# Going through magnetic resonance imaging - patients' experiences and the value of information and preparation for adults and children

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2010

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# GOING THROUGH MAGNETIC RESONANCE IMAGING

## PATIENTS' EXPERIENCES AND THE VALUE OF INFORMATION AND PREPARATION FOR ADULTS AND CHILDREN

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ISBN 978-91-86671-33-4
Printed in Sweden by
Media-Tryck
Lund 2010


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## CONTENTS

# ABSTRACT

Magnetic resonance imaging (MRI) is becoming an increasingly common form of examination for both adults and children. Although it is non-invasive and considered painless, both adults and children experience anxiety during the examination. The technique is sensitive to motion and for that reason many children are anaesthetised. The aim of this thesis was to improve patient care through exploring adult patients' experiences of undergoing MRI, to examine the value of increased written information for adult patients and to examine whether children receiving age-adjusted preparation and realisation of MRI could go through the examination without deep sedation or anaesthesia. A further aim was to study over a five year period, the commonness of the use of MRI versus CT for children, and the occasions on which the children had deep sedation or anaesthesia.

To examine the patients' lived experience of going through an MRI examination, nineteen patients were interviewed and the interviews were analysed with hermeneutic phenomenological analysis (Paper I). A two group controlled experimental design was used to examine the impact that increased written information in connection with MRI had on patient anxiety and image quality (motion artefacts). The written information that was part of the prevalent routine was given to 118 adult patients (control group) while 124 patients received also increased written information (intervention group). Anxiety was measured and image quality concerning motion artefacts was assessed (Paper II). Data from the radiological information system were scrutinised for all children between 0 and 15 years having had MRI or computer tomography (CT) over a period of five years (Paper III). A two-group controlled experimental design was used to examine whether or not children between the ages of three and nine could go through MRI awake. The usual preparation was given to 36 children (control group) and age-adjusted preparations and the opportunity to watch films during the MRI were given to 33 children (intervention group). Data were collected concerning the examination, motion artefacts, and parent satisfaction, and costs were calculated (Paper IV).

The results showed that the essential feeling experienced when undergoing MRI was that of being in another world with a great variation in degree of perceived threat to one's self-control. This had an impact on the effort it took for the patients to handle the situation and thus on their need for support (Paper I). Increased written information did not decrease patient anxiety but it did significantly decrease the number of patients assessed to have image motion artefacts (Paper II). For children under 16 years of age there was a significant increase in the number of MRI examinations compared to CT over the five year period: however, there was no decrease in the number of CT examinations. Deep sedation or anaesthesia was used on 43% of MRI and 7% of CT occasions (Paper III). Of the 36 children having MRI with the routine procedure, 30 had deep sedation or anaesthesia and six were awake. They all had acceptable examinations. Of the 33 children having age-adjusted preparations 30 had the examination awake with acceptable image quality, two refused the examination and one examination was terminated due to severe image motion artefacts. More children in the intervention group had motion artefacts (although the results were acceptable for diagnostic purposes) than in the control group. Parents were equally or more pleased with the care in the intervention group than in the control group and significantly so concerning communication. The costs were calculated to be lower in the intervention group (Paper IV).

In conclusion the studies show that there are great variations in the experiences of patients undergoing MRI examinations and that care needs to be individualised. Although increased written information decreased the number of patients with image motion artefacts it was not enough to decrease patient anxiety. The number of MRI examinations for children are increasing, and with age-adjusted preparations and routines more children can undergo MRI without deep sedation or anaesthesia.

## ORIGINAL PAPERS

This thesis for the doctoral degree is based on the following papers:

I Törnqvist, E., Månsson, Å., Larsson, E-M. & Hallström, I. (2006). It's like being in another world - patients' lived experience of magnetic resonance imaging. *Journal of Clinical Nursing*, 15, 954-961.

II Törnqvist, E., Månsson, Å., Larsson, E-M. & Hallström, I. (2006). Impact of Extended Written Information on Patient Anxiety and Image Motion Artifacts During Magnetic Resonance Imaging. *Acta Radiologica*, 47, 474-480.

III Törnqvist, E., Månsson, Å., Holtås, S. & Hallström, I. MRI and CT in children – trends during the period 2002 to 2006. Submitted for publication.

IV Törnqvist, E., Månsson, Å. & Hallström, I. Do children going through magnetic resonance imaging need deep sedation or anaesthesia? In manuscript.

Paper I and II have been reprinted with the kind permission of the respective journals.

# INTRODUCTION

Although the method is non-invasive and considered painless, both adults and children experience anxiety during Magnetic Resonance Imaging (MRI) (Katz, Wilson, & Frazer, 1994; McIsaac, Thordarson, Shafran, Rachman, & Poole, 1998; Tyc, Fairclough, Fletcher, Leigh, & Mulhern, 1995). During the MRI examination adult patients use different kinds of coping strategies (Quirk, Letendre, Ciottone, & Lingley, 1989a). However, not all patients can cope with the situation and interrupt the examination prematurely due to panic attacks or claustrophobia (Avrahami, 1990; Eshed, Althoff, Hamm, & Hermann, 2007; Kilborn & Labbe, 1990), and some need sedation or anaesthesia to be able to go through the examination (Malviya et al., 2000; Murphy & Brunberg, 1997). The narrow space and loud clicking noise is above all considered to be the cause of anxiety or prematurely terminated examinations for adults (Quirk et al., 1989a), but for children and their parents the intravenous injection is identified as the most distressing procedural component (Tyc et al., 1995).

MRI is a technique that is sensitive to motion during image data collection which may impair image quality and create so-called motion artefacts (McRobbie, Moore, Graves, & Prince, 2007; Westbrook, Kaut Roth, & Talbot, 2005). Thompson et al. (1994) showed that adults' anxiety may cause increased movement during data collection and thus an increase of motion artefacts. When examining children, deep sedation or general anaesthetics are often used due to the technique's sensibility to motion and the relatively long duration of the examination (30 to 90 minutes) (McRobbie et al., 2007). Computed tomography (CT) is sometimes interchangeable with MRI for diagnostic reasons and as CT is a faster technique children having CT do not need deep sedation or general anaesthetics as often as children having MRI. However, CT involves ionizating radiation and as children are more sensitive to ionizating radiation than adults are (ICRP, 2007), it is especially important not to use CT when children are involved more than necessary (Brenner, Elliston, Hall, & Berdon, 2001; Donnelly et al., 2001; Fricke et al., 2003; Frush et al., 2002; Goo & Suh, 2006; Huda, Chamberlain, Rosenbaum, & Garrisi, 2001; Huda, Lieberman, Chang, & Roskopf, 2004; McLean, Malitz, & Lewis, 2003; Pages, Buls, & Osteaux, 2003; Paterson, Frush, & Donnelly, 2001; Shrimpton & Wall, 2000; Theocharopoulos et al., 2006; Ware, Huda, Mergo, & Litwiller, 1999; Verdun et al., 2008).

Studies have shown that for adults, anxiety can be reduced during MRI examinations through a combination of increased information, patient-staff interaction and/or relaxation strategies (Grey, Price, & Mathews, 2000; Lukins, Davan, & Drummond, 1997; Quirk, Letendre, Ciottone, & Lingley, 1989b; Selim, 2001; Thompson & Coppens, 1994; Youssefzadeh et al., 1997), but also that the quality of supportive care has an impact on the patients' experiences (Nazemi & Dager, 2003). Some studies have shown (Hallowell, Stewart, de Amorim, & Ditchfield, 2008; Harned & Strain, 2001; Pressdee, May, Eastman, & Grier, 1997) that the number of children who needed sedation or anaesthesia could be diminished with the adjusted preparation and/or realization of the examination.

As MRI is becoming increasingly applicable and common for adults as well as for children it is important to study patients' experiences and the adjusted preparation and realization of MRI examinations. If the adjusted preparation and realization of examinations facilitates for patients undergoing an MRI then there will be a gain both for patient comfort and for efficiency in the use of resources.

# BACKGROUND

## Magnetic Resonance Imaging

Since the introduction of MRI in clinical settings in the early 1980s (Shellock, 2002) there has been an extraordinary development (McRobbie et al., 2007; Westbrook et al., 2005). Initially it was only organs without any "movement" (such as the brain and spine) that were suited for MRI examinations, but today, for example, rapid sequences have improved MRI examinations of the thorax and abdomen. Besides the anatomical images, perfusion, diffusion (Parsons et al., 2001) and functional MRI have developed and are now employed in clinical practice (Pineiro, Pendlebury, Johansen-Berg, & Matthews, 2002). Thus, for example it is now possible to separate salvageable ischemic tissue from dead tissue in the brain (Parsons et al., 2001), and to locate different brain activities (Goswami, 2004). Also MRI of vessels throughout the body (Magnetic resonance angiography, MRA) (Chandromohan, Parikh, Akhtar, & Delgado, 2005), the heart (Budoff et al., 2005), and the abdominal organs (Zalis & Singh, 2004) is increasing**.** An increasing accessibility to MRI scanners, and the new fields of examination will lead to referral of a larger number of patients to MRI examinations.

The principle of MRI is that hydrogen nuclei (protons) in the body act as "small magnets" when inserted in a strong magnetic field. When exposed to radiofrequency pulses from a transmitting coil, the protons absorb energy and emit detectable signals. To detect the signals a receiver coil is placed close to the examined organ. To locate the signal spatially in three dimensions, magnet gradients are used. The gradients are small magnetic fields that vary in strength. During image data collection the gradients are switched on and off, which creates a loud hammering noise. The duration of an imaging sequence is about one to nine minutes (Westbrook et al., 2005) and the duration of a total examination of one patient is between 20 and 90 minutes.

To enable a strong magnetic field the scanner is built so that the patients lie inside the scanner in a tunnel, approximately 2 metres long and 60 centimetres wide, with the examined organ in the centre of the tunnel**.** This means that the head and body will be inside the tunnel for most examinations. The average scanner is about 2 metres wide, 2 metres high and 2.5 metres long, although newer scanners may be somewhat smaller (Dewey, Schink, & Dewey, 2007). Some scanners have a more open design so that the patient is not entirely enclosed, but the magnets in these scanners are less powerful with a subsequent decrease in image quality (Carr & Grey, 2002), and they also have a lesser capacity for advanced examinations.

The expenses for a head MRI vary between about SEK 3 011 (without contrast medium) and SEK 4 724 (without and with contrast medium) (Södra Regionvårdnämnden, 2010). Thus, an MRI is costly and if the examination is interrupted or the image quality is impaired it affects not only the patients' experiences (Lukins et al., 1997) and the diagnostic accuracy (Mirowitz, 1999) but it is also a serious waste of resources (McIsaac et al., 1998).

## Image motion artefacts

The quality of magnetic resonance images is dependent on many different factors, and there are several sources of image disturbances (artefacts). All MRI images have artefacts to some degree and it is therefore important to minimise the risk for motion artefacts as much as possible (McRobbie et al., 2007; Westbrook et al., 2005). Image data for several images is collected simultaneously during one sequence, which makes the method sensitive to motion during data collection (Myhr, Nordlid, Ajörnerud, & Lihaug, 2002). Thus movements during image sequences will cause image motion artefacts with impaired image quality as a result. To avoid motion artefacts, efforts are made to minimise the influence of involuntary body movements (for example blood pulsation or heartbeats) and, accordingly, image quality is dependent on the patients being able to lie still during image sequences. Artefacts due to movements are shown on the images as blurring or ghosting (McRobbie et al., 2007; Mirowitz, 1999; Van de Walle, Lemahieu, & Achten, 1997). Blurring of the anatomical structures and the interfaces between them will appear on the images averaging the moving structures. Ghost artefacts are partial copies of the patient's images appearing at a different location (McRobbie et al., 2007). Motion artefacts can be severe and result in a dramatic decrease in image quality (Van de Walle et al., 1997), which can jeopardise the diagnostic accuracy (Mirowitz, 1999).

## Computed tomography

The CT technique has also developed rapidly during the last decade. Previously CT had the disadvantage that it could only create good images in one direction. The development of first the spiral-CT, and later, the multi-slice technique, has made it possible to reconstruct images in every direction (Bushong, 2008). The multi-slice technique has also significantly decreased the duration of the examination, and this shorter duration, combined with the fact that the technique is not as sensitive to motion, probably allows for more children, for instance, to have the examination without deep sedation or anaesthesia.

The principle of CT is that ionizing radiation is used and density differences in the body are measured to create the images. An x-ray tube rotates around the patient and detectors measure the radiation coming through the patient while a computer reconstructs the data to cross-sectional images. The multi-slice technique implies several detector rows and the creation of several cross-sectional images (the most

common number is between 16 and 64) for every circle from the x-ray tube (Bushong, 2008).

