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Postoperative recovery in day surgery

Evaluation of psychometric properties and clinical usefulness of a questionnaire in day surgery

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To my family

CONTENTS

ABSTRACT

Background: Day surgery has increased during recent decades in many countries and represents approximately 50% of surgical procedures performed in Sweden. Day surgery implies that the patient is admitted and operated on during the same day and discharged without an overnight stay at the surgery unit. Undergoing a day surgical procedure thereby means that the major part of the postoperative recovery takes place in the patient's home, leaving the patient and his/her supportive network responsible for the postoperative care. Day surgery also implies that health care professionals have to adapt to outpatient care and find valid measurements for monitoring a patient's recovery progress after discharge.

Aims: The aim of Study I was to evaluate the psychometric properties of a translated version of the Post-discharge Surgical Recovery (PSR) scale in a Swedish day surgery sample in terms of data quality, internal consistency, dimensionality and responsiveness. The aim of Study II was to describe postoperative recovery on postoperative days 1, 7 and 14 after different orthopaedic day surgical procedures, as well as to identify possible predictors associated with postoperative recovery two weeks after surgery.

Methods: Six-hundred and seven patients who had undergone an orthopaedic surgical procedure (n=358), general surgery (n=182) or gynaecological surgery (n=67) were included. To assess postoperative recovery, the PSR scale and the emotional state, physical comfort and physical independency dimensions of the Quality of Recovery-23 (QoR-23) were used. In addition, patients' background data and self ratings of their ability to work or handle usual business and general health were obtained. Data were collected preoperatively and on postoperative days 1, 7 and 14. In Study I data quality and internal consistency were evaluated using descriptive statistics, correlation analyses and Cronbach's alpha. The dimensionality was determined using an exploratory factor analysis, and the responsiveness was evaluated through the standardized response mean (SRM) and the area under the receiver operating characteristics curve (AUC). In Study II, patients' postoperative recovery and general health were compared over time using Friedmann's ANOVA and between surgical groups of patients using the Kruskal-Wallis test. To determine predictors of recovery, a multiple linear regression analysis was performed with the PSR score on postoperative day 14 as the dependent variable.

Results: In Study I, two items were deleted from the Swedish version of the PSR scale. This was based on several low inter-item (<0.30) and item-total correlations (<0.40) and substantial ceiling effects (65%). After the deletion of two items, the Cronbach's coefficient alpha was 0.90 and the average inter-item correlation was 0.44. According to the factor analysis, a single dimension was found explaining the common variance to 44%. The SRM (1.14) indicated a robust ability to detect changes in recovery. The AUC was 0.60 for the entire scale, but varied (0.58-0.81) when the PSR score on postoperative day 1 was categorized into three intervals. In Study II, the shoulder patients experienced significantly lower postoperative recovery and general health one and two weeks after surgery ($p<0.001$). Significant predictors of recovery on postoperative day 14 were age, perceived health and emotional status on postoperative day 1 and type of surgery, and explained the dependent variable to 33%.

Conclusions: The Swedish version of the PSR scale seems to be a consistent and valid instrument for the assessment of postoperative recovery at home in Sweden. The recovery process for orthopaedic day surgery patients differs, with shoulder surgery patients in particular showing poor recovery, which could be considered when day surgery patient education programmes are developed.

LIST OF PAPERS

This thesis is based upon following the papers, which will be referred to in the text by their Roman numerals (I and II):

I. Berg Katarina, Idvall Ewa, Nilsson Ulrica, Franzén Årestedt Kristofer, Unosson Mitra. Psychometric evaluation of the post-discharge surgical recovery scale. Journal of Evaluation in Clinical Practice 2010; 16 (4), 794-801. Reprinted with permission from the publisher.

II. Berg Katarina, Idvall Ewa, Nilsson Ulrica, Unosson Mitra. Postoperative recovery after different orthopaedic day surgical procedures. Submitted.

ABBREVIATIONS

ACI	Arthroscopy
ADL	Activities of daily life
ASA	American Society of Anesthesiologists
AUC	Area under the receiver operating curve
BMI	Body mass index
PAF	Principal axis factoring
POD	Postoperative day
PONV	Postoperative nausea and vomiting
PSR	Post-discharge Surgical Recovery scale
QoR-40	Quality of Recovery-40 items
QoR-23	Quality of Recovery-23 items
ROC	Receiver operating curve
S-PSR	Swedish Post-discharge Surgical Recovery scale
SRM	Standardized response mean
VIF	Variance inflation factor

INTRODUCTION

Day surgery has a long history. In fact, early in the previous century Nicoll [1] described successful paediatric day surgery in Scotland. However, activity was low in the day surgery area for many years and only started to develop gradually in the Anglo-Saxon countries during the 1970's. In recent decades day surgery rates have steadily increased in many countries, with the US and Canada having the highest percentage (~75%) [2]. In Sweden, day surgery represents approximately 50% of the surgery performed [3]. Advances in surgical and anaesthetic techniques, along with economic and political initiatives, have led to the increase in the number of surgical procedures being performed as day surgery [2]. Day surgery is defined as a surgical procedure performed on a patient who is admitted and operated on during the same day and discharged without an overnight stay [4]. In some countries (e.g. the US and the UK) less than a 24-hour stay is sometimes regarded as a day surgery procedure [4], illustrating the importance of a definition of the concept in studies to facilitate the interpretation of results. Ambulatory surgery is synonymous with day surgery. Other terminologies like day case-, day care- and same day surgery are found in the literature as well. In this thesis, the term day surgery is used.

Patient satisfaction studies demonstrate that day surgery is a popular choice with most patients [5-8]. These studies elucidate day surgery as an efficient service with minimal disruption of personal habits and routines. Recovery is not always straightforward, however, and patients report several unanticipated worries. The organization of day surgery seems to be especially beneficial to the elderly and children, though as it only minimally disrupts their ordinary life and allows them to recover in familiar surroundings [9].

