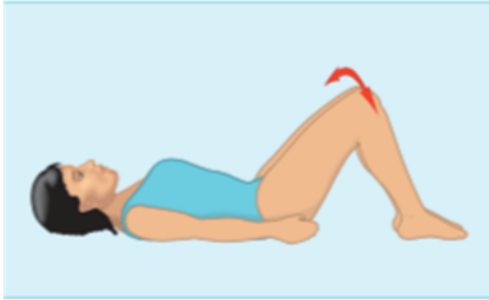
- 1 Knip fast och bestämt, så länge du kan.
- 2 Utför övningen 1 gång per träningstillfälle

När du är säker på att du bara aktiverar bäckenbotten och ingen annan muskelgrupp kan du naturligtvis göra övningarna sittande eller stående.



#### D Bäckentippning

- 1 Ligg på rygg på en plan yta, med böjda ben och fotsulorna mot underlaget.
- 2 Dra in magen, tippa stjärten lite uppåt samtidigt som du pressar svanken ned mot underlaget, håll i 2 sekunder.
- 3 Slappna av långsamt
- 4 Upprepa 10 gånger



#### E Knärullning

- 1 Ligg på rygg på en plan yta, med böjda ben och fotsulorna mot underlaget.
- 2 Dra in magen, håll ihop knäna, fäll knäna långsamt från sida till sida.
- 3 Upprepa 10 gånger



#### F Anpassad Sit ups

- 1 Ligg på rygg på en plan yta, med böjda ben och fotsulorna mot underlaget.
- 2 Placera händerna på lårens framsidor, dra in magen.
- 3 Lyft huvudet från kudden
- 4 Håll i 3 sekunder, gå sedan långsamt tillbaka till utgångsposition.
- 5 Upprepa 10 gånger

Bild från Thompson, 2007

Ref. Thompson MJ. Parastomal hernia: incidence, prevention and treatment strategies. Br J Nurs 2008;17(2): S16, S18-20.

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## Intervjuguide

| Forskningsområde              | Intervjufrågor   | Följdfrågor   |
|-------------------------------|--|---|
| <b>Inledande frågor</b>       | Kan du beskriva hur det varit att använda Träningstavlan?        | <p>Vad tycker du varit bra med tavlan?</p> <p>Vad tycker du varit mindre bra med tavlan?</p>  |
| <b>Mål med Träningstavlan</b> | Kan du beskriva varför du haft Träningstavlan efter operationen? | <p>Har det varit tydligt för dig varför du haft tavlan?</p> <p>Ja: Kan du beskriva vad som hjälpte dig att förstå det?</p> <p>På vilket sätt har det varit tydligt för dig?</p> <p>Skulle du kunna beskriva något exempel som gjorde det tydligt för dig?</p> <p>Nej: Vad var det som var oklart?</p> <p>På vilket sätt skulle du vilja ha det förklarad för dig?</p> |

|  |   |   |
|--|---|---|
|  |   | <p>Kan du komma på flera anledningar varför du har haft tavlan?</p>   |
|  | <p>Hur upplever du att den personal som du träffat här på avdelningen varit involverad/stöttande i ditt arbete med Träningstavlan?</p> <p>Har andra personer i din närhet som anhöriga eller vänner stöttat dig och i så fall på vilket sätt?</p> | <p>Har personalen på avdelningen och du pratat om varför du har haft tavlan?</p> <p>Ja: På vilket sätt har det varit värdefullt för dig att prata om varför du haft den?</p> <p>Nej: Hur tror du det skulle hjälpt dig att få prata om varför du haft den?</p> <p>Om patienten pratar om FT/SJG:</p> <p>Är det andra än fysioterapeuten/sjukgymnasten som pratat med dig om tavlan, ssk, usk, läkare?</p> <p>Ja: Kan du beskriva vad de tyckt och hur du har upplevt det?</p> |

|  |   |  |
|--|---|--|
| <p><b>Praktiska handhavandet med Träningstavlan?</b></p> | <p>Kan du beskriva hur du tycker det varit att använda Träningstavlan praktiskt?</p>  | <p>Vad tycker du varit bra med Träningstavlan?</p> <p>Kan du berätta om något varit svårt med hur man ska använda tavlan?</p>  |
| <p><b>Träningstavlan som motivationsverktyg</b></p>      | <p>Kan du beskriva för mig på vilket sätt Träningstavlan påverkat hur mycket du rört på dig här på avdelningen?</p>                         | <p>Har den hjälpt dig att vara mer fysisk aktiv?</p> <p>JA: Skulle du kunna berätta om ett tillfälle då tavlan hjälpt dig att vara fysisk aktiv?</p> <p>Nej: Vad tänker du om det?</p> |
|  | <p>Vilken roll har tavlan spelat för dig beroende på hur du mår (någon dag du varit mer uppåt och/eller någon dag du varit mer låg)</p>     | <p>Kan du beskriva en situation där du inte mått bra av tavlan?</p>  |
| <p><b>Effekten av Träningstavlan</b></p>                 | <p>Överhuvudtaget, hur tycker du att tavlan påverkat dig när det gäller din möjlighet att vara fysisk aktiv under tiden på avdelningen?</p> | <p>Och nu när du snart ska från sjukhuset, är det något med Träningstavlan som du tror kommer kunna hjälpa dig med din rehabilitering framåt?</p>                                      |
| <p>Avslutande frågor</p>                                 | <p>Är det något du tycker att vi glömt prata om när det gäller Träningstavlan?</p>  |  |