The development of the multi-slice technique has also improved the image quality and this has increased the use of CT examinations. Studies have shown that there has been a major increase in CT examinations during the latest decade (Aldrich & Williams, 2005; Aroua, Trueb, Vader, Valley, & Verdun, 2007; Bhargavan & Sunshine, 2005; Hart & Wall, 2004). However, the development of the technique has not generally led to a decrease in the dose of radiation per patient and examination (ICRP, 2001). Hart and Wall (2004) estimated that although only 7% of all the diagnostic radiological procedures were CT examinations, approximately 47% of the collective radiation dose of all medical x-ray examinations was from CT examinations. In general children are more sensitive to ionizing radiation than adults and the risk that children exposed to this radiation in early childhood might develop cancer in their lifetime is estimated to be about three times that of the population as a whole (ICRP, 2007). The brain was long considered to be almost unaffected by ionizing radiation but recent studies suggests that small children are sensitive to ionization radiation to the brain (Hall et al., 2004; Karlsson et al., 1998). Although CT is still preferable in some cases and MRI in others the rapid development has made both techniques acceptable choices for the necessary diagnostic information (Forstner, 2007; Karantanas, Yarmenitis, Papanikolaou, & Gourtsoyiannis, 2007; Korzeniewski, Birbeck, DeLano, Potchen, & Paneth, 2008; Lawrentschuk, Gani, Riordan, Esler, & Bolton, 2005; Rudack, Jorg, Kloska, Stoll, & Thiede, 2007). The expenses for a head CT vary between about SEK 1 420 (without contrast medium) and SEK 2 491 (without and with contrast medium) (Södra Regionvårdnämnden, 2010).

## Anxiety and distress

Anxiety is a normal reaction when people are exposed to loss or to threatening events (Taylor, 1995). It is when the anxiety is disproportional to the event that there is a problem. Different individuals have different thresholds for the arousal of anxiety (Taylor, 1995). Anxiety sensitivity can be described as the fear of anxiety symptoms, and a person's anxiety sensitivity will affect their experiences when exposed to a variety of stressful stimuli (McNally, 1990). Another aspect and definition of anxiety is trait anxiety, which is a person's general anxiety level and has an impact on the situational (state) anxiety (Lazarus, 1991; Spielberger, 1983). Fromm (2006) talked about "having security or being secure". If persons are secure they are not as vulnerable in different situations or relations as if they merely have security. This is comparable to findings of Andersson (1984), who showed that individuals could have more or less inner security or situation-dependent security. People with situation-dependant security are more vulnerable to the situation or to relations with other people and will therefore more easily react with anxiety. Due to the individual's different life situations, this vulnerability changes over time and in life crises, for example, our vulnerability increases (DeMasi, 2004).

For children it is normal to experience different kinds of fear as part of their development (Ollendick, King, & Muris, 2002). Forsner (2006) found that for children between seven and ten years of age anxiety in medical care was personal and that reality and fantasy was mixed and equally important for the child's experiences. Medical care could be experienced as dangerous and threatening like a monster. To be afraid in medical care implied fear of having pain and being hurt but also to be unfairly treated, ignored and forced. Although children's anxiety is influenced by their age (Forsner, 2006; Ollendick et al., 2002) and personality (Forsner, 2006; Kain, Mayes, O'Connor, & Cicchetti, 1996), children of all ages found that the way they were addressed and met by their parents (Forsner, 2006; Kain et al., 1996) and staff (Forsner, 2006) was of vital importance for their experience of anxiety.

Of patients having MRI, studies have shown that 25% to 53% of adults (Blanchard et al., 1997; Katz et al., 1994; McIsaac et al., 1998; Thorpe, Salkovskis, & Dittner, 2008) and 30% of children over eight years (Tyc et al., 1995) experienced moderate to high levels of anxiety during the examination. Conscious sedation is sometimes used to make it possible for highly anxious adults to tolerate MRI examinations, and Murphy and Brunberg (1997) showed that 14.2% of 939 adult patients needed sedation to tolerate MRI. Conscious sedation for children is also frequently used, but fails, however, in between 2 and 40% of cases due to aborted examinations or image motion artefacts (Cengiz, Baysal, & Ganidagli, 2006; Iwata, Okumura, Kato, Itomi, & Kuno, 2006; Keengwe et al., 1999; Malviya et al., 2000; Voepel-Lewis, Malviya, Prochaska, & Tait, 2000). Thus pre-school children are often anaesthetised (Malviya et al., 2000; McRobbie et al., 2007).

Thorpe et al. (2008) found that for adults going through MRI the amount of anxiety was related to the perceived amount of time spent having physical symptoms of panic and that the cognition reported was that of suffocation, harm caused by the scanner and lack of perceived control. Nazemi and Dager (2003) studied factors contributing to MRI-related distress for adults and found that they could be divided into three broad categories: structural-procedural features, individual characteristics and the quality of supportive care provided by health care staff. It is also suggested that patient anxiety arises from the enclosed space, the duration of the examination, the hammering noise, the temperature within the tunnel (Quirk et al., 1989a), pain, and being exposed to something unknown (Katz et al., 1994). Tyc et al. (1995) found that both children over the age of 8 and their parents identified the intravenous injection as the most distressing procedural component in connection with an MRI examination.

## Panic attack and phobias

If an individual is overwhelmed with anxiety a panic attack may occur (DeMasi, 2004). It is estimated that about 10% of a population has experienced occasional panic attacks. Panic attacks are described as a terrible experience where the persons experiencing the attack feel convinced that death is imminent (DeMasi, 2004), that they are going crazy or are losing control (Ottosson, 2010). At one level the person may know that they are not going to die, but at the same time they lose all capacity to

control their anxiety and truly believe that they are going to die. During the attack the body sensations, such as tachycardia, palpitations, body tremors, excessive sweating and most importantly a sense of suffocation (DeMasi, 2004), are often misinterpreted as a sign of danger and the person who experiences an attack feels that the fear is uncontrollable (Merckelbach & Muris, 2001). The panic attack may occur unexpectedly or be related to known anxiety-arousing situations (Ottosson, 2010). Studies have shown that about 40% of adults with panic disorder had an onset before the aga of 20 (Diler, 2003). Even younger children may experience panic attacks but it is rare among younger children and often emerges in adolescence (Diler, 2003; Klein, 2009). Doerfler et al.(2007) showed that panic disorder in children was often combined with separation anxiety and general anxiety disorder.

In a study of more than 4 000 patients over 5 years of age going through MRI, 1.97% suffered from claustrophobia (Eshed et al., 2007) and among adults and children undergoing MRI, 1.5% to 6.5% interrupted the examination prematurely due to panic attacks or claustrophobia (Avrahami, 1990; Eshed et al., 2007; Kilborn & Labbe, 1990). When a panic attack occurred it was often unexpected, and 39 out of 46 adult patients experienced their first panic attack ever during the MRI examination (Avrahami, 1990). Different questionnaires have been used trying to predict anxiety, fear or panic attacks during MRI. McIsaac et al. (1998) found that the use of Claustrophobia Questionnaire (CLQ) predicted subjective anxiety; McGlynn et al. (2003) found self-efficacy ratings to be a functioning predictor of fear responses. However, Harris et al. (2004) did not find CLQ useful as a predictor but found that the "MRI version" of Fear Survey Schedule (MRI-FSS) predicted panic symptoms and the same scale and State-Trait Anxiety Inventory (STAI), measuring state anxiety, predicted high anxiety.

Claustrophobia may be defined as anxiety in situations with confined freedom of movement and can be part of agoraphobia or be an isolated specific phobia (Ottosson, 2010). For adults claustrophobia is one of the most common phobias (Depla, ten Have, van Balkom, & de Graaf, 2008), but this type of situational phobia has a late onset and is thus not so common among children. However, it has been shown, that for example blood-injury-injection phobias have an early onset and are more common among children (Merckelbach & Muris, 2001). As patients often need intravenous injection this kind of fear or phobia may of course negatively affect an MRI examination.

Harris et al. (1999) propose that claustrophobia is comprised of two separate components – confinement and suffocation – and concluded that patients undergoing MRI were affected only by confinement. Studies (Kilborn & Labbe, 1990; Lukins et al., 1997; McIsaac et al., 1998) have shown that the experience of a panic attack during the examination may cause patients to develop phobias in enclosed places, and Lurkins et al. (1997) found a 38% increase in MRI-related fear seven months after the examination was performed. On the other hand, Harris et al. (1999) suggest that successful completions of the examination of anxious patients may decrease their fear of confined places in the future.

Although other phobias may have other stressors, it is known that having a specific phobia increases the likelihood of experiencing panic attacks in other situations (Merckelbach & Muris, 2001). Agoraphobia, which is considered to be a much more disabling condition than claustrophobia, as it involves more situations that are experienced as fearful, is often contemporaneous with claustrophobia (Ottosson, 2010). A definition of agoraphobia is: fear of being in places or situations from which escape might be difficult or help might not be available, and these situations are avoided or endured with obvious distress or the person needs a companion (Overbeek, Vermetten, & Griez, 2001). This situation may very well be experienced during an MRI examination.

## Coping strategies

Coping strategies can be defined as a dynamic process with a series of cognitive and behavioural efforts to manage internal or external stressors (Lazarus, 1991). Lazarus (1991) describes coping strategies that affect the emotional process in two different ways. Problem-focused coping is an action-centred form of coping where effort is made to change the situation. Emotion-focused coping is mainly an act of thinking rather than changing the environment or relation. Denial, avoidance or the changing of one's attitude towards the situation are all forms of emotional coping (Lazarus, 1991). Another way of describing coping is as information seeking (monitoring) or information avoidance (blunting) (Shaw, 1999).

Locus of control is a variable which has shown to have an impact on a person's coping resources. Individuals with a strong internal locus of control believe that their own abilities and efforts will influence their future, whereas an individual with a strong external locus of control believes strongly in powerful others and that fate and destiny shape their future (Mitchell, 1997). There is an implicit assumption that internal locus of control is good, but in some situations a strong belief in powerful others may be an advantage, for example during hospitalisation (Shaw, 1999).

Salmela et al. (2010) examined how children between four and six years of age coped with their fears in medical care. They found that the subjective experiences of coping consisted of pleasure, positive images, security, confidence, care, understanding the meaning of the situation, participating, readjustment, asking for help and protecting oneself. The coping strategies were familiar to them and a part of their everyday lives. Forsner (2006) found that small children were looking for help from adults as a way of handling frightening situations.

Studies (Blount et al., 1992; Cohen, Blount, & Panopoulos, 1997; Jay, Elliott, Ozolins, Olson, & Pruitt, 1985) have shown that children's distress before medical events may be decreased if the children are trained in coping strategies. Cohen et al. (2002) found, however, that when children (3-7 years) were trained in a coping strategy (calm breathing, think of I am cool and calm) prior to the medical event but without the support of adult coachers during the medical event this was not sufficient enough to decrease their distress. Zelikovsky et al. (2000) used age-adjusted information,

demonstration with role-play, coping skills training and distraction for children (3-7 years) going through voiding cysto-urethrogram. They found that both parents and staff rated the children in the intervention group as being more cooperative and having less distressed behaviour than the other children. However, according to the rating of parents and staffs, as well as according to the children's self-report, the distress was not significantly decreased.

Quirk et al. (1989a) found that adult patients going through MRI examinations use imaginative visualisation, blinding, and breathing relaxation techniques as coping strategies. Nazemi & Dager (2003) studied patients with panic disorder undergoing MRI and found that they used emotion-focused strategies (avoidance, wishful thinking, self-reproach, and projection) to a higher degree than patients in a control group. However, in response to an experimental MRI situation the group converged in the using of problem-focused strategies (seeking social support, counting one's blessings, and religiosity). They found that patients with panic disorder were capable of effective coping when they faced a highly stressful, but structured, situation if they experienced relative control over the situation.

## Patient information and preparation

In Sweden patients have the right to be informed about their health condition, treatments and examinations (SFS, 1982:763), as is also the case in other countries (WHO, 1994). There also seems to be an agreement among health care staff that information should be given to patients about medical events (Hoffmann & Worrall, 2004), but there does not seem to be any agreement on how the information should be given or what the information should contain.

### *Adults*

Research on the content of the information given and whether or not patient information reduces distress during threatening medical events was rather intense during the 1970s (Johnson, Leventhal, & Dabbs, 1971; Johnson, Morrissey, & Leventhal, 1973; Leventhal, Brown, Shacham, & Engquist, 1979). Leventhal, Johnson and co-workers argued that information should contain not only information about the procedure (procedural information) but also about sensations (sensory information) and expected time durations (temporal information) of the event in order to decrease distress (Johnson, 1973; Johnson et al., 1973; Leventhal et al., 1979). Procedural information was the preferred written information patients mentioned when asked what kind of information they wanted. However, when the same patients were able to choose between different kinds of information booklets, the booklet containing not only procedural but also sensory and temporal information as well as coping strategies was preferred (Wallace, 1984).

Although procedural, sensory and temporal information has been shown to successfully decrease adult patients' distress or anxiety in several studies (Doering et al., 2000; Johnson, 1973; Leventhal et al., 1979; Wallace, 1986), the results have not been conclusive, and some studies have shown that there has been no reduction in patient

distress (Maguire, Walsh, & Little, 2004; Mikulaninec, 1987). Later reviews of written information are focused on the layout and readability (Hoffmann & Worrall, 2004; Walsh & Shaw, 2000), and emphasise that the information must be easy to read.

The advantage of written information is that patients can read the information whenever they want to and as many times as they want to. The advantage of oral information is that a meeting takes place between the caregiver and the patient, with an opportunity for communication and increased interaction. Research has found that communication is a need that is highly ranked by patients and that nurses do not consider communication as important as patients do (Hallstrom & Elander, 2001a). It has also been shown that the most common complaints from patients about care have to do with poor communication between patients and staff (Morrison & Burnad, 1997). In a Swedish study Hallström et al. (2001b) found that communication was the most prominent need for patients in surgical and medical wards. Communication implies that a dialogue takes place between the patient and caregiver, whereas information may be one-sided. They found patients who actively sought attention and communication, but also patients who did not want to disturb the staff.