After leaving the day surgery unit, the patient and his/her supportive network are responsible for the postoperative care at home [10], as opposed to hospitalized patients who have the advantage of health professionals facilitating their recovery when problems are identified [11]. To manage recovery at home a high degree of self-care is necessary, but not all patients are prepared for this [12]. When discharged following day surgery, the patient and his/her supportive network may be at a loss for what to do when managing clinical care needs [13]. Day surgery implies that health

professionals must adapt to a shift from inpatient to outpatient care [14]. The patient's ability to resume normal activities postoperatively is an important indicator of a successful day surgery procedure. For the evaluation of patient-based outcomes and the period of recovery, standardized and valid instruments are needed [15]. Few such instruments are available, and even fewer have been validated or used in Sweden. This thesis contributes to the Swedish knowledge about the use of instruments for assessing and evaluating the postoperative recovery process within the first two weeks after day surgery.

BACKGROUND

The complexity of procedures and the number of patients with existing co-morbidity has increased in day surgery [16]. In Sweden procedures such as laparoscopic cholecystectomy, anterior cruciate ligament repair, shoulder surgery, hernia repair in the elderly, tonsillectomy, transvaginal procedures for urinary incontinency and minor gynaecological prolapse have changed from being in-hospital procedures ten years ago to mainly day surgical procedures today [3]. Due to this increase in day surgery it cannot be excluded that, in coming years, per- and postoperative morbidity will increase. Consequently, identifying risk patients in advance seems important. However, the literature regarding patient selection is not univocal [16-20]. The factors that influence outcome in day surgery are many [16]. Patient characteristics (age, comorbidity, body mass index (BMI), smoking), surgery and anaesthesia (site and duration of operation, degree of invasiveness, type of anaesthesia, endotracheal intubation), social factors (social/cultural conditions, escort availability, surveillance at home) and the kind of facility where the surgery is performed are such factors [16]. In Sweden, patient selection is mainly based on the American Society of Anesthesiologists' (ASA) classification, type of anaesthesia and BMI, and the surgeon makes the first assessment of the patient's qualifications for a day surgical procedure. The patient brings a completed health/medical questionnaire to the day surgery unit, and at almost all institutions an anaesthesiologist makes an additional preoperative assessment on the day of surgery [21]. The day surgery unit is most often staffed by nurses, chiefly those specialized in anaesthesia or post-anaesthetic care, and assistant nurses [22].

Mortality and major morbidity following anaesthesia [23, 24] and day surgery are extremely low [25] but post-discharge symptoms are common [26]. Pain is the most common post-discharge complaint both in Sweden [3] and elsewhere [12, 27-29]. For instance, pain was a common reason for hospital admission [3], and Pavlin et al. [29] reported that 60% of day surgery patients experienced moderate to severe pain the first postoperative day. Also, Coll et al. [28] showed that 60% of patients experienced moderate to severe pain the first postoperative day which still was present in 44% of the patients on postoperative day 3. In an Australian study among women undergoing a reproductive day surgical procedure, 70% of the women reported pain

following discharge and more than half of them were still in pain on postoperative day 2 [27]. Postoperative nausea and vomiting (PONV) is also a troublesome symptom post-discharge [21, 30, 31]. In a sample with multiple types of day surgery, 50% of the patients reported that PONV affected their ability to resume normal activities on the first postoperative day [32]. In a review article from 2002, the incidence of nausea was 17% and the incidence of emesis was 8% during the first postoperative week [26]. When patients were asked to rank their preferences for avoiding a postoperative symptom and to value it through an "imaginative dollar allocation", nausea and vomiting were ranked very high and were worth paying a great deal to avoid [33, 34]. Cognitive discomforts also appear post-discharge. Fatigue and tiredness were problematic among gynaecology [12, 35] and urology patients [12, 36]. Drowsiness, dizziness and amnesia affect patients in connection to discharge and afterwards [30, 37, 38], which is important to take into account when giving discharge instructions [37]. A changed body image and appearance might be bothersome to some patients [12, 39]. For instance, patients with hernia repair or hydrocele repair might experience anxiety if they are unprepared for the discoloration, swelling and bruising that might occur postoperatively [12]. Women felt a high level of anxiety regarding altered body image after an excisional breast biopsy [39]. Psychological changes like mood swings and anxiety have been identified post-discharge. These might be due to disturbed nocturnal sleep [12], non-resumed role functions [35] or stress waiting for a diagnosis [39].

Postoperative recovery is individual and a composite of different physical and psychological themes, which is hard to grasp or determine whether or not it has occurred [40]. Two concepts that are closely related to recovery are convalescence [41] and rehabilitation [42]. Convalescence means the regaining of health and strength [43], and is used interchangeably with recovery in some studies [10, 44]. In other studies, convalescence is used as a concept describing the patient's ability to resume common activities (work, activities of daily life (ADL), recreation) [45, 46]. In the context of rehabilitation, human functioning and disability are important components. Human functioning is viewed in relation to the individual health condition and personal and environmental factors. Disability is complementary to functioning, and encompasses impairment and limitations in activities [47]. Rehabilitation is the process of getting back into good condition and restoring a state of health using constructive activities [43], and is thus closely related to the functional postoperative recovery.

Postoperative recovery is grounded in a patient's perception of his/her own health prior to surgery. This perception creates an internal standard which is then mediated through a variety of factors including experiences of prior illness, the surgical procedure itself, expectations regarding recovery, the intensity of symptoms and exposure to external stimuli (e.g. a medical condition or postoperative distress highlighted in media) [48, 49]. Recovery is complete when the postoperative condition is again equal to the internal standard [50].

The concept of postoperative recovery is used in a wide range of disciplines, and a general definition might be difficult to find. However, a conventional concept runs the risk of being diffuse and hard to discuss. In the nursing discipline, a broad and common definition would be valuable and useful when discussing postoperative recovery. In a concept analysis [41], it was suggested that postoperative recovery is an energy-requiring process of returning to the preoperative level of normality and wholeness regarding physical, psychological, social and habitual functions. This holistic definition is based on characteristics of postoperative recovery found in the literature. The defining attributes of postoperative recovery that were found are as follows:

i. an energy-requiring process,
ii. a return to a state of normality and wholeness,
iii. a regained control over physical, psychological, social and habitual functions,
iv. a return to preoperative levels of independency/dependency in activities of daily living, and
v. a regained level of optimal well-being [41].

These attributes are then further developed [51] suggesting that the physical dimension is separated into physical symptoms and physical function. Furthermore, activity was suggested as a more useful label for the habitual dimension as this dimension focused on ordinary activities in life. Other holistic definitions are also used. Zalon [52] proposes that recovery from surgery is an improvement in functional status and a perception of recuperation. Kleinbeck [11] describes recovery after day surgery as the patient's perception of a 100% return to his/her usual self. Postoperative recovery is also seen as the period of time during which the patient has measurable and dynamic changes in health status attributable to the surgical procedure [44].