Besides written (Wallace, 1984) and verbal information (Leventhal et al., 1979), video film information (Doering et al., 2000) was also shown to decrease patient anxiety. Hjelm-Karlsson (1988) found that patients going through intravenous pyelography preferred at least two different sources of information and showed that patients felt more relaxed and in control of the situation when they received preparatory information through slides/tape as well as written information. It is suggested that behavioural information, or behavioural training, decreases anxiety when used together with preparation information (Lukins et al., 1997; Thompson & Coppens, 1994; Wallace, 1984), although some studies did not show any decrease in subjective anxiety (Johnson, Fuller, Endress, & Rice, 1978; Maguire et al., 2004).

Several explanations as to why preparatory information decreases anxiety have been proposed. One explanation is that preparatory information stimulates moderate fear levels and coping strategies if the information provides accurate expectations of the event. Another is that objective explanations of diffuse body reactions help patients understand that the discomfort is harmless which thus reduces fear. Yet another explanation emphasises that preparatory information enhances the individual's sense of control over the stressor (Leventhal et al., 1979). Lazarus (1991) suggested that perceived control over a threatening stimulus reduces its perceived aversiveness and Johnson et al. (1978) state that they have based their work on the assumption that people acquire a sense of control over a situation when they are given information that allows them to form a cognitive image of the event. Research on the effect of perceived control has, however, shown mixed results with regards to people's emotional reactions (Johnson & Leventhal, 1974).

The patient's personality has an influence on the benefits of preparatory information (Wilson-Barnett, 1984). In a meta-analysis Hathaway (1986) found a tendency suggesting that information should be adjusted to the patient's individual level of fear

or anxiety. Less fearful patients would be likely to benefit from procedural information, whereas more fearful patients would benefit from information which focuses on psychological content. Later studies have examined whether individuals' coping styles influenced the preferred level of preparatory information (locus of control) (Mitchell, 1997) or reduction in anxiety (monitors or blunters) (Davis, Maguire, Haraphongse, & Schamberger, 1994), but no such correlation was found.

Regarding adult patients undergoing MRI, studies have shown that patient anxiety has been decreased when enhanced information has been combined with increased patient-staff interaction and information about relaxation strategies (Grey et al., 2000; MacKenzie, Sims, Owens, & Dixon, 1995; Youssefzadeh et al., 1997). When different interventions are used simultaneously it is difficult to recognise which is the most effective method. Quirk et al. (1989b) compared different interventions such as increased information (video and oral), descriptions of relaxation strategy, and training of relaxation strategies. The findings indicate that patient preparation should include more than the provision of information if it is to reduce patients' anxiety. Information and help with guided imagery (Thompson & Coppens, 1994) and relaxation strategy training (Lukins et al., 1997) have been found to reduce patient anxiety. In a few cases hypnosis was proven successful for claustrophobic patients (Friday & Kubal, 1990; Simon, 1999).

It has been proven that the supportive care of patients has an impact on their experiences during MRI (Nazemi & Dager, 2003). Out of 500 adult patients undergoing MRI, 301 found part of their visit to the MRI department pleasant, mostly due to patient-staff interaction (MacKenzie et al., 1995).

### *Children*

In the Nordic countries standards concerning health care for children and adolescents have been in use since the late 1980s (NOBAB, 2003), also emphasised by the European Association for Children in Hospital (EACH) (Brandazzi, 2008)**.** The standards are based on the UN "Convention on the Rights of the Child" (UNICEF, 1989) and emphasise for instance, that the child has the right to have parents (or other persons) close by during the entire hospital stay. Children and parents are entitled to information about the child's disease as well as treatment and care in a way they can understand and that is adjusted to the age of the child. The child and the parents should also be able to participate in decisions regarding treatment and care of the child and all children shall be protected against unnecessary treatments and examinations (NOBAB, 2003). The value of the parents' presence during medical procedures has shown mixed results in international studies (Cameron, Bond, & Pointer, 1996; Palermo, Tripi, & Burgess, 2000; Piira, Sugiura, Champion, Donnelly, & Cole, 2005), and it is not always "taken for granted", as it is in Sweden, that, for instance, the parents shall be present during anaesthetisation until the child is asleep. However, Runeson (2002) and Björk (2006) found that children have a need to have their parents nearby in situations experienced as threatening by the child. Paediatric health care in Sweden strives towards a family-focused-care which besides the children's needs also emphasises the needs of the whole family (Shields, Pratt, & Hunter, 2006). Studies (Hallstrom &

Elander, 2007; Hallstrom, Runesson, & Elander, 2002) have shown that parents too, have a need to be near their child and participate to different extent in the care of the child.

The age of the child naturally has an impact on his/her needs while in hospital and while being prepared for examinations or treatment. The assumption that children of about three to four years of age are going through an important period of changes is concluded by several theoreticians (Havnesköld & Risholm-Motander, 2009). Havnesköld et al. (2009) sum up the different theoreticians' views and suggest that there are common features such as that the children can now think about themselves and the world in terms of narratives. Children at this age are also no longer bound to their own experiences but may imagine situations they have not experienced themselves. For pre-school children play is considered to be essential by many theoreticians and thinking is at a very concrete level (Havnesköld & Risholm-Motander, 2009). Pramling (1983) found when studying pre-school children's ways of learning and understanding that they learned by doing and that to learn a skill means to be practically involved in doing it.

For children, the information in connection with examinations or treatments is often combined with another form of preparation. Studies have shown that when children received structured written and verbal information together with demonstrations and/or play, they needed sedation to a lesser degree when going through intravenous pyelography (Edwinson & Lindahl, 1986) and were calmer in connection with acute appendectomy (Edwinson, Arnbjornsson, & Ekman, 1988). Kain et al. (2001) decreased children's anxiety prior to anaesthesia by decreasing sensory stimuli such as background music and only having a single-care provider.

Distraction as a way of reducing distress for children during medical events has shown mixed results (Cassidy et al., 2002; Cavender, Goff, Hollon, & Guzzetta, 2004; Dahlquist, Pendley, Landthrip, Jones, & Steuber, 2002; Tak & van Bon, 2006). However, in a Cochrane review it was concluded that distraction, combined with cognitive-behavioural interventions and hypnosis was the most efficient way of reducing distress and pain for children in needle-related procedures (Uman, Chambers, McGrath, & Kisely, 2008). In a recent study Willis and Barry (2010) concluded that 92% of children between two and six years of age could go through at least some of the radiation therapy sessions without general anaesthesia with the use of an audiovisual system where the child could watch a movie or their parents.

For children going through MRI it is shown that the number of children who need sedation or anaesthesia can be diminished with adjusted preparation and/or realization of the examination (Hallowell et al., 2008; Harned & Strain, 2001; Pressdee et al., 1997). In the study by Pressdee et al. (1997) the children were referred to a play specialist prior to the examination. They had age appropriate verbal information and they used photos and an MRI model to demonstrate how it looks and sounds to undergo an examination. There were 169 children between 4 and 8 years of age in the study and only one of them needed a new MRI examination under general anaesthesia

at a later stage. Also Hallowell et al. (2008) referred 291 children, between 4 and 17 years of age, to a play specialist. The children viewed or read a photographic story book. They were lying in a mock MRI machine, listening to the sound and watching a DVD film (just like during an examination). If they could lie still for 5 minutes during practice, they were referred to MRI without general anaesthesia. Of the 291 children 227 could continue without general anaesthesia and for 218 the examination was considered to be diagnostically acceptable. Harned et al. (2001) showed a significant increase of children who managed to go through an MRI examination without general anaesthesia, when the children used an MRI compatible audio/visual system.

## Nursing care

So, studies indicate that members of the staff play an important role for many patients (Forsner, 2006; Hallstrom & Elander, 2001b; MacKenzie et al., 1995; Morrison & Burnad, 1997; Salmela et al., 2010), and that information and preparation may decrease anxiety (Blount et al., 1992; Cohen et al., 1997; Doering et al., 2000; Edwinson et al., 1988; Jay et al., 1985; Johnson, 1973; Leventhal et al., 1979; Uman et al., 2008; Wallace, 1986) for both adults and children in medical care. In Sweden it is the radiographer (or X-ray nurse as it is called in Sweden) who is responsible for patient care as well as for carrying through the examinations (including the rigorous security concerning metal objects or metal implants due to the strong magnetic field). Thus, the Swedish radiographer has to know how to take X-ray or MRI images of good quality as well as how to take care of the patient. The stipulations for radiographers' education (HFS, 1998:1003; Cap.6, Sup.2) emphasise the need not only for technical skills, but also for a holistic outlook on people as well as the ability to care for patients and their nearest. The Swedish Health and Medical Services Act prescribes, for example, that the care of patients shall be of good quality, give patients security and trust, be effected with respect for patients' integrity and be adjusted to suit each patient (SFS, 1982:763).

In Sweden few studies have focused on patient experiences or care in radiological examinations. More research concerning radiological patient care is therefore desirable. To establish effective routines in patient care, studies concerning both children and adults undergoing MRI are required, and patients have to be consulted so that the care can be adjusted to their needs (Hallstrom & Elander, 2001b). It is therefore desirable to examine patient's experiences and whether or not increased patient preparation may help children go through MRI without anaesthesia or deep sedation, and also decrease patient anxiety among adults, with improved image quality as a result.

# AIMS

The overall aim of this thesis was to improve patient care through exploring patient's experiences of going through MRI examinations and to examine the value of increased examination preparation for adults and children.

The specific aims were to:

- illuminate adult patients' lived experience during MRI examinations (Paper I).
- evaluate whether increased written information to adult patients prior to MRI examinations decreased their anxiety and image motion artefacts (Paper II).
- assess the choice of examination, MRI versus CT, performed in children over a period of 5 years and to examine the cases of children in both groups who had general anaesthesia or deep sedation (Paper III).
- examine whether children of three to nine years of age can go through MRI without deep sedation or anaesthesia if they receive age-adjusted routines (Paper IV).

# METHOD

## Design

In this thesis an inductive descriptive design including qualitative interviews (Paper I), deductive experimental designs (Paper II and IV) and a historical survey (Paper III) were used. An overview of the thesis can be seen in Table 1.

**Table 1.** Overview of the thesis

| Study | Sample | Methodology/Instrument | Paper |
|---|---|---|---|
| 1 | 19 adult patients | Conversational interviews<br>Hermeneutic phenomenological analysis | I |
| 2 | Control group: 118 adult patients<br>Intervention group: 124 adult patients | Questionnaires<br>Motion artefact assessment<br>Statistical analysis | II |
| 3 | All children (8119) 0 - 15 years having MRI or CT from 2002 to 2006 | Register data<br>Statistical analysis | III |
| 4 | Control group: 36 children<br>Intervention group: 33 children | Questionnaires<br>Motion artefact assessment<br>Statistical analysis | IV |

A hermeneutic phenomenological approach, inspired by van Manen (1997), was used to explore patients' lived experience during MRI examinations. Phenomenology is the

study of a phenomenon and aims to describe the way things appear to us in experience or consciousness. Phenomenology originated in the early 1900s when Husserl described phenomenology as the study of our life-world; the life-world is the world of pre-theoretical experience which is also that which allows us to interact with nature and to develop our own cultural forms. Husserl emphasised the importance of, and possibilities for, pure description of lived experience, while Heidegger focused on persons in a context, thus including interpretation as an important ingredient in the analysis (Moran, 2008). Hermeneutics may be described as the theory of interpretation (Moran, 2008) and in hermeneutic phenomenology the hermeneutic circle constantly re-evaluates and re-interprets data in order for the whole to be understood from the parts and the parts from the whole (van Manen, 1997). Hermeneutic phenomenology tries to be attentive to both terms of its methodology (Merleau-Ponty, 2002; van Manen, 1997). The characteristic of hermeneutic phenomenological research is that it always begins in the life-world and describes the experiences before being reflected upon rather than how the experiences are conceptualised. The aim is then to acquire a deep understanding of the phenomenon by reflecting on the essence, the variations and structures of meaning of the phenomenon. There is no "recipe" for how to conduct a hermeneutic phenomenological study, but there is a philosophic framework with a starting point in the life-world: as things appear to us in experience or consciousness (Merleau-Ponty, 2002; van Manen, 1997) (Paper I).

To examine whether increased written information had an impact on adult patient anxiety and image motion artefacts (Paper II), and to examine adjusted preparations and routines for children undergoing MRI examinations (Paper IV) as well as to explore trends for children undergoing MRI or CT (Paper III), quantitative methods were used. In paper II and IV, a two-group controlled experimental design was used, with patients assigned to control, and to intervention groups. In paper III a retrospective design was used to survey trends for usage of MRI and CT in children.

## The context of the studies

All studies took part at a referral university hospital in the Southern Swedish Health Care Region (pop. 1.5 million). Both adults and children are admitted to the hospital for routine care as well as for specialist care and examinations.

The radiological department had, at the beginning of the studies, three MRI scanners (Siemens Magnetom Vision, 1.5T; Siemens Magnetom Expert, 1T; Siemens 3T Allegra) and two CT scanners. During the time of the four studies most of these scanners were exchanged for newer models, and one additional MRI and one additional CT scanner was installed. Thus, at the end of the study the MRI scanners comprised three whole body scanners (Philips Intera 3T, two Philips Intera 1.5T Nova) and one head scanner (Siemens 3T Allegra) and the three CT scanners all operated on the multi-slice technique (Philips MX 8000 16 slice, two Philips Brilliance 64 slice). In study 1 and 2, two MRI scanners (Siemens Magnetom Vision, 1.5T and Siemens Magnetom Expert, 1T) were used as well as in study 4 (Philips Intera 1.5T, Philips Intera 3T). In study 3 all MRI and CT scanners at the radiological department were

included. In February 2002 the hospital introduced a new radiological information system (RIS) which facilitated the data collection in the survey study (Paper III).

The Children's Hospital in Lund offers several specialities including institutional and non-institutional care as well as day care units. Staff at one of the paediatric day care units takes care of the children before and after the examinations when the children have general anaesthesia or deep sedation during the examination or when the child needs a peripheral venous catheter for contrast medium. In study 4 three nurses and one nurse assistant were involved in the care at the day care unit and about eight radiographers/radiological nurses, all well trained and with a longstanding experience of MRI examinations, were involved in performing the MRI examinations.

## Sample

To study patients' lived experience of going through MRI examinations a sample of 19 adult patients who had undergone MRI were interviewed. The inclusion criteria were that the patients should be over 18 years, could speak and understand Swedish, were outpatients and were placed in the scanner with their heads inside the tunnel. The patients were selected to give a wide range of experiences (e.g. age, gender, level of anxiety). The interviewer was present in the department (in private clothes) to make the strategic selection, and met the patients in the reception area thus being able to see them and hear their potential expression of worry. During a period of one and a half months, three patients who did not complete the examination, six patients who showed worries but completed the examination, and ten patients who did not show any worries prior to the examination were interviewed. The age of the patients ranged from 22 to 73 years; 12 patients were women and seven were men (Paper I).

In study 2 calculation of necessary sample size showed that two equal-sized samples of 98 participants each would have a power of 80% to detect a mean difference in STAI-S of 3 units as significant with a *P*-value <0.05. A control group of 118 consecutive patients during four months and an intervention group of 124 consecutive patients during the following four months participated. The inclusion criteria were that the patients had a head and/or spine MRI, were outpatients, over 18 years old and were able to complete the questionnaires on their own. The patients in the control group received basic written information and the patients in the intervention group received increased written information including procedural, sensory and temporal information besides routine written information. (An overview of the recruitment of patients is shown in Paper II.)

In order to survey the trend regarding children undergoing MRI and CT examinations, all children (0 to 16 years of age) who had been through these examinations at the hospital, from February 2002 to February 2007, were included (Paper III).

In study 4, calculation of necessary sample size showed that 30 plus 30 children give a power of 0.80 to prove a difference between the control and intervention group of 30% unit with a significance of *P*-value <0.05. A control group of 36 consecutive children

during 13 months and an intervention group of 33 consecutive children during the following 14 months participated in the study. The intervention group included children having MRI for diagnostic reasons (n=17) and children, born full term and preterm, being assessed for development of the brain (n=16). The inclusion criteria were that the children were between three and nine years old, were scheduled for an elective MRI examination of head or head and spine, had no obvious mental retardation and their families could speak and understand Swedish. The children studied in the control group went through MRI examinations according to the usual routine, thus most children had deep sedation or anaesthesia. The children in the intervention group had age adjusted preparation and realisation of the examination and were scheduled to undergo the examination awake. (An overview of the recruitment of patients is shown in Paper IV.)

## Routine care and intervention design

### *Adults*

The *routine care* entailed that patients were given their appointment date approximately two weeks in advance by mail, accompanied by basic written information about the MRI examination. This information dealt with the tunnel with light inside it and the loud, repetitive clicking noise. It also informed patients that the staff can observe them throughout the examination, that the examination is painless and that patients can listen to music during the examination. In the same letter they were asked to complete a questionnaire about metal implants, pregnancy etc. On arrival at the MRI department the patients handed in the completed questionnaire, removed all metal objects, were asked if they wanted to listen to music, and were given the opportunity to ask questions. The radiographer responsible for the examination gave the patients brief oral information before starting the examination. There were no written guidelines for how the oral information was to be given nor for the use of intercom, thus this was dependent upon the individual radiographer. Every patient received a buzzer to use if he/she wanted to get in contact with the staff during the examination. A mirror, which enables the patients to look out of the tunnel, was available only if asked for (Paper II).

The *intervention* design consisted of increased written information which was based on the patients' expressed wishes for information in the narratives from the interviews (Paper I), and a literature survey of research on patient information. The increased written information, including procedural, sensory and temporal information (Hjelm-Karlsson, 1988; Johnson & Leventhal, 1974) was mailed together with the appointment date and basic written information. The information sheet (two full pages) had the title "Do you want to know more about MRI examination?" and included: 1) patient procedure (e.g. register at the reception, choose music, lock in personal belongings, lie on a movable bed and be inserted into the scanner, receive ear plugs and buzzer, lie still during examination, especially when image data is collected/when there is a clicking noise), 2) examination procedure (e.g. short overview of imaging sequences, longer sequences dependent on examination, the clicking noise, sometimes contrast medium is used), 3) brief explanation of possible inconvenience during the

examination (e.g. loud noise, narrow tunnel, coil close to examined area, prohibition of metal objects in the room), 4) possible means to decrease the discomfort (e.g. buzzer, music, intercom interaction with the staff, the possibility to bring someone into the room, the use of a mirror), 5) possible experiences when undergoing an MRI (e.g. inconvenience of narrow space, loud noise and vibrations), 6) general duration times (approximate examination duration, duration of short overview images, usual duration of sequences, and also when the participants could expect the answer from the examination to be sent to their doctor) (Paper II) (Appendix I).

### *Children*

The *routine care* for children in the age group between 3 and 9 years old implies that most children are scheduled for MRI examinations with deep sedation or anaesthesia. The parents receive the appointment date together with brief information about the examination (for adults) and a booklet for children about preparation for anaesthesia which should be read by parents and child together. The child is given an appointment for the paediatric day care unit 2 hours prior to the MRI examination. Every child receives Emla$^{R}$ (a local anaesthetic to facilitate insertion of peripheral venues catheter) and is examined by a paediatrician. When called for, the child (with one or two parents) is transported to the MRI department in a bed and the parent/s stay with the child until he/she is fully asleep. Anaesthetic staff members (physician, nurse and nurse assistant) meet and take care of the child during the whole examination whilst the radiological staff performs the examination. Anaesthesia is usually accomplished with Propofol$^{R}$. After examination the child is transferred to the recovery ward for children by the anaesthetic staff and the parent/s are sent for. After a recovery period of about one hour, the child goes back to the day care unit for another couple of hours before the family can go home. Children going through MRI without anaesthesia had the same brief written information as adults, were given the possibility of listening to music, and were offered to come and visit the MRI unit prior to the examination (Paper IV).

The *intervention design* included extra preparation in three ways. Firstly, a booklet and a story book were sent to the family by mail which should be read by the parents and the child together. The booklet described the course of events at the hospital including the MRI examination on an age relevant level. The story book with text and painted pictures in 20 pages, described a girl who is scheduled for an MRI of her head, how she practises lying still, and how she experiences the examination as a fairy tale. Secondly, a model of an MRI scanner made in “doll size” with a doll, a head coil, a movable examining table and an MP3 player with the MRI sound recorded. The child was offered to test an MRI examination for the doll when arriving to the day care unit. Thirdly, the child was offered to look at DVD films during the examination with a special mirror placed at the coil (head examinations) or through mirror glasses (spine examinations). The sound of the film was transferred through the headphones. Also, all children were offered the opportunity to visit the department prior to the examination (Paper IV) (Appendix II).

## Instruments

### *Interview*

To illuminate patients' lived experience of going through MRI, conversational interviews inspired by van Manen (1997) were used. In hermeneutic phenomenology the interview serves the purpose of exploring and gathering experimental narrative material that may serve as a resource for developing a rich and deep understanding of a phenomenon. Before starting the interview process the interviewer made explicit her pre-understanding of the phenomenon so as to minimise bias. The conversational interviews were unstructured but in order to grasp a full and deep understanding the interviewer tried to capture the persons lived relations, lived time, lived body, and lived space (van Manen, 1997) in relation to the experience of going through MRI. All interviews started with the question "Can you tell me spontaneously about your experiences during your MRI examination?" The patients' narrative directed the interviews thereafter. To deepen the understanding of the phenomenon, the interviewer, through actively listening to the patients, encouraged them to clarify their experiences by asking them questions like: "What do you mean?", "How did you feel?" or "What did you think?" (Paper I).

### *Questionnaires*

*Anxiety*

The STAI (State-Trait Anxiety Inventory) is a psychometric self-report test and a measure of anxiety "right now" (state anxiety, STAI-S) or general anxiety (trait anxiety, STAI-T). Both STAI-S and STAI-T contain 20 statements, each with four reply alternatives. The formulations of the statements are of both positive and negative value. Examples of statements from the STAI-S are: "I feel calm" and "I feel upset". The response alternatives to these statements are: Not at all, Somewhat, Moderately so, and Very much so. Examples of statements from STAI-T are: "I feel satisfied with myself" and "I feel nervous and restless". The possible answers to these statements are: Almost never, Sometimes, Often, and Almost always. The answers are weighted from one to four. Accordingly the lowest score is 20, indicating "a calm person", and the highest score is 80, indicating a very anxious person (Spielberger, 1983). There is no formal cut-off limit for STAI, but 40 and above is most often considered to indicate a high level of anxiety (Kvaal, 2005). STAI used to measure anxiety is validated and considered reliable (Spielberger, 1983) and has frequently been used to measure the anxiety of patients undergoing MRI examinations in other studies (Dantendorfer et al., 1997; Grey et al., 2000; Kilborn & Labbe, 1990; Lukins et al., 1997; MacKenzie et al., 1995; Quirk et al., 1989a; Selim, 2001; Thompson & Coppens, 1994) (Paper II).

*Patients' satisfaction*

To measure patients' satisfaction with the information, a questionnaire was made for study 2. The questionnaire contained five questions with two alternative responses (yes and no). The questionnaire was constructed and approved by the four authors of paper II and was tested for content and understanding on persons with knowledge of MRI examinations. The questionnaire was thereafter tested for face validity on 20 patients and was found to be easy to understand and fill in. The questions were: Have you

undergone an MRI examination previously? Are you satisfied with the written information? Are you satisfied with the oral information? Would you have appreciated more information prior to the examination? Did you phone the MRI department to receive additional information before your MRI? (Paper II).

*Parent's satisfaction*
To measure the degree of parent satisfaction with regard to the care, for example such as information, communication, emotional needs, technical skills, inclusion of family and general satisfaction, an adjusted version of the questionnaire "Healthcare Satisfaction Module specific for Hematology/Oncology" (Varni, Quiggens, & Ayala, 2000) was used. The original version including 25 questions was first translated into Swedish by a native Swedish speaking nurse with a good knowledge of English and thereafter back-translated by a native speaking Englishman to English. The two English versions were compared and assessed by the translators and a professor in nursing care and it was found that although some words were changed the meaning of the questions were the same. After permission from the creator of Healthcare Satisfaction Module specific for Hematology/Oncology" (Varni et al., 2000) the questionnaire was adjusted in order to evaluate a situation including examinations instead of only general care. Five questions were drawn from the original version (for example a question about the parents' satisfaction with the help they had received when the child went back to school), and 8 questions were adjusted to suit the situation of the examination (the words diagnosis, disease and treatment were changed to examination), for example the question "How satisfied are you with how much information was provided to you about your child's diagnosis" was changed to "How satisfied are you with how much information was provided to you about your child's examination". The translated and modified version with 20 questions was first tested for face validity by professionals in health care education and, later, on eight parents to children with brain tumours admitted to the paediatric day care unit. The questionnaire was considered easy to understand and to complete. The questionnaire uses a Likert scale including five alternatives, 1-5 points. The points were transferred to a scale from 0-100 (0/25/50/75/100) where 0 is "very dissatisfied" and 100 is "very satisfied" (Paper IV).

## *Protocols*
The radiological information system (RIS) was used to survey the trend for children having MRI or CT examinations (Paper III) and to obtain background information about the patients in the intervention studies (Paper II and IV). For the *survey study* (Paper III) the protocol contained information about: all MRI/CT examinations, examination dates, patients' age on the examination date, number of examinations and whether the examination was carried out under general anaesthesia or deep sedation.

The protocols for *background information* included: age, sex, examination time, whether the examination was successfully completed, whether contrast medium or sedation/anaesthesia were used, which organ was examined and the diagnosis (Paper II and IV). In study 2 patients' diagnoses were graded in three groups: *normal* for those with no pathology, *non-severe* for those with a non-life-threatening disease, for

instance disc herniation or benign tumours, and *severe* for those diagnosed with a life-threatening or disabling disease, for example malignant tumours or multiple sclerosis (Paper II). In study 4 times were also measured for both the duration of the anaesthesia, as well as for the time spent at the recovery ward and at a day care ward before and after the examinations (Paper IV).

A specific protocol was made for assessment of *image motion artefacts.* The protocol included a description of the degree of motion artefacts (none, mild, moderate or severe) and with regard to the number of sequences with acceptable image quality for diagnostic purposes (100, 75, 50 or 25% with acceptable image quality) (Paper II and IV).

## Data collection

Patients were invited to participate in the interview study after the examination was completed. The patients were offered the choice of time and place for the interview, and they all chose to be interviewed directly after the MRI in the hospital. The interviews were all tape-recorded and transcribed literally. The interviews lasted between 30 and 90 minutes (Paper I).