The recovery process after day surgery is divided into three phases: early, intermediate and late [53, 54]. The early phase comprises the time from discontinuation of anaesthesia until the patient has stable protective reflexes. This phase lasts only minutes and is followed closely by the intermediate phase, during which the patient awaits readiness for home discharge (hours). The late phase comprises the time from discharge until the patient reaches the level of preoperative health and well-being (days) [53].

Day surgery represents one of the most important medical revolutions of the past 20 years in terms of resource utilization, customer satisfaction and value for money [16]. Patients are a major and important part of the customer base, and assessment of their experiences is a principal end-point after day surgery [55]. Although it is obvious that an evaluation of patients' subjective recovery is essential to acquire knowledge to facilitate their progress of well-being as well as to develop the health care organization, few validated methods are available. In Sweden, formal follow-ups are infrequent and when they are used, this usually occurs by telephone on postoperative day 1-2 [3]. There are several ways to assess postoperative recovery after day surgery [56]. Clinically oriented endpoints are frequently used, with pain and PONV as most commonly reported [9, 31, 38]. Clinical endpoints are also used for the evaluation of different anaesthetic agents or anaesthetic techniques, for the assessment of early and intermediate [57-60] as well as late recovery [60-62]. Typical clinical endpoints in early recovery related to the type of anaesthesia are time until the patient can follow commands, is extubated, and is oriented to place and date [57, 59, 63]. In the intermediate recovery phase, the patient's experience of symptoms [58, 59] and different cognitive measurements (i.e. the digit-symbol substitution test) [59] are frequently used. Evaluation of type of anaesthesia during the late recovery phase uses patients' experiences of symptoms and adverse side effects [60-62]. Experiences of the ride home [61] and feelings of concentration and forgetfulness at home [62] are also used. Process of care measures, such as time to home readiness and discharge [57, 58, 60, 62-64] and unanticipated admission after discharge [65-69], are other often-used measures of the quality and outcome of day surgery. Patient satisfaction is an important outcome of day surgery, and is used in the evaluation of recovery [5, 7, 70, 71], along with patients' perceptions of the quality of recovery [72, 73].

In order to emphasize evidence-based health care and in connection to the increase in day surgery, patients' self-reporting of postoperative recovery has

become more important to identify [55]. The use of questionnaires as a method of data collection has increased in recent years [74]. Questionnaires designed to measure postoperative recovery can be general or disease- or site-specific. An advantage of general recovery instruments is that they can be used in a wide range of surgeries [75]. Several instruments for the assessment of postoperative recovery have been developed during the past decade [10, 11, 35, 72, 73, 76-78]; however, none are fully validated. Two instruments, the Post-discharge Surgical Recovery (PSR) scale [11] and the Quality of Recovery-40 (QoR-40) [73], are to date reported to have the most satisfactory psychometric properties [75, 79]. The PSR scale has not been used or tested in a Swedish sample, but a modified version of the QoR-40 has recently been tested in Sweden [72, 80].

AIMS

The overall aim of this thesis was to validate the post-discharge surgical recovery scale in a Swedish day surgery sample, as well as to investigate postoperative recovery after day surgery.

The specific aims were:

I. To evaluate the psychometric properties of a translated version of the PSR scale in a Swedish day surgery sample in terms of data quality, internal consistency, dimensionality and responsiveness.

II. To describe postoperative recovery on postoperative days 1, 7 and 14 after different orthopaedic day surgical procedures and to identify possible predictors associated with postoperative recovery two weeks after surgery.

METHODS

Subjects

Patients scheduled for a day surgical procedure, aged 18 years or older and able to read and understand Swedish, qualified for participation. Eight-hundred and fifty-one consecutive patients were eligible to be asked to participate. Of these, 76 missed being asked and 135 declined participation, resulting in 640 subjects who gave informed consent to participate. A hundred patients were recruited from a day surgery unit at a county hospital, 270 from a day surgery unit at a university hospital and 270 from a private day surgery unit. Of the patients who gave informed consent to participate, 33 were excluded due mainly to postoperative hospitalization. The included patients had undergone an orthopaedic surgical procedure (n=358), general surgery (n=182) or gynaecology surgery (n=67). A flow chart of the patients in Studies I and II is shown in Figure 1. Patients were recruited consecutively during three periods during the period 2003-2005.

Measurements

The PSR scale is a self-report measure of postoperative recovery post-discharge after a day surgical procedure [11]. The patient's health status, activity, fatigue, work ability and expectations are aspects illustrated by the PSR scale which comprises 15 items rated on a ten-point (1-10) semantic differential scale. The items' anchor words are constructed both from negative to positive and in the opposite direction. When computed, all items are directed from negative to positive. The PSR score is computed using the individual sum score, divided by total possible score and multiplied by 100. The possible score range is 10-100, with higher scores indicating a more favourable recovery. The instrument has been tested regarding validity and reliability by its constructor [11].