In study 2 four questionnaires were completed by the patients in the control and intervention groups. To measure patient anxiety in relation to the MRI examination, STAI-S (measuring state anxiety) was used. The patients completed one STAI-S questionnaire before the MRI and one after. When answering the STAI-S after the examination the patients were instructed to estimate how they felt during the MRI. Directly after the examination the patients also completed the questionnaire about information satisfaction and the questionnaire about their general (or trait) anxiety (STAI-T). Background information was obtained from the radiological information system after the reports had been performed (Paper II).

The diseases for the 242 patients in study 2 were graded as normal (15%), not severe (70%) or severe (15%). Patients in the intervention group were significantly more often graded as non-severe or severe compared with the control group. The mean age in the control group was 50.7 and in the intervention group 49.4. In the control group 48% were women and in the intervention group 60%. Significant differences were seen between the groups regarding examination duration (28.5 and 24 min. respectively), head examinations (39% and 25%), and contrast medium injections (39% and 26%). In total, 95% of the questionnaires in the control group and 98% in the intervention group were successfully completed (Paper II).

In study 4 the protocols were completed in connection with the examination in the control and intervention group. The parents were asked to answer the questionnaire when the child and parent/s returned to the day care unit if the child was anaesthetised or deep sedated, or directly after the examination if the child was awake during the MRI (Paper IV).

All of the 36 children and parents in the control group who were asked to participate accepted. In the intervention group sample A, 17 of the 26 children and parents who were asked accepted participation, and in sample B all 16 children and parents scheduled for the MRI accepted to participate. Children in the intervention group had about a 5 minute longer examination ($P$=0.003) and children in the control group had about a 3 hour longer hospital stay ($P$<0.001). There were no significant differences in gender ($P$=0.933) and age ($P$=0.054). Mean age in the control group was 6.40 and in the intervention group 7.16. The most common kind of examination in the control and intervention group sample A was that of head examinations without and with contrast medium (25 of 36 and 11 of 17 respectively) and all the MRI examinations in sample B were head examinations without contrast medium (Paper IV).

Image motion artefacts were assessed by the neuroradiologist on duty while reporting on the MRI examination (Paper II), or by the radiographer and neuroradiologist (Paper IV). The assessments were registered on the protocol. MRI examinations assessed to contain motion artefacts were scrutinised a second time by an expert neuroradiologist (Paper II).

All data for the survey study were collected from the radiological information system on one occasion (Paper III).

# ANALYSIS

## Hermeneutic phenomenology

The aim of the hermeneutic phenomenological analysis was to capture the meaning and variations in patients' lived experience (van Manen, 1997) during MRI examinations. The analysis process entailed multiple readings of the text. Reflections on each interview as a whole were made for a holistic approach and summaries of each interview were made for later comparison. After this a line-by-line approach was used and each line in the transcript was examined to answer the question "What does this line say about the person's experience?" Structures of experiences that described the patients' lived experience were identified. When structures of experiences emerged from the text the writing process started as a part of the analysis. During the analysis process the holistic and line-by-line approaches were integrated and the focus was constantly on the phenomenon of the patients' lived experience of going through MRI (Paper I).

Three researchers were involved throughout the analysis process and a fourth researcher, with experience of MRI, joined in the later part of the analysis process to give further dependability to the findings. After discussions and repeated rewritings, consensus was reached among the researchers (Paper I).

## Statistical analysis

In the statistical analysis the software SPSS™ was used. In paper II, III and IV, for nominal data a chi-square test or Fisher's exact test was used. In paper II Student's t-test was used when data had normal distribution and Mann-Whitney's U-test when not. However, STAI values describing anxiety during the examination do not have normal distribution but are presented with mean values to facilitate comparison with other studies. Wilcoxon's matched-pairs signed-ranks test was used for comparison of pre-MRI anxiety and anxiety during the examination. In paper III Pearson's Chi-Square test for trend was used for changes of numbers of examinations over the five years and Pearson's Chi-Square test was used for evaluation between groups. To evaluate the number of children who were deep sedated or anaesthetised the number of occasions was noted. If, for instance, a child had a head and spine examination at the same session it is counted as 2 *examinations* but one *occasion*. In Paper IV Mann-Whitney U-test was used for comparison between the groups. *P*-values <0.05 were considered statistically significant.

# ETHICAL CONSIDERATIONS

Ethical approval and permission to undertake the studies was given by the Ethics Committee at Lund University, Sweden (LU: 535-02) and Regional Ethical Review Board, Lund University, Sweden (606/2006). There are ethical gains and costs for participants in research studies. Effort was made to decrease the losses for the involved parties and some of the included patients and parents spontaneously expressed positive feelings about being a part of the studies. A potential ethical cost in study 1 was the risk of unpleasant memories being aroused during the interview. Being conscious about this risk the interviewer made sure that there was enough time for the patients to express their feelings during the interview and tried to make sure that patients did not leave the interview without being able to talk through their experience. All patients received an information sheet including a telephone number to the interviewer for later contact if needed. The patients were asked whether a tape recorder could be used and were informed that the interviews would be transcribed verbatim (Paper I). A potential ethical cost for the children prepared to do the MRI awake, in study 4, was the risk that they might have to repeat the examination again with anaesthesia if they were not able to complete the MRI without deep sedation or anaesthesia. This was balanced with the benefits that might be implied should the children be able to have their examination without deep sedation or anaesthesia. Parents were used as proxies as the children were judged not to have the legal right to make decisions about participation in the study (Paper IV) (Beauchamp & Childress, 2008). Future patients will benefit if the research helps to improve the care of patients undergoing MRI. Important ethical issues were found to be those concerning informed consent and confidentiality.

## Informed consent

Informed consent is an ongoing agreement by participants in research studies after risks, benefits and alternatives have been adequately explained to them (Beauchamp & Childress, 2008; Royal College of Nursing, 2005). With respect for the patients' autonomy, informed consent was obtained from all adult patients (Paper I and II) and all parents to the included children (Paper IV). All patients and parents were given oral and written information about the study and were informed that participation was voluntary and that they could interrupt their participation whenever they wished, and that this would not affect their or their child's care and treatment.

The patients in study 1 were asked to participate in the study and received the information (written and oral) directly after their MRI examination. They had the opportunity to choose the time and place for the interview and were given time to reflect on their participation. Both the patients and the interviewer signed a form of informed consent before the interview started (Paper I).

Written information was sent to the patients in study 2 together with the appointment letter approximately two weeks prior to the MRI examination, which gave the patients time to reflect on their participation (Paper II).

With regard to children, special considerations have to be made. When children are to be involved in research studies at least one parent (or other care giver) should give informed consent as well as the child if he/she has the possibility of understanding. In study 4 in the intervention group both parents signed a consent form whenever this was possible. As informed consent implies that the information should be understood, the information to the child was age-adjusted (Beauchamp & Childress, 2008; Hallström & Lindberg, 2009). Information, together with the booklet and story book, was sent home to the families with information about the study of children having MRI examinations without deep sedation or anaesthesia. One information sheet was intended for the parents and one for the child. The information was sent so that the parents and child could think about the participation for at least a few days. If the parents decided that the child should be included in the study an appointment without anaesthesia was scheduled. They were also told that if the child could not complete the examination, or the image quality was not good enough, they would have a new examination scheduled with anaesthesia. As the parents took the decision to give informed consent at home the children were not asked for assent. However, the MRI examination could not be carried out without the child's collaboration (Paper IV).

## Confidentiality

Patients in all studies were guaranteed confidentiality. No names of patients were included on the tapes and transcribed interviews in study 1, thus no connection to any person could be made. In quotations when names are mentioned the names are altered so that no connection can be made to specific persons (Paper I). Questionnaires and protocols in study 2 were coded as soon as they were all linked together. In study 4 no

papers contained the children's names thus codes were used throughout the whole data collection. To make sure that the patients (Paper II) and parents (Paper IV) should not be concerned about members of staff reading their answers on the questionnaires only code numbers were presented on the questionnaire and a box to put the questionnaires into was used, or a sealable envelope was handed to them. All material was kept safe and separate from the code lists. The code lists were only reachable for the researchers. In study 3 all data were collected from the radiological information system. The data were kept safe, analysed and described in a way making it impossible to identify or link specific information to individual patients.

# FINDINGS

## Feelings of being in another world

The essential theme of going through an MRI examination was identified from the patients' lived experience as a *feeling of being in another world*. The strange environment with the enclosed space and hammering noise made the experience unusual and something outside of the normal frame of references of the patients. Associations were often made to other enclosed spaces such as coffins or wooden sofas with lids. The unusual situation with the enclosed space and irregular hammering noise led to the patients experiencing difficulties keeping track of time. The situation inside the scanner made the patients feel isolated, lonely, far away, and dependent on others, which generated a feeling of being in another world.

The feeling of being in another world had an impact on the patients' experience. Three structures of experiences related to the lived experience of patients undergoing MRI, were identified: *threat to self-control*, *efforts to handle the situation* and *a need for support.* Patients' described feelings of threat varied from no threat at all to a feeling of panic, and this had an influence on the effort it took to handle the situation, and the need for support. The more threat to self-control patients experienced, the more need for useful strategies and support was experienced.

Patients who described *no or little threat* to self-control could easily handle the situation and relax. Patients who felt no threat at all acknowledged the unusual character of the situation but it did not influence their self-control during the examination. They did not have the urge to "flee from the situation" (in their minds) but could look around and think about what was going on. Patients who felt some threat could easily relax by thinking about something else. The need for support described by these patients was that they needed basic information about the procedure, and the means to get in touch with the staff if they wanted to. Interaction with the staff during the examination was appreciated but not necessary.

Patients who experienced *more threat* to self-control had to work harder to be able to relax and be "somewhere else in their minds". They closed their eyes, thought about their breathing, about later rewards, and/or motivated themselves, and if they had difficulties relaxing on their own they looked for reassurance from others. These patients needed basic information, the buzzer (which was very important to them) and they also needed to trust that there was somebody there for them. Patients felt a need to keep track of time and often used the music to be able to do that.

Patients who experienced a *great threat* to self-control and had feelings close to panic had to struggle with their feelings and reactions. For some it meant that they had to terminate the examination whilst others were able to stay on in the situation. Instead of trying to relax they were looking for a sense of control, not only over reactions and thoughts, but over the whole situation. To feel in control over the whole situation they wanted detailed information, contact with the radiographer throughout the examination

and they needed to trust that the radiographer would respond directly if they needed to get out of the scanner. If the patients felt they could trust the staff, they could sometimes diminish the need for control and relax instead. On the other hand, if something unexpected happened or the patient did not experience a sense of control, this could be enough for the panic to take over (Paper I).

## Impact of written information on patient anxiety and motion artefacts

Satisfaction with the written and oral information was reported by > 90% of the patients in both groups, with no significant difference between the groups. More information was asked for by 14% of the patients in the control group and by 9% in the intervention group. Prior to their MRI examination 10% of the patients in the control group and 7% of the patients in the intervention group called the MRI department.

No significant difference in patient anxiety (STAI-S) was seen before or during the MRI between patients in the two groups. Mean STAI state scores before the examination were 33.8 in the control group and 35.0 in the intervention group and mean STAI state scores during the examination were 30.5 and 32.0 respectively. However, the anxiety for both groups was significantly lower during the examination than before the examination ($P<0.001$).

Irrespective of whether it was the patient's (in both groups) first MRI or not, no difference regarding anxiety was seen. Comparison of gender differences (in both groups) showed that women reported significantly higher anxiety scores than the men did ($P<0.001$).

The proportion with STAI scores ≥40 (indicating high anxiety) was similar in the control group and the intervention group, both before MRI examination (25% versus 31%, $P=0.292$) and during the examination (18% versus 23%, $P=0.369$). Diagnosis severity did not differ significantly between the 67 patients in both groups who had STAI scores ≥40 and those who had STAI scores <40 (normal, non-severe, and severe in 15%, 78%, and 8% for scores ≥40 versus 15%, 68% and 17% for scores <40).

Differences between the groups were seen concerning image motion artefacts. Significantly more motion artefacts were reported on the images for the patients in the control group (15.4%) than in the intervention group (4%). In the control group images from 18 patients contained motion artefacts while in the intervention group motion artefacts were present in images from 5 patients ($P=0.003$). The severity of the diagnoses did not differ significantly between the 23 patients with motion artefacts versus those without such artefacts (diagnosis normal, non-severe and severe in 17%, 74% and 9% versus 15%, 70% and 15%, respectively) (Paper II).

## Trends for children going through MRI or CT

During the five year period 8119 MRI and CT examinations were performed on 6392 occasions on children aged 0 to 16 years. 4418 examinations were performed with MRI and 3701 were CT examinations. There was a significant linear trend towards an increase in MRI examinations ($P<0.001$) from 45.7% the first year to 57.9% the fifth year of the total examinations. The total numbers of CT was, however, not reduced. For children under the age of 1½ years there was also a significant linear trend towards an increase of MRI examinations from 45.4% to 71.2%, and in these children there was also an actual decrease in the number of CT examinations.

In 43.1% of the occasions on which children had MRI they had deep sedation or general anaesthesia and the corresponding figures for CT was 6.8% (Paper III).