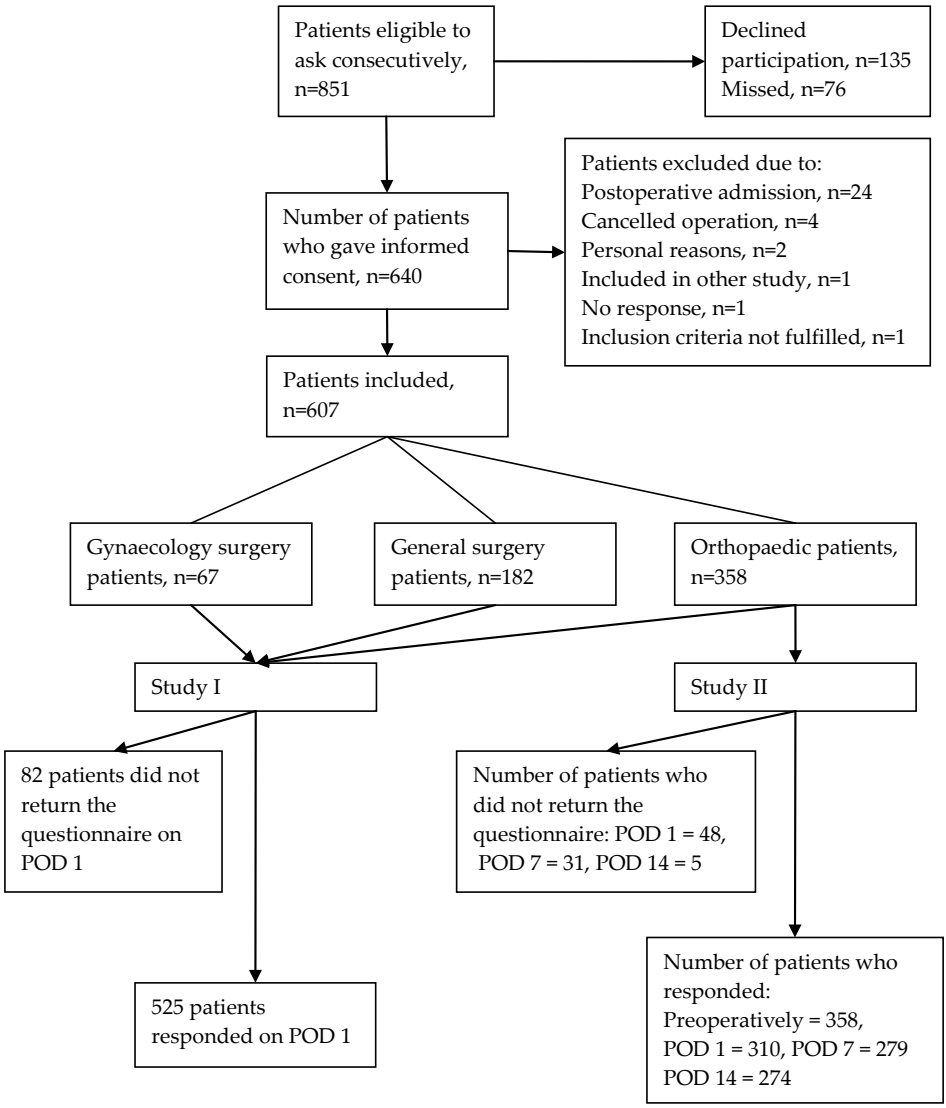

Figure 1. Flow chart of patients included in Studies I and II.

After permission was received to use the PSR scale from its constructor, a Swedish version of the scale was constructed. This version of the PSR scale was obtained using a translation/back-translation procedure, with a native translator at every occasion [81]. To ensure the instrument's relevance in a Swedish context, the research group evaluated all items for relevance as well as the equability between the original and the back-translated instruments. Finally, an adjustment was made to the original PSR scale: One item was split

into two in order to catch both the emotional dimension and a more general view of the patients' 'normal self'. Two original items were also excluded and placed outside the scale. One item concerning time to recover and another concerning time to return to work and were replaced in order to allow the respondents to give a more specific estimation of time. These adjustments resulted in a 14-item modified version of the PSR scale being used, the Swedish Post-discharge Surgical Recovery (S-PSR) scale (see Appendix).

Emotional state, physical comfort and physical independence were assessed using the Quality of Recovery-23 (QoR-23) [72]. This is a 23-item instrument for the assessment of the quality of postoperative recovery. The items are distributed as follows: eight items concerning emotional state, ten items concerning physical comfort, and five items concerning physical independence. All items are rated on a five-point scale (1-5). The ratings are summed, and higher scores indicate higher quality of recovery. The original instrument for the assessment of the quality of recovery consisted of 40 items and did not focus solely on day surgery patients, although they were included during its development and the evaluation of the instrument's validity and reliability [73]. The Swedish modified version, QoR-23, has been psychometrically tested and has shown initial support for use in day surgery patients [72].

In addition to the S-PSR scale and QoR-23, two supplementary questions were used. One regarded the patients' ability to work or handle usual business at home, rated on a five-point scale (1 = not at all, 5 = all the time), and the other regarded the patients' global health on a self-rated ten-point scale (1 = very poor health, 10 = excellent health).

To receive the patients' background data (age, gender, smoking, residence, employment and education) and the preoperative physical ASA classification, a structured questionnaire and patient records were used.

Procedures

On arrival at the day surgery unit, each patient was asked about participation and given verbal and written information about the research project. Verbal consent to participate was obtained. Before surgery, demographic and baseline data were collected and a physician or specially trained nurse assessed the

patient's ASA classification. At baseline, ten items from the S-PSR scale e.g. the patient's alertness, pain, tiredness, activity, need for a day time nap, mobility, living situation, physical exercise, bowel conditions and personal care were assessed, as was his/her experience of health during the preceding 12 months. When the patients were discharged from the day surgery unit, they received the S-PSR scale, the QoR-23 and the supplementary questions in a postage-paid envelope to be filled out on the first postoperative day (POD). In advance of PODs 7 and 14, two additional questionnaires were sent to the patients' homes to be answered on the seventh and fourteenth days after surgery, respectively.

Ethical considerations

The studies followed common ethical principles for clinical research regulated by the World Medical Association Declaration of Helsinki, and were approved by the Regional Ethical Review Board, Linköping, Sweden (Dnr 03-333). Each participant received both verbal and written information about the study, and was also informed that participation was voluntary. The participants were clearly informed about the possibility to withdraw from the study whenever they wanted without giving any explanation. The participants were guaranteed confidentiality, and coded lists and completed questionnaires were kept safe. No risks were identified for taking part in the studies.

Statistical analyses

Descriptive data are presented as frequencies, percentages, means and standard deviations (SD) as appropriate (I, II). Data quality of the S-PSR scale was evaluated through the number of missing items and assessment of floor and ceiling effects. To evaluate internal consistency, Cronbach's alpha and Pearson's product moment correlation were used (I). To determine the dimensionality of the S-PSR scale, an exploratory factor analysis with a principal axis factoring (PAF) and an oblique rotation were used (I). The internal- and external responsiveness [82] of the scale were evaluated (I). For the evaluation of internal responsiveness, the standardized response mean (SRM) was used, which characterizes the ability of the S-PSR scale to change over time. The external responsiveness was evaluated using the area under the receiver operating characteristics (ROC) curve (AUC) and Pearson's product

moment correlation. For the ROC analysis, one of the supplementary questions (the patient's ability to work or handle usual business) was used as a dichotomized external criterion. The AUC was interpreted as the probability of the S-PSR scale to distinguish improved from non-improved patients according to the external criterion. In the correlation analysis, changed scores in the S-PSR scale were correlated to change scores in patients' self-rated health. Friedman's ANOVA was used to compare the patients' recovery during the first two weeks after surgery (PODs 1, 7 and 14), followed by Wilcoxon's signed rank test in cases of significance (II). For comparisons between the different orthopaedic surgical groups (on the respective postoperative day), the Kruskal-Wallis test was used. The Bonferroni correction was used when multiple comparisons were made. To identify predictors of postoperative recovery two weeks after surgery, a multiple linear regression analysis was used with the S-PSR score on POD 14 as the dependent variable. Independent variables were: age, gender, residence, smoking, employment, education, ASA classification, perceived health, emotional state, physical independence, physical comfort on POD 1 and type of surgery, all variables in the equation selected in a block. Through inspection of the correlation matrix, two variables (emotional status and physical comfort) were found to be highly correlated to each other. To decide which variable to use in the equation, the tolerance and the variance inflation factor (VIF) were assessed [83].

RESULTS

Background data

The mean age of included patients (n=607) was 49.7 (±15.6) years and ranged between 18 and 86 years. The male/female proportion was 50/50 and the females were slightly older, 51.0 (±14.8) years, compared to the males at 48.4 (±16.4) years ($p<0.05$). The majority of patients were working, classified with ASA class one or two, cohabited and had an education up to secondary school level. Three-hundred and fifty-eight patients were scheduled for an orthopaedic surgical procedure, 182 for general surgery and 67 for gynaecological surgery. Regarding background data, no difference was found between the genders except in employment, where more men were working and more women were retired or assigned their employment as "other", e.g. on sick- leave or at home ($p<0.001$). There were also more men than women scheduled for a general surgical procedure ($p<0.001$) (Table 1).

Psychometric evaluation of the S-PSR scale

The evaluation of the psychometric properties is based on data from POD 1 (data quality, internal consistency and factor analysis) and from POD 14 (responsiveness). When data quality was assessed two items, *bowel function* and *personal care*, showed a ceiling effect of 65%. These two items also showed low inter-item correlations (<0.30) and item-total correlations (<0.40). Based on these results, it was determined that data quality was unsatisfactory regarding the two items, and it was decided that they would be excluded from the S-PSR and the subsequent analysis. After reduction of items, Cronbach's alpha increased from 0.89 to 0.90 and the average inter-item correlation increased from 0.37 to 0.44. Two other items, *expectations on recovery* and *frame of mind*, showed a ceiling effect and two items, *mobility* and *normal life*, showed a floor effect. However, the internal consistency was satisfactory regarding these items and it was decided that they would remain in the scale.

Table 1. Patient characteristics (N=607)

	male/female	p-value[a]
Gender	303/304	
ASA		
I	225/216	
II	73/78	
III	5/9	
missing	1	
Residence		
Cohabiting	229/230	
Single	71/69	
missing	8	
Employment		<0.001
Working	234/177	
Retired	49/85	
Unemployed	10/11	
Other	6/24	
missing	11	
Education		
Compulsory school	87/89	
Secondary school	134/110	
Degree from university	77/96	
missing	14	
Planned surgical procedure		<0.001
Orthopaedic surgery	189/169	
General surgery	114/68	
Gynaecological surgery	0/67	

[a] Chi^2 analysis between the genders
ASA= American Society of Anesthesiologists' classification

The measures of sampling adequacy were ensured, and the factor analysis initially showed a two-factor model. The scree plot showed one factor more prominently (eigenvalue 5.9) compared to the second factor (eigenvalue 1.2). Except for two items, *alertness* and *physical strength*, all items loaded >0.40 in this factor model and the cross loadings were several. The two-factor solution explained 52% of the total common variance, with the second factor contributing with 7% and a correlation between the factors of 0.68. Based on the examination of the scree plot, factor-loadings, the second factor's contribution to the common variance explained and the correlation between the two factors, a one-factor solution was considered most appropriate. The

one-factor solution explained 44% of the total common variance (Table 2). This factor- solution was in concordance with the factor analysis performed during the original instrument's development. The single dimension was called *perceived at-home postoperative recovery*, in concordance with the constructor of the PSR scale.

The patients' mean change in the S-PSR score from POD 1 to 14 was 19.6 (± 17.1) and the internal responsiveness (SRM=1.14) was judged to be satisfactory. The variety of change in S-PSR score from POD 1 to 14 was wide (-39.2 to 87.5), even though the majority of patients (89%) had improved. The external responsiveness, using changes in patients' ability to work or handle usual business at home as an external criterion, showed that the AUC was 0.60 for the entire scale. To determine whether the external responsiveness varied depending on the magnitude of the S-PSR score on POD 1, separate values for AUC were calculated at three different S-PSR score intervals, 10-39, 40-69 and 70-100. The AUC values were 0.81, 0.73, 0.58, respectively, indicating that the scale's accuracy in distinguishing improved from non-improved patients' in relation to the external criterion decreased when the S-PSR score on POD 1 increased.

Postoperative recovery in orthopaedic day surgery patients

The major part of the patients included in this thesis had undergone an orthopaedic day surgical procedure (Figure 1). Three-hundred and fifty-eight patients (189 male, 169 female) who had undergone arthroscopy (ACI) in the knee (140 subjects), surgery on the hand or arm (128 subjects), foot or leg (71 subjects) or shoulder (19 subjects) were included. The women were slightly older than the men in this group, at 50.8 (±14.6) and 47.5 (±16.4) years, respectively ($p<0.05$).

Before surgery the shoulder patients had more pain (4.1 ±1.8) than the ACI patients (5.6 ±2.2), hand/arm patients (6.5 ±2.7) and foot/leg patients (6.1 ±2.8) ($p<0.001$) (higher values more favourable). Preoperatively, the ACI patients were more immobile (6.1 ±2.6) than the hand/arm patients (7.2 ±2.7) ($p<0.001$). No differences existed in the patients' perceived health during the preceding 12 months.

Table 2. Results of the factor analysis* performed on the Swedish Post-discharge Surgical Recovery (S-PSR) scale on POD 1 in a mixed day surgery sample (n=506).