## Children going through MRI without deep sedation or anaesthesia

In the control group all 36 children, 30 in deep sedation or anaesthesia and 6 awake, had acceptable examinations. Of the 33 children in the intervention group, undergoing the MRI awake, 30 had acceptable examinations. Two refused the MRI and for one child the examination was terminated. Concerning image motion artefacts five in the control group and 13 in the intervention group were assessed to have artefacts. In the control group four of the children's images were graded as mild and one as moderate, and in the intervention group 11 were assessed to be mild, one moderate and one severe, and therefore prematurely terminated.

The assessment of parent satisfaction showed that the parents were equally or more satisfied with the care in the intervention group, with a significant difference concerning communication ($P=0.027$). Calculation of costs showed that head examinations without and with contrast medium added up to SEK 13 964 with deep sedation or anaesthesia and 5 258 without. However, six children in the control group went through MRI awake which makes the costs for the control group with 30 children with deep sedation and 6 without, SEK 450 468 which gives a cost per child of SEK 12 513. In the intervention group sample A, nine parents and children preferred the examination in deep sedation and if we assume that also nine in sample B would have done the same had the circumstances been equal we calculate with 18 children with deep sedation or anaesthesia, 33 without and three repeated examinations. That gives 51 children (54 examinations) with a total cost of SEK 466 758 and a cost per child of 9 152 SEK. The calculated cost for booklet, story book, model, projector, film screen, DVD player, DVD films, shelf and carpenter was SEK 30 200 (Paper IV).

# DISCUSSION

## Methodological considerations

The purpose of research is to arrive at well-founded conclusions about variables that would not otherwise be detected (Kazdin, 2009). In quantitative research the quality of the study is often evaluated by its validity and reliability. The study's validity is a measure of the truth or accuracy of a claim and is an important concern throughout the whole research process (Burns & Grove, 2001). The same verification strategies may be used in qualitative studies but this is often considered to be inappropriate (Polit & Beck, 2006) and is often evaluated by the criteria of trustworthiness, as suggested by Lincoln and Guba (1985).

### *Trustworthiness*

To describe patients' lived experience of undergoing MRI examinations, hermeneutic phenomenology was the methodological choice (Paper I). Hermeneutic phenomenology aims to capture the pre-reflective lived experience of a phenomenon and attempts to gain insightful descriptions of the way we experience the world rather than how we conceptualise the world. In that way the methodology does not produce theories with which we can explain and/or control our world, but rather offers a possibility for plausible insights that bring us in more direct contact with the world we live in. Hermeneutic phenomenological studies do not focus on what has actually happened or how often things happen but how the phenomenon is experienced (van Manen, 1997). Accordingly the findings in the interview study describe the lived experience of 19 patients and there was no emphasis on what "actually happened" but on how the patients experienced the situation, nor was consideration paid to how frequent or how rare these experiences were.

Lincoln and Guba (1985) suggested four criteria to establish trustworthiness in qualitative studies: credibility, transferability, dependability and conformability.

*Credibility* refers to the confidence in the truth of the data and the conclusions. Recommendations to establish credibility involve creating activities that make it likely that credible data and interpretations will be produced (Lincoln & Guba, 1985; Polit & Beck, 2006). A problem in phenomenological research may be the knowledge a researcher has of the phenomenon before the inquiry starts, which may bias the findings (van Manen, 1997). To minimise biases the interviewer made explicit her pre-understanding of the phenomenon to ensure that the pre-understanding was useful in the interview and analysis process, but did not influence the findings in a biased way. To establish the credibility of the data collection, the patients being interviewed were chosen to give a wide range of experiences, for example gender, age, and patients showing different kinds of anxiety before and during the MRI examination. The patients were not asked to take part in the study until after the examination was completed, to prevent them from thinking about the interview while going through the examination, since it was the pre-reflective experience that was of interest. As the

patients were interviewed directly after the MRI this increased the possibility of getting the patients' pre-reflective experience. To establish credibility in the analysis process, two researchers besides the interviewer read all the interviews and took part in the whole analysis process.

*Transferability* refers the degree to which the findings can be generalised or transformed to other groups or settings (Lincoln & Guba, 1985; Polit & Beck, 2006). Qualitative research does not aim to generalise (van Manen, 1997), and the findings in study 1 are not intended to be generalised to all patients going through MRI examinations but can be seen as useful information in clinical practice.

*Dependability* refers to the stability of data over time and conditions. The recommendations for establishing dependability are to let two teams deal with data separately or to let an external reviewer scrutinise the data (Lincoln & Guba, 1985; Polit & Beck, 2006). To establish dependability in study 1, besides the three researchers participating in the whole analysis process, a fourth researcher with a long experience of MRI examinations took part at the end of the analysis to verify the plausibility of the findings.

*Confirmability* refers to the objectivity or neutrality of the data (Lincoln & Guba, 1985; Polit & Beck, 2006). To strengthen the conformability, descriptions of the stages of the research process and quotations are presented in order to elucidate the interpretations from the text material (Paper I).

### *Validity and reliability*

To evaluate a study's strength and weakness in quantitative research Kazdin (2009) points out four types of validity that can be used to convey key facets of the research: internal validity, construct validity, statistical conclusion validity, and external validity.

*Internal validity* refers to the extent to which the findings can be explained by the intervention (Kazdin, 2009; Polit & Beck, 2006). That is, in this case, if the increased information and preparation can explain the findings in paper II and IV. Due to the great number of staff members involved, the long duration of data collection (Paper II and IV), and the many re-bookings of appointments (Paper II), random selection was not chosen in study 2 and 4 which may impair the internal validity. It was considered especially important in study 4 that all the professionals needed to be conversant with the procedures and routines used which was considered to be difficult with two different procedures running in parallel (Paper IV). Instead of random selection, consecutive sampling was used for both study 2 and 4, with a control group followed by an intervention group. When random selection is not used there is an increased risk for selection biases, thus sample characteristics and intend to treat were checked to control to control for that.

In study 2 there were significant differences between the control and intervention groups concerning the duration of the examination, contrast medium injections and

diagnoses between the groups. The fact that fewer patients in the intervention group received contrast medium injections may be one explanation for their shorter median examination time (Paper II).

In study 4 there was a significant difference concerning the type of examination since the children in sample B in the intervention group all had head examinations without contrast, whilst most children in sample A and the control group had head examinations without and with contrast medium. Since the intravenous injection was identified as the most stressful procedural component for children over the age of eight going through MRI (Tyc et al., 1995) it might have influenced the findings. The children in sample B were also older than in sample A and the control group which may affect the outcome in sample B but, on the other hand, the examination of the children in sample B had a longer duration bringing with it the added problem of having to lie still for a long time. Nine parents and children in the intervention group sample A chose to have the examination in deep sedation or anaesthesia. There were no significant differences in the age of those who had the MRI with deep sedation or anaesthesia or those who had the MRI awake ($P$=0.349) which must strengthen the internal validity (Paper IV).

Another threat to internal validity is that of history, i.e. that other events concurrent with the intervention can affect the measured variables (Polit & Beck, 2006). To avoid bias due to different kinds of preparations and routines only a few types of MRI examinations (e.g. head and/or spine) were used in study 2 as well as in study 4. In study 2, two four-month periods were chosen; long enough to enable examinations of an adequate number of patients, and short enough to avoid changes in routines and staff during the data collection process which was important in order to minimise the risk of history biases. Another way of attempting to minimise history biases, was to ask the patients in study 2 about the information they had received, so as to ensure that the patients in the control group had received the routinely given written information and that the patients in the intervention group had received the increased written information (Paper II).

To minimise history biases in study 4, two samples were recruited for the intervention group as the number of eligible children was limited due to the fact that only elective examinations were included and that the children were not included again after the successful completion of one MRI awake. It was considered important that the data collection should not last over too long a period as changes in the organisation and environment would have biased the result. In study 4 the parents were asked about the preparation their child had received and there was also a control to ensure that the examinations were carried out according to the prevalent routine for the control group and according to the intervention design for the intervention group (Paper IV).

Another threat to internal validity is maturation (Polit & Beck, 2006) where events over time may have an impact on the results. In study 2, over 50% of the patients had previously undergone MRI examinations. However, there was no significant difference with regard to anxiety between patients having had an MRI before and patients having their first MRI. Thus, the risk of bias due to maturation in study 2 must

be considered to be low (Paper II). In study 4 no child in the intervention group had been trough an MRI examination without deep sedation or anaesthesia before they were included in the intervention group. These children were not either included again when they had successfully completed an examination awake. The risk of maturation biases must also be considered to be low in study 4 (Paper IV).

To avoid the Hawthorne effect of having the patients affected by being part of a study (Polit & Beck, 2006) the patients (Paper II and IV) and parents (Paper IV) were treated in the same way by the researcher in the control groups as in the intervention groups.

In a survey where the data is collected from medical journals there are two critical aspects. One aspect is how consistent the recorded source data is and the other is how the data is collected from the documents (DePoy & Gitlin, 1999). In the survey study (Paper III) data was collected from the hospital's radiological information system. The data is recorded from the doctor's letter of referral and while the examination is being performed through standardised routines, and it is data that is necessary in order to make the examination. The data from the radiological information system was transferred to excel tables and from there to SPSS. The source as well as the transformation of data must be considered reliable.

*Construct validity* refers to the degree to which the measuring procedure actually measures what it is supposed to measure, and whether or not it is the studied intervention that in fact is responsible for any changes that have been found (Kazdin, 2009). To strengthen the construct validity in study 2, STAI (Spielberger, 1983) was used measuring anxiety and experienced neuroradiologist assessed the image motion artefacts. In study 4 no questionnaire measuring parent satisfaction with the care was found suitable for examination circumstances. However, an established questionnaire could be modified and used. The assessment of image motion artefacts, in study 4, was accomplished by radiographers with a long experience from MRI and, if there was any doubt, a neuroradiologist was consulted.

*Construct validity* refers also to the degree to which an instrument measures what it is supposed to measure. STAI, used to measure anxiety for the adult patients, is one of the most used instruments for measuring anxiety (Kvaal, 2005) and has been used for several intervention studies for patients undergoing MRI (Dantendorfer et al., 1997; Grey et al., 2000; Katz et al., 1994; Kilborn & Labbe, 1990; Lukins et al., 1997; MacKenzie et al., 1995; Quirk et al., 1989a, 1989b; Selim, 2001; Thompson & Coppens, 1994). Construct validity has been established for both the trait and state part of the STAI (Spielberger, 1983). Comparisons with other instruments measuring personality showed evidence of convergent and divergent validity of STAI (Spielberger, 1983). Spielberger (1983) measured state anxiety (STAI-S) of over one thousand working adults in a non-stressful situation and found the mean value to be 35.5 (Paper II).

The ad-hoc instrument made to measure the patients' satisfaction with the information in the intervention study for adults was tested for face validity by persons familiar with

MRI and on 20 patients, and was found to be understandable and useful for its purpose (Paper II).

The modified version of Healthcare Satisfaction Module specific for Hematology-/Oncology (Varni et al., 2000) used to measure parent satisfaction in study 4 were, after translation and adjustment tested for face validity on colleagues and parents. Thus, no construct validity or reliability testing was performed which decreases the validity, and therefore the results must be interpreted with caution. However, almost all questionnaires handed in were completed which indicates that the questionnaire was easy to understand and complete. More research concerning the instrument is needed, however (Paper IV).

The *reliability* of an instrument is the degree of consistency with which it measures what it is supposed to measure (Polit & Beck, 2006). The reliability of STAI has been tested in stressful events by Spielberger (1983). The reliability was tested with test-retest correlations for college and high school students. The median reliability coefficients for *trait* anxiety were 0.765 and 0.695. For the *state* part of the instrument the reliability coefficient was low (median 0.33). This is not surprising, however, as state anxiety changes over time, thus measures of internal consistency such as the alpha coefficient provide a more meaningful index. The median alpha coefficient for working adults, military recruits, college and high school students was 0.93. The reliability tests showed higher internal consistency when state anxiety was measured during stressful events than in relaxed situations (Spielberger, 1983) which is in accordance with the conditions for the patients going through MRI (Paper II).

Although the modified version of Healthcare Satisfaction Module specific for Hematology/Oncology was not tested for *reliability,* the original version is. The internal consistency reliability was tested by Varni et al. (2000) by factor analysis on 113 parents of paediatric patients. Each domain in the questionnaire had a Cronbach alpha exceeding .70 and the Cronbach alpha for the total questionnaire was over .90.

Image motion artefacts cannot be measured in any precise numbers; this is a subjective assessment, although common to radiographers and radiologists with experience of MRI. To minimise bias, only expert neuroradiologists (Paper II) and trained MRI radiographers (Paper IV) assessed the image motion artefacts. For the adults, images assessed to contain motion artefacts were scrutinised a second time by an expert neuroradiologist (Paper II), and for the children (Paper IV), a neuroradiologist was consulted if there were any doubts as to the quality of the images. The images of one adult patient were at first assessed to contain motion artefacts but in the check-up were assessed as normal. Concerning the other images, there was concordance between the experts (Paper II).

*Statistical conclusion validity* refers to the extent to which statistical relations can be detected and the influence this has on the conclusions drawn (Kazdin, 2009). To strengthen the statistical conclusion validity in study 2 and 4, power-analyses were performed and the P-value was set at 0.05. As the samples in both studies were

consecutive, information about the studies was sent to more patients/families than needed for the size of the groups since the number of patients/families rejecting to participate was not yet known. All patients/families who received information about the studies were then included.