		Two-factor solution			One-factor solution	
Item		1	2	h^2	1	h^2
Right now I feel:						
1.	drowsy vs. alert	0.73	0.38	0.57	0.62	0.38
2.	pain vs. no pain	0.63	0.48	0.40	0.62	0.38
3.	tired vs. energetic	0.72	0.52	0.53	0.69	0.48
4.	in need of a daytime nap vs. not in need of a daytime nap	0.68	0.58	0.49	0.70	0.49
5.	a wish to stay at home vs. no wish to stay at home	0.76	0.75	0.68	0.83	0.69
6.	no strength for physical exercise vs. strength for physical exercise	0.54	0.39	0.29	0.52	0.29
7.	worse than expected vs. better than expected	0.64	0.47	0.41	0.62	0.39
8.	not back to my usual frame of mind vs. back to my usual frame of mind	0.61	0.41	0.37	0.57	0.33
9.	unable to perform normal activities vs. able to perform normal activities	0.57	0.84	0.70	0.72	0.52
10.	immobile vs. mobile	0.46	0.85	0.75	0.65	0.42
11.	not recovered from surgery vs. recovered from surgery	0.67	0.68	0.54	0.74	0.54
12.	not back to normal life vs. back to normal life	0.56	0.67	0.48	0.66	0.44
Eigenvalue before rotation		5.85	1.20		5.85	
Percentage of variance explained		45	7		44	
Cronbach's α (salient loadings)		0.86	0.84		0.90	
Pearson's product moment correlation between factor 1 and 2				0.68		

* Common factor analysis with principal axis factoring and Promax rotation

h^2=final communalities

All patients improved in postoperative recovery from POD 1 to 14, except those who had undergone shoulder surgery. This was statistically significant in both the S-PSR score ($p \leq 0.001$) and the assessment of physical comfort, emotional state and physical independence ($p < 0.001$) (Table 3). However, when comparing the different surgical groups regarding included items in the S-PSR scale, we found that the shoulder patients only improved in *usual activity* and *mobility* and worsened in their *expectations on recovery* during the first two weeks postoperatively ($p < 0.05$). Other patients improved in all items but one ($p < 0.05$). The shoulder patients also showed lower physical comfort ($p < 0.001$) and emotional state ($p < 0.05$) on PODs 7 and 14 compared to the other orthopaedic patients. On PODs 1, 7 and 14, both the shoulder and the hand/arm patients were more physically dependent than the patients who had had surgery on their lower extremities ($p < 0.05$) (Table 3).

According to the correlation between emotional status and physical comfort ($r = 0.78$) and the assessment of the tolerance and the VIF, the emotional state variable seemed most appropriate and was chosen for use in the regression analysis. Patients' age ($p < 0.05$), perceived health on POD 1 ($p < 0.001$), emotional state on POD 1 ($p < 0.01$) and type of surgery ($p < 0.001$) emerged as predictors of postoperative recovery on POD 14. Shoulder surgery seemed to have the most negative impact on patients' recovery. Approximately 34% of patients' recovery was explained by this model.

Table 3. Mean scores (±SD) in postoperative recovery assessed using the S-PSR scale, physical comfort, emotional state, physical independence and perceived health for orthopaedic day surgery patients on PODs 1, 7 and 14.

	Max score	ACI (knee) patients *n = 112**	Hand/arm patients *n = 112**	Foot/leg patients *n = 62**	Shoulder patients *n = 16**	p-value[a]
S-PSR score (12 items)	100					
POD 1		57.0 (15.1)	59.8 (17.8)	53.4 (17.4)	50.5 (17.0)	0.038
POD 7		69.2 (17.8)	71.2 (16.3)	67.7 (15.5)	50.8 (17.5)	0.001
POD 14		76.6 (16.4)	76.7 (15.8)	74.8 (15.6)	52.6 (13.9)	<0.001
p-value[b]		<0.001	<0.001	<0.001	0.629	
Physical comfort (10 items)	50					
POD 1		43.1 (5.7)	42.2 (5.9)	41.5 (7.2)	39.3 (6.9)	0.075
POD 7		45.7 (5.9)	45.7 (4.4)	45.8 (4.6)	39.7 (5.9)	0.001
POD 14		47.4 (3.7)	46.4 (4.2)	47.6 (2.6)	41.1 (5.3)	<0.001
p-value[b]		<0.001	<0.001	<0.001	0.368	
Emotional state (8 items)	40					
POD 1		33.5 (6.0)	33.6 (5.5)	33.1 (5.8)	32.1 (5.0)	0.520
POD 7		34.6 (6.6)	35.3 (4.8)	35.0 (5.5)	30.1 (5.9)	0.012
POD 14		36.4 (4.6)	35.4 (5.5)	37.5 (3.1)	30.5 (6.2)	<0.001
p-value[b]		<0.001	<0.001	0.001	0.656	
Physical independence (5 items)	25					
POD 1		21.8 (2.4)	18.6 (3.8)	21.7 (2.5)	20.0 (3.0)	<0.001
POD 7		23.4 (2.2)	20.3 (3.4)	22.8 (2.7)	19.9 (3.1)	<0.001
POD 14		24.0 (1.7)	21.2 (3.2)	23.8 (1.4)	20.8 (2.9)	<0.001
p-value[b]		<0.001	<0.001	0.001	0.058	
Perceived health (1 general item)	10					
POD 1		6.6 (1.9)	6.8 (2.0)	6.3 (2.3)	5.7 (1.9)	0.114
POD 7		7.4 (1.8)	7.5 (1.8)	7.5 (2.0)	5.9 (1.9)	0.009
POD 14		7.9 (1.8)	8.1 (1.7)	7.9 (1.8)	6.1 (1.7)	0.001
p-value[b]		<0.001	<0.001	<0.001	0.239	

ACI =Arthroscopy

*sample sizes vary slightly

[a] p-value between surgical groups measured using Kruskal-Wallis test

[b] p-value for changes within groups measured using Friedman's ANOVA

DISCUSSION

General postoperative recovery instruments, such as the PSR scale, have grown in popularity as outcome measures for research purposes [75]. The origin of the development of the PSR scale was a need for an instrument designed specifically for discharged day surgery patients [11]. This purpose was appealing to us in our search for instruments to use. Cross-cultural studies are needed in nursing research [84]; not only for international comparisons and the development of nursing, but also for the time and cost savings. However, instruments developed previously in other countries need to have good psychometric properties and cultural acceptance and must be appropriately translated [81]. The PSR scale had been previously psychometrically tested with satisfactory results [11]. The original version was therefore obtained from the constructor and was examined regarding its overall suitableness for use in a Swedish day surgery context. Since no gold standard for the translation process exists, we performed a translation/back-translation procedure with psychometric tests in the Swedish population, a procedure that has been commonly used [84]. Native and professional translators were used in the translation process. To secure the same meaning of the items between the original and translated versions of the PSR scale, nurses with experience from postoperative and anaesthesia care also checked the semantic equivalence. Translation adequacy can also be based on similarities in reliability and validity with the source instrument [85]. In this respect, the original PSR scale and the S-PSR scale agreed (I).

The S-PSR scale showed satisfactory data quality, internal consistency, dimensionality and responsiveness when two items were deleted from the scale. The remaining items were found to be homogenous and closely related to each other, capturing patients' perceived postoperative recovery at home. On the other hand floor, and ceiling effects were present in some items, which may affect content validity [86], reliability and responsiveness [87]. Those items showing floor effect (*mobility* and *normal life*) were at the recommended 15% limit and had the lowest mean values in contrast to the two remaining items with ceiling effect (*expectations on recovery* and *frame of mind*), which had the highest mean values. The floor effect might be due to the numerous orthopaedic patients and their problems with mobility on POD 1 (II) and the fact that the majority of patients, as expected, had not returned to their normal

life on POD 1. Regarding the ceiling effects, it seems that patients in this sample felt more recovered than expected. Also, undergoing a day surgical procedure did not seem to affect the patient's frame of mind much. These two items may be reflected in each other. If a patient feels better than expected, his/her frame of mind is probably unaffected by, for instance, anxiety. In order to further analyse floor and ceiling effects, it would be desirable to have an even more heterogeneous sample or to collect data from equal numbers of patients in each surgical group.

In most cases, a high degree of internal consistency is desirable in an instrument [88]. The majority of inter-item correlations in the S-PSR were, as recommended, between 0.30 and 0.70 [89] or 0.80 [90]. A moderate correlation illustrates that the items in the S-PSR scale are related to each other and constitutes different aspects of perceived postoperative recovery at home. A measure illustrating this is the item-total correlation, which should be above 0.20 [88] or 0.30 [91], a criterion the S-PSR scale attained. Another measure of the internal consistency is Cronbach's coefficient alpha. Cronbach's alpha was 0.90 in the S-PSR scale and is, according to the recommendations of 0.70 to 0.90 [91] or 0.95 [86], satisfactory.

The factor structure in this study was very similar to the one performed by the instrument's constructor [11]. However, the common variance explained was in the lower boundary, and to further examine this single dimension of postoperative recovery at home a confirmatory factor analysis should be used.

A quality criterion in health status measurements is responsiveness. A considerable number of definitions of responsiveness exist [92], but they all concern the ability of an instrument to detect changes over time [86]. A consensus on what constitutes a responsive measure or how responsiveness should be quantified is lacking [82, 92]. The internal responsiveness characterizes the ability of a measure to change over a particular pre-specified time- frame [82]. The SRM analysis showed that the S-PSR scale had a high ability to detect changes in perceived postoperative recovery during the two first postoperative weeks. However, this clinical change was not surprising since recovery after day surgery is a dynamic process that moves in a positive direction for most patients. An assessment of patients' own judgements of what constitutes important changes in recovery would further strengthen the internal responsiveness [92].

The aim of the external responsiveness is to measure a clinical change related to a corresponding change in a reference measure of health status [82]. To distinguish between improved and non-improved patients, the patient's assessment of his/her ability to work or handle usual business two weeks after surgery was used as a reference measure. Another reference measure used was the change in scores from POD 1 to POD 14 in perceived health and its correlation to the change in the S-PSR score. The S-PSR scale's ability to discriminate between improved and non-improved patients at POD 14 became more accurate when the S-PSR score on POD 1 was distributed in homogenous groups. The recommended value of AUC ≥0.7 [86] was achieved when the S-PSR score was less than 70 on POD 1. This may be explained by a wide range of change in S-PSR scores from POD 1 to 14 in the group with an initial S-PSR score ≥70 and therefore a large number of possible cut-off scores when running the AUC statistics. The external criterion, work or handle usual business, may have been too rigorously dichotomized with its breakpoint between the two most superior levels, which can have affected the outcome. The correlation between change in perceived health and change in S-PSR score was strong. Measurements of internal and external responsiveness indicate that the S-PSR scale is a responsive instrument.

From the perspective of the psychometric analyses (I), the unanimous results with the original instrument [11] and previous international studies [75, 79], the S-PSR scale seems to be a valid instrument for the assessment of postoperative recovery at home in Sweden.

In Study II, we found that shoulder surgery patients experienced considerably lower postoperative recovery compared to the other groups of orthopaedic patients. Shoulder surgery has increased as a day surgical procedure during the past decade [3], and improved postoperative pain control has contributed to this [93]. However, postoperative pain is still a problem and different techniques for relieving pain in this group of patients are reported [94, 95]. Pain affects an individual's general health [96], and the shoulder surgery patients in this study (II) had lower self-rated health on PODs 7 and 14. Other factors such as a longer period of sick leave, a more troublesome rehabilitation and more dependency on help regarding ADL, for instance, probably also have an impact on the experience of health. This more extensive period of time for recovery might be reflected in the shoulder surgery patients' reduced expectations regarding recovery two weeks after surgery.

Patient age in day surgery is an issue of debate in the literature [16, 18, 66, 97, 98], and we found age to be a significant negative predictor of postoperative recovery two weeks after surgery. It may not be only the chronological age itself that is the key factor for the recovery process; other individual medical and social factors need to be taken into account when determining suitability for a day surgical procedure in older patients [97]. However, older patients also benefit from the day surgery concept, with its minimal disruption of normal habits and routines [9], provided that they are supported at home.

Psychological factors have been found to have an impact on patients' recovery and surgical outcome [99, 100]. Studies concerning the consequences of psychological factors on recovery in day surgery patients are rare [101, 102]. In our study, the patient's emotional state on POD 1 was a predictor of recovery on POD 14. Items included in the emotional state were related to patients' feelings of well-being, control, comfort with the situation, mood and sleep. Factors that might have had an effect on a patient's emotional state could be their not being sufficiently prepared for the self-care at home and/or being worried about the clinical care [13], or if sleep was affected by pain. It is a challenge to provide patient education in the limited time contact nurses have with patients in day surgery [103, 104], and it is important to evaluate the efficiency of when and how to deliver it [105]. Further studies are needed to investigate whether a patient's emotional state is of significance in day surgery as well as to ensure that insufficient patient education does not affect the patient's emotional state.