Both STAI (Paper II) and the modified Healthcare Satisfaction Module specific for Hematology/Oncology (Paper IV) use Likert scale with four and five response alternatives respectively. The values of each item are ordinal-level data but the summed score is often treated as interval-level data to allow more sophisticated statistical analyses such as parametrical tests (Polit & Beck, 2006). To be able to compare the result to other studies, parametric tests were used when analysing STAI scores when there was normal distribution. Non parametric tests were used when the distribution was not normal, as with anxiety during MRI, although mean values were presented to enable comparison (Paper II). Non-parametric tests were used analysing data from the modified Healthcare Satisfaction Module specific for Hematology-/Oncology (Paper IV). To avoid biased statistical conclusion validity in regard to motion artefacts, statistical significance was only tested between the control and intervention groups for the total amount of artefacts. The number of patients with images containing motion artefacts would have been too small if statistical comparisons had been made between the groups for patients with mild, moderate and severe artefacts (Paper II and IV).

*External validity* refers to the extent to which findings can be generalised beyond the conditions of an experiment. Threats to external validity are, for example, sample characteristics and various characteristics of the environment (Kazdin, 2009). Although only head and spine examinations were included in study 2 many examinations are very similar in regard to the information patients receive and the way in which the examinations are conducted. The biggest difference in anxiety for adult patients is often assumed to be if patients have the head inside the scanner or not due to the narrow space (Avrahami, 1990; Eshed et al., 2007; Kilborn & Labbe, 1990). When conducting head, spine and all other examinations of the body and arms the head needs to be inside the scanner and for such examinations the external validity must be considered to be high.

Also in study 4 only head and spine examinations were included and many examinations of children are also similar with regard to preparations and the way in which the examinations are performed. For small children, since they are short, even when they are examining their legs the head will be inside the scanner. As the circumstances of different examinations are fairly similar age-adjusted preparation and watching films during the examination must be applicable for most MRI examinations. The parents decided whether or not the children should go through the MRI awake and since 30 out of 33 children in the intervention group were able to have the MRI awake it seems that the parents are good predictors of what their child could handle, which strengthens the external validity of study 4. Included in the study were children between three and nine years but no child under the age of four was included in the

intervention group thus no comment can be made on children under the age of four as to whether they can have the MRI awake or not (Paper IV).

The environment in an MRI department with the scanner is special. Although the scanners are fairly similar (except for the open scanners) there are differences. For example, new scanners with shorter tunnels than the ones used in the present studies are now available (Dewey et al., 2007). However, there are still patients who experience discomfort and need sedation, which indicates that the findings of paper II and IV may be applicable in the future even with new scanners available.

During the retrospective data period for the survey of children having MRI and CT nearly all MRI and CT scanners were replaced. Also one additional MRI scanner and one CT scanner was installed. During this period patients were referred to other hospitals. As this concerned both MRI and CT it should not have an impact on the trend over the five years but probably explains the drop in number of examinations in 2005.

## General discussion

The development of MRI has been extraordinary during the last few decades (McRobbie et al., 2007; Westbrook et al., 2005) and the areas of examination are growing (Chandromohan et al., 2005) which means that more and more adults and children will be going through MRI examinations. This emphasises the importance of studying ways to improve patient care and how image quality may be improved by patient preparation.

"It's like being in another world" was found to be the overall lived experience of going through MRI examinations with a variation in experiences from "this was nothing" to feelings of panic (Paper I). This is not surprising since we all have different personalities with different ways in which we respond to threatening situations (Andersson, 1984; Fromm, 2006; Lazarus, 1991; McNally, 1990; Merckelbach & Muris, 2001; Shaw, 1999; Spielberger, 1983; Taylor, 1995). A variation of experiences is also seen in other studies reporting differences in anxiety (Blanchard et al., 1997; Katz et al., 1994; McIsaac et al., 1998), patients needing sedation to tolerate MRI (Murphy & Brunberg, 1997), and patients terminating their examinations prematurely (Avrahami, 1990).

The experiences during the examination caused a threat to the patients' self-control and had an impact on their way of handling the situation. The greater the threat, the stronger the need for an effective coping strategy was experienced by the patients. Patients who mastered the situation with ease could relax, usually by thinking about something else. Patients, who felt a greater threat closed their eyes, thought about their breathing, or motivated themselves. They also looked for support from others to reassure them that they were not alone. The patients with feelings close to panic looked for help to stay in control over the situation (Paper I). It seems that the greater the feeling of threat the patients experienced, the stronger their need for a problem-

focused strategy. Quirk et al. (1989a) found that patients used imaginative visualisation, blinding, and breathing relaxation techniques to relax but did not find patients who needed help to stay in control. Nazemi et al. (2003) found, however, that patients with panic disorder were capable of coping effectively when they faced a highly stressful, but structured situation, and if they experienced a relative degree of control over the situation, which is comparable to the need to feel in control that patients close to panic experienced in the interview study (Paper I).

The need for support felt by the patients varied according to the perceived threat to self-control and the effort it took to handle the situation. Patients, who were not particularly threatened by the event felt that they wanted basic information and to be able to get in contact with the staff if they needed to. They appreciated if the staff contacted them during the examination, but it was not necessary. More anxious patients needed reassurance from somebody, they needed to know that someone was there for them to be able to relax. Sometimes they brought someone to be with them during the examination, but they also looked for reassurance from the staff. Music was sometimes used as an aid to relaxation, but was also a way of keeping track of time. Those who experienced difficulties during the examination wanted detailed information throughout the examination in order to feel that they were in control of the situation and most importantly, they needed to trust the staff to take them out of the scanner immediately if they felt they had to interrupt the examination (Paper I).

Some patients declared their worries about the examination clearly but others did not. In other words, some patients did not mention or display any worries before or during the examination, but during the interview they revealed a strong threat to their self-control (Paper I). Hallström et al. (2001b) found that some patients in surgical and medical wards actively sought attention and communication, but there were also some patients who did not seek any attention as they did not want to disturb the staff. Besides the fact that some patients are not telling the staff about their worries, panic attacks during MRI are often unexpected for the patients themselves (Avrahami, 1990), which makes it even more difficult to predict which patients will suffer from high anxiety and panic attacks. Attempts to predict anxiety or panic attacks show inconclusive results (Harris et al., 2004; Katz et al., 1994; Kilborn & Labbe, 1990; McGlynn et al., 2003; McIsaac et al., 1998). This indicates difficulties using questionnaires or other instruments in predicting patients who become highly anxious or terminate MRI examinations.

Thus the patient-staff interaction seemed to be important to patients who felt anxiety before and during the examination. The ability to see the patients' needs and individualise the support, communication, or patient-staff interaction, must be considered important, especially since some patients do not express their needs so as to avoid disturbing the staff (Hallstrom & Elander, 2001b). The importance of patient-staff interaction is also demonstrated by the fact that panic attacks are often unexpected, seem hard to predict, and can cause patients to develop a phobia for enclosed places (Kilborn & Labbe, 1990; Lukins et al., 1997; McIsaac et al., 1998). Also if highly anxious patients can go through the examination successfully this may

reduce their fear of confined places in the future (Harris et al., 1999). Conscious sedation is a common treatment for patients with intense anxiety or panic during MRI and although it is considered safe and effective it is time-consuming (Bluemke & Breiter, 2000; Francis & Pennell, 2000) and it must be considered important that as few patients as possible need sedation to tolerate MRI. In some cases, hypnosis has helped claustrophobic patients to go through MRI (Friday & Kubal, 1990; Simon, 1999). However, hypnosis would be difficult to offer patients in normal clinical practice, but may be useful in special cases.

Increased written information, including procedural, sensory and temporal information, did not decrease patient anxiety (Paper II). Although some studies involving procedural, sensory and temporal information have shown a decrease in anxiety for patients going through threatening medical events (Doering et al., 2000; Johnson, 1973; Leventhal et al., 1979; Wallace, 1986), other studies have not been able to show a decrease in anxiety (Maguire et al., 2004; Mikulaninec, 1987). The intervention studies which successfully decreased anxiety for patients going through MRI examinations included other interventions besides information (Grey et al., 2000; MacKenzie et al., 1995; Youssefzadeh et al., 1997). Quirk et al. (1989b) conclude that information should be combined with other interventions in order to reduce anxiety.

The mean anxiety measured (mean STAI score) on adult patients going through MRI must be considered low in comparison with other studies (Dantendorfer et al., 1997; Grey et al., 2000; Katz et al., 1994; Kilborn & Labbe, 1990; Lukins et al., 1997; MacKenzie et al., 1995; Quirk et al., 1989a, 1989b; Selim, 2001; Thompson & Coppens, 1994) and Swedish norm mean values (Forsberg & Bjorvell, 1993). However, between 25% and 31% of the patients indicated high anxiety (STAI scores >40) (Kvaal, 2005), which is in accordance with other studies (Blanchard et al., 1997; Katz et al., 1994; McIsaac et al., 1998; Thorpe et al., 2008) showing that 25 to 53% of patients experience medium to high levels of anxiety. Thus, even if the total group showed low mean patient anxiety, a considerable number of patients experience high levels of anxiety (Paper II). When comparisons for gender differences were made it was shown that women reported significantly higher levels of anxiety than men did. The same was also found by Blanchard et al. (1997) and Dewey et al (2007) for patients going through MRI and by Walker (2002) for patients going through surgery (Paper II).

Image motion artefacts significantly decreased for adult patients who received increased written information. Only 4% of patients' had images containing motion artefacts when they received increased written information compared to 15.4% of the patients when they did not (Paper II). Dantendorfer et al. (1997) found motion artefacts in 12.8% out of 297 patients' images. As the anxiety did not decrease (Paper II) it seems that anxiety was not the main reason for motion artefacts. The same result, showing no correlation between anxiety and motion artefacts, was found by Dantendorfer et al. (1997) and McIsaac et al. (1998). A possible explanation for the decrease in motion artefacts is that the knowledge of the procedure, including knowledge about when the data is collected, helps the patient to lie still during the

important periods. Mikulaninec (1987) found no decrease in anxiety among patients going through surgery, but found increased knowledge about the procedure. Thus, written information containing information that the image data are collected during the periods of hammering noise may reduce image motion artefacts. Reduction of motion artefacts is important as the impaired image quality can jeopardise diagnostic accuracy (Mirowitz, 1999) and therefore the efficiency of the examination (McIsaac et al., 1998).

The development and accessibility of MRI has increased the number of children going through MRI. Over a period of five years CT examinations were fairly constant while a significant increase was seen for MRI (Paper III). Studies (Aldrich & Williams, 2005; Aroua et al., 2007; Bhargavan & Sunshine, 2005; Borretzen, Lysdahl, & Olerud, 2007; Hart & Wall, 2004) have shown that for adult patients there has been a huge increase in CT examinations. As children are more sensitive to ionization radiation than adults (ICRP, 2007), and bearing in mind that the development of CT in general has not led to a reduction of patient radiation dose per examination (ICRP, 2001), it must be considered advantageous, that there was no increase of CT examinations in this study. Especially so for the children under the age of 18 months as there was an actual decrease in the number of CT examinations from 54.6% to 28.8% over the five year period (Paper III). When children undergo an MRI examination they are not exposed to any ionization radiation. However, many children are deep sedated or anaesthetised. The survey study showed that in 43.1% of the occasions of children having MRI they had deep sedation or anaesthesia compared with 6.8% for children having CT (Paper III).

Age appropriate information and film distraction enabled 30 out of 33 children between four and nine years of age to go through MRI awake with acceptable images. Thus, we see, as has previously been shown by Pressdee et al. (1997), Harned et al. (2001) and Hallowell et al. (2008), that children can lie still during an MRI examination if they are prepared and/or distracted by film. There are several advantages for the child and its family if the child can perform the examination without deep sedation or anaesthesia. The child will not need deep sedation-/anaesthesia with the discomforts and risks that this might imply (Malviya et al., 2000; Von Ungern-Sternberg & Habre, 2007), the child will not need to be fasting and the hospital stay will be shorter. Also, there will be benefits for the health care system if the children can have their MRI awake. Since deep sedation or anaesthesia requires the presence of both anaesthetic and radiological staff there are limitations regarding the scheduling of examinations with a risk of longer waiting times for an MRI. Calculations of costs also showed a decrease in the costs even though some parents preferred their children to have the MRI in deep sedation or anaesthesia and some children needed to repeat the examination (Paper IV).

An important factor for the examinations is that the image quality is good enough for diagnostic purposes. Not surprisingly, more of the children having the MRI awake had motion artefacts on the images than did the children having deep sedation or anaesthesia. However, only one child having the examination awake had so many

artefacts that the MRI was prematurely terminated. The rest had acceptable examinations in spite of the artefacts (Paper IV). Hallowell et al (2008) showed that 96% of their 227 children between the ages of three and 17 who underwent MRI without deep sedation or anaesthesia had acceptable examinations, although 60% showed signs of movement on the images. Adult patients too have been shown to have motion artefacts on their images. In study 2, four % of the adult patients who had received increased written information and 15.4% of those who had not, had motion artefacts on their images (Paper II). Dantendorfer et al. (1997) found motion artefacts in 12.8% of 297 adult patients' images.