The model produced in Study II explained postoperative recovery to 33% on POD 14. This result indicates that postoperative recovery after a day surgical procedure is also influenced by factors not included in the S-PSR scale or in the emotional state, physical independence or physical comfort dimensions in the QoR-23. A patient's recovery is perceived and interpreted by past medical history, current symptomatic sensations and information from various sources, guiding the individual through the recovery process [48, 49]. Patients mean different things when they say they are recovered [106], which is not easily captured in a questionnaire [42]. Further research is needed regarding what constitutes postoperative recovery and how to assess it.

Methodological considerations

There are some methodological weaknesses in our studies. Preoperative data regarding emotional state, physical independence and physical comfort were not collected, making comparisons before and after surgery impossible.

There are several ways to assess responsiveness, but some methods need a predefined cut-off regarding the attribute and since no gold standard of postoperative recovery is available, the chosen methods were considered appropriate. Reproducibility is a recommended measurement property when developing and evaluating health status questionnaires [86]. Reproducibility entails repeated measurements in stable individuals, which is complicated in a dynamic process like recovery after day surgery. No test-retests were performed, but should be considered in the future.

The second aim of Study II was to explore predictors associated with postoperative recovery two weeks after surgery using multiple regression analysis. To avoid the risk of missing an important variable, all variables considered important for postoperative recovery at home were put into the equation in a block, all at the same time. Different approaches for variable entry are available; forward, backward or stepwise variable entry adds or removes independent variables on the basis of statistical significance and thus the usefulness of a particular variable is determined by statistical criteria, rather than theory. The major problem with these techniques is that important variables run the risk of being left out of the equation [83].

A number of patients fell out of the studies. This might be due to an age-related factor, as younger patients were more inclined to leave the studies. Perhaps the younger patients had a more rapid recovery process and were back at work, and therefore did not deem it important to complete the study assignment. On the other hand, a contrary explanation could be that patients who were in pain or suffered from some other problem on POD 1 could not manage or did not want to fill out the questionnaire. POD 2 might be a more appropriate day for assessment. Some patients did not fill out the questionnaire on one of the days of assessment, which resulted in their exclusion in the paired analysis.

Clinical implications

The S-PSR scale supports health care professionals in assessing postoperative recovery at home. The S-PSR score indicates the patient's overall well-being, and as a complement it might also bring some focus to certain individual items (i.e. the pain item). The instrument is short and easy to fill out, and is also useful in the current practice of telephone follow-ups. The S-PSR scale could easily be incorporated into the customary call and thereby augment the nurses' follow-up of the patient. Assessment over time and of many patients can identify an average score for a particular procedure. If a patient does not reach this average score for a particular procedure, then he/she could be followed more closely by the nurse or referred elsewhere in the health care organization. The recovery trajectory among orthopaedic day surgery patients differs, which ought to be considered when education programmes are planned. Shoulder patients in particular need to know in advance what to expect regarding the recovery process.

CONCLUSION

The S-PSR scale seems to be a consistent and valid instrument for the assessment of postoperative recovery at home after a day surgical procedure in Sweden. To further strengthen the instrument's validity, continued assessments of items' floor and ceiling effects, a confirmatory factor analysis and an analysis of its reproducibility are recommended.

The recovery process for patients undergoing orthopaedic day surgery differs, and needs to be considered when postoperative care and patient education programmes are developed. Shoulder patients in particular seem to need a tailored preoperative education and a close follow-up.

The model explaining recovery on postoperative day 14 needs to be expanded, as factors not examined in this study presumably contributes to a day surgery patient's experience of recovery. Further research is needed to identify such factors.

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APPENDIX

The items in the original PSR scale and in the S-PSR scale after the translation process and after evaluation of the items' relevance to Swedish day surgery patients.

The original PSR scale *15 items*	**The S-PSR scale** *14 items*
Right now I feel:	Just nu känner jag mig:
1. drowsy vs. alert	1. slö vs. pigg
2. worst possible pain vs. free of pain	2. mycket smärtpåverkad vs. smärtfri
3. very tired vs. full of energy	3. mycket trött vs. full av energi
4. not able to do much activity vs. able to do usual activities	4. inte alls kapabel att göra det som jag brukar göra vs. helt kapabel att göra det som jag brukar göra
5. a need for a daytime nap vs. no need for a daytime nap	5. ha ett stort behov av vila på dagtid vs. inte alls i behov av vila på dagtid
6. it's difficult to move around vs. able to move around like normal	6. inte alls lika rörlig som vanligt vs. precis lika rörlig som vanligt
7. the need to stay at home vs. ready to get out of the house and do something	7. så dålig att jag bara vill vara hemma vs. bra och kan vistas utanför hemmet
8. my bowels are in poor condition vs. no problem with diarrhoea, gas, or constipation	8. ha stora besvär av gaser, diarré eller förstoppning vs. inte alls ha stora besvär av gaser, diarré eller förstoppning
9. unable to do much exercise vs. like doing more exercise	9. helt utan kraft/ork att fysiskt anstränga mig vs. ha kraft/ork att fysiskt anstränga mig
10. a need for help in caring for myself vs. able to handle all my own personal care	10. ha stort behov av hjälp med min personliga hygien vs. inte alls ha behov av hjälp med min personliga hygien
11. worse than I thought I would vs. better than I thought I would	11. sämre än jag trodde att jag skulle göra vs. bättre än jag trodde att jag skulle göra
12. need more recovery time vs. recovered from surgery	12. inte alls återhämtad efter operationen vs. helt återhämtad från operationen
13. very different from my normal self vs. almost back to my normal self	13. inte alls tillbaka till min vanliga livsföring vs. helt tillbaka till min vanliga livsföring
	14. inte alls tillbaka till mitt vanliga själsliga tillstånd vs. helt tillbaka till mitt vanliga själsliga tillstånd
14. it's going to take a long time to get well vs. it's only going to take 1 or 2 more days to get well	-
15. unable to work at all vs. ready to get back to work	-

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