In order to help the children experience a sense of control and become familiar with the examination situation, those who had agreed to have the MRI awake received information in different ways from the booklet, story book and the model (Paper IV). As children develop at a different pace, learn about and understand situations in different ways (Pramling, 1983), and mix reality and fantasy (Forsner, 2006) it was considered an advantage that different kinds of information was used. Runeson et al. (2002) found that the most prominent needs during the hospitalisation of children undergoing a threatening situation were; a need for a sense of control, a need to have their parents nearby, a need for what is familiar and a need for integrity. All children (Paper IV) had their parent/s nearby until they were asleep if sedated or anaesthetised and during the whole examination if they were not. Although international studies (Cameron et al., 1996; Palermo et al., 2000; Piira et al., 2005) show mixed results concerning the presence of parents during medical procedures Runeson (2002) and Björk (2006) found that children had a need to have their parents nearby in threatening medical situations (Paper IV).

The parents in the intervention group were equally or more pleased with the care and, with regard to communication, this difference was significant (Paper IV). Earlier studies have shown that a good communication with the staff is of the most importance for parents with long-term ill children (Hallstrom & Elander, 2007; Hallstrom et al., 2002). Good co-operation and communication between the staff at the paediatric day care unit and at the radiological department was essential for the results achieved. The staff members at the paediatric ward unit prepared the children with intravenous catheters, showed the model, and were prepared to answer any question concerning the MRI. When the child was to undergo the examination awake it was the radiographers rather than the anaesthetic staff who met the child and the parent/s, and who were thereby responsible for the care the family received (Paper IV).

## CONCLUSIONS AND RELEVANCE TO CLINICAL PRACTICE

The lived experience of going through MRI was perceived as a feeling of "being in another world", which had an influence on the patients' self-control, their handling of the situation, and their need for support. The studies showed that the information received and the interaction between patients and staff has important influences on patients' lived experience, although increased written information did not decrease the adult patients' anxiety. The findings imply that the patients needed basic information about the procedure and means to get in contact with the staff if needed, and that some patients also needed reassurance to be able to relax while others needed help and trust to stay in control over the situation. Extended written procedural, sensory, and temporal information did not, according to this thesis, decrease patient anxiety or increase information satisfaction but helped to reduce motion artefact on the patients' images. Reduction of motion artefacts is important for the efficiency of the examination and the accuracy of diagnoses.

The individual experience of going through MRI implies that the care needs to be individualised and adjusted for each patient. To be able to adjust the care the radiographer needs to identify the patients' needs through communication and close patient-staff interaction and to build a trusting relationship with the patients. Information should be given to help patients lie still during image data collection in order to avoid image motion artefacts.

MRI examinations are becoming increasingly common for children as well as adults and many children have deep sedation or anaesthesia due to the relatively long duration of the examination, and the technique's sensibility to motion. The findings imply that with age appropriate information, and with preparation and distraction during the examination, most children between four and nine years of age can go through the MRI awake. More of the children who were awake had motion artefacts on their images, although the images were, for the most part, acceptable. The parents were equally or more pleased with the care, and the costs were calculated to be lower in the group where children had age appropriate information and preparation. Thus, age appropriate preparations and film distraction for the children, and good communication and co-operation between the family and staff, as well as among the members of the staff at the paediatric and radiology units may realise the possibility of many children being able to have their MRI awake.

## FURTHER RESEARCH

The findings of this thesis gave rise to insights that further research is needed regarding possibilities to decrease anxiety and image motion artefacts, as well as to improve the care for adults as well as children.

Study 1 and 2 reviled the variation in need for support for adult patients and that increased written information alone did not diminish patient anxiety. Other studies

(Grey et al., 2000; MacKenzie et al., 1995; Youssefzadeh et al., 1997) have shown that a combination of interventions may decrease anxiety. However, further research is needed to find ways of improving the care of patients of patients going through MRI that can easily be applied in clinical practice, for instance through studying the importance of the interaction between patients and staff and the effect of combinations of different interventions.

Not many studies concerning children going through MRI were found. It was shown that most children between four and nine years of age, having head examinations, could go through MRI awake when they had age-adjusted preparations. It would be interesting to implement the intervention used in study 4 in a larger sample and follow up the result. It would also be interesting to investigate other kinds of examinations where the child needs anaesthesia due to difficulties of lying still. But there are also other aspects that need further studies such as how the children experience the examination, the value of different interventions and how anxious they are. No study was found that examined the anxiety of children under the age of eight having MRI. The parents were asked, through a questionnaire, about their experiences of the care that the child and they themselves had received. It would also be interesting to find out the parent' thoughts of the impact that different interventions had on their child's ability to go through MRI awake.

Image quality is crucial for the diagnostic safety of the examination. It was shown that adult patients receiving increased written information had fewer image motion artefacts than those who did not. Thus, preparation may facilitate for patients to cooperate and thereby improve the diagnostic accuracy of the examination and more research is desirable to further explore the impact of preparatory information on image quality.

No validated and reliable questionnaire concerning children going through examinations was found. The questionnaire Healthcare Satisfaction Module specific for Hematology/Oncology that was used in order to measure parent satisfaction with the care was therefore modified to suit the circumstances of the examination. The questionnaire could be valuable in connection with all kinds of examinations for children if validated and tested for reliability. Further research aimed to test the questionnaire is therefore desirable.

## SUMMARY IN SWEDISH

Magnetisk resonanstomografi: Patienters upplevelser och betydelsen av anpassad information och förberedelse för vuxna och barn.

Magnetisk resonanstomografi (MRT) har sedan tidigt 1980-tal ökat i betydelse och är idag en vanlig undersökning för både vuxna och barn. Undersökningen innebär att patienten ligger i en smal tunnel i magnetkameran och när bilderna tas hörs kraftiga knackande ljud. Undersökningstiden varierar från 20 till 90 minuter. Trots att undersökningen är icke-invasiv och anses vara smärtfri finns det beskrivet att 25–53% av vuxna och barn som genomgått MRT upplever moderat till svår oro och att 1,5–6,5% av patienter avbryter undersökningen framför allt på grund av det trånga utrymmet. Det är också beskrivet att oroliga patienter rör sig mer under undersökningen, vilket kan förorsaka rörelseartefakter med sänkt bildkvalité som följd. För att kunna genomgå undersökningen sövs därför många barn. Även datortomografi (DT) har ökat i betydelse under senare tid. Fördelen med DT är att undersökningen är snabb och inte lika känslig för rörelser men nackdelen är att joniserande strålning används. Studier har visat att oro hos patienterna kan minskas vid MRT med en kombination av ökade förberedelser och ökad interaktion mellan patient och personal. Interventionerna utgår ofta från personalens uppfattningar om vad som är bra för patienterna och det saknas studier om patienternas egna erfarenheter och få studier som undersökt om barn klarar att genomgå undersökningen vakna. MRT är en relativt dyr undersökning och det är av betydelse för såväl kostnadseffektiviteten som för att minimera patienters väntan och lidande att undersökningen kan göras snabbt och med god bildkvalitet. Syftet med studierna var därför att undersöka vuxna patienters upplevelser, som de beskriver dem själva, efter att ha genomgått MRT och att undersöka hur patienternas oro och bildkvalitén påverkas av utökad skriftlig information. Vidare var syftet att kartlägga användandet av MRT och DT för barn under en femårsperiod och undersöka om barn mellan 3 och 9 år kan genomgå MRT undersökningar utan att sövas om de får åldersanpassade förberedelser och möjlighet att se film under undersökningen.

Med syfte att undersöka och belysa patienters upplevelser av att genomgå MRT genomfördes kvalitativa intervjuer med 19 patienter. Ett strategiskt urval av patienter som avbröt undersökningen (3), som visade oro men klarade att genomgå undersökningen (6), och som inte visade någon oro (10) ingick i studien. Intervjuerna skrevs ut och analyserades med hermeneutisk fenomenologisk ansats. I analysen framkom ett gemensamt tema där patienterna beskrev upplevelsen av att genomgå MRT som ”att vara i en annan värld”. Detta upplevdes som ett hot mot deras självkontroll och påverkade den ansträngning som krävdes för att genomgå undersökningen liksom behovet av stöd. Alla patienterna upplevde att de hade behov av information och möjlighet att kunna kontakta personalen vid behov. De som upplevde stort hot mot självkontrollen behövde känna sig i kontroll över situationen och hade behov av ytterligare stöd. Interaktionen mellan patient och personal visade sig vara viktig för patienterna och ibland var tillit till personalen en förutsättning för att de skulle kunna genomföra undersökningen. Sammanfattningsvis varierade patienternas upplevelser betydligt varför det är av största betydelse att kunna individualisera omhändertagandet av patienter utifrån varje individs specifika behov.

En två sidor lång skriftlig information utformades, baserad på patienternas berättelser och forskning angående patientinformation. Informationen utformades så att den innehöll information om hur undersökningen gick till (procedural information), kunde upplevas (sensory information) och hur lång tid en undersökning vanligtvis kunde ta (temporal information). En kontrollgrupp bestående av 118 patienter erhöll standardinformation och en interventionsgrupp bestående av 124 patienter fick även den utökade skriftliga information. Patienternas oro innan och under undersökningen mättes med ett instrument som mäter oro, (STAI) och deras tillfredställelse med informationen med ett frågeformulär som togs fram för denna studie. Bildkvaliteten med avseende på rörelseartefakter bedömdes av neuroradiologer. Resultatet visade att den utökade skriftliga informationen inte minskade patienternas oro eller påverkade patienternas tillfredsställelse med informationen. Däremot förekom signifikant färre rörelseartefakter i bilderna hos den grupp av patienter som fått utökad skriftlig information, jämfört med de patienter som fått standardinformation.

Data från det radiologiska informationssystemet från Lunds universitetssjukhus användes för att kartlägga hur många barn (0-15 år) som genomgått MRT och DT undersökningar under åren 2002 till 2006 och hur många barn som sövdes. Sammanlagt genomfördes 8119 undersökningar vid 6392 tillfällen. Det var en signifikant ökning av MRT undersökningar i förhållande till DT under de fem åren. Djup sedering eller generell anestesi användes i 43,1% av tillfällena vid MRI och 6,8% vid DT.

För att undersöka om barn mellan 3 och 9 år kunde genomgå MRT undersökningar utan att sövas genomfördes en kontrollerad experimentell studie med en kontrollgrupp med 36 barn och en interventionsgrupp med 33 barn. Barnen i kontrollgruppen genomförde undersökningen enligt befintliga rutiner vilket medförde att 30 av barnen sövdes och 6 undersöktes vakna. För barnen i interventionsgruppen ändrades rutinerna på tre sätt 1) de fick hemskickat en broschyr och sagobok om undersökningen att läsa tillsammans med sina föräldrar 2) de fick titta på och leka med en modell av en magnetkamera och lyssna på ljudet 3) de fick titta på DVD film under undersökningen. Av de 33 barnen klarade 30 undersökningen med acceptabel bildkvalité även om det fanns fler barn i interventionsgruppen som hade rörelseartefakter på bilderna. Föräldrarna i interventionsgruppen angav samma eller högre tillfredsställelse med omvårdnaden än föräldrarna i kontrollgruppen. Kostnaden för undersökningarna i interventionsgruppen beräknades bli lägre i jämförelse med kostnader för undersökningar i kontrollgruppen.

Studierna visade att muntlig och skriftlig information, åldersanpassade förberedelser och interaktionen mellan patient och personal är av stor betydelse för patienters upplevelser av och möjlighet att genomföra undersökningen. Personalen behöver vara medveten om den betydelse de har, efterfråga vilka behov varje enskild patient har och omhänderta varje patient på ett individuellt sätt. För att bättre förstå hur och om patienternas oro kan minskas behöver omvårdnaden och då speciellt interaktionen mellan patient och personal ytterligare studeras.

## ACKNOWLEDGEMENTS

This thesis for the degree of Doctorate was carried out at the department of Health Sciences, Lund University. I wish to express my sincere gratitude to everyone who has had any part in this work. In particular I wish to thank:

- All respondents in this study, adult and child patients as well as parents who participated in the studies and so willingly shared their experiences with me.
- My supervisor, Professor Inger Hallström at the Department of Health Sciences and Vårdalinstitutet, The Swedish Institute for Health Sciences, Lund University, for believing in me and helping me into the world of research. With your great knowledge and skilful supervision you have been invaluable to me when learning about the research process and realizing this thesis. Thank you.
- My co-supervisor, Åsa Månsson, senior lecturer at the Department of Health Sciences, Lund University, for your encouragement, skilful supervision and being my friend through all this years.
- My co-supervisors in different parts of the studies, Professor Elna-Marie Larsson and Professor Stig Holtås, Centre for Medical Imaging and Physiology at Lund University Hospital for skilful supervision, encouragement and for showing interest in my work. I would also like to thank my supervisor in my master-project Professor Freddy Ståhlberg for skilful supervision when helping me into the "MRI-world" and inspiring me to continue my studies.
- All staff at the MRI department: Titti Owman, Bengt Olsson, Lena Frostgård, Boel Hansson, Eva Hallberg, Ingalill Enochsson, Marie Johansson, Lena Kulstad, Johanna Wiksten, Karin Karlsson, Håkan Månsson, Emma Robertsson, Catharina von Essen, Krister Askaner, Tomas Henriksson, Liselott Lundh, who helped me and supported me in my work and also made me feel welcome. Your help and support has been invaluable. Special thanks also to Johan Olsrud for making the DVD film watching possible.
- The neuroradiologist who helped with the assessment of image motion artefacts.
- Anna Westergren, Marie Palmqvist, Elisabeth Bengtsson and Inger Svensson at the Paediatric Day Care unit for help and support as well as for making me feel so welcome. Charlotte Castor who have given me invaluable help and support. I also learned a lot from you. Thank you.
- Hanna Örnskär and Linda Jönsson (my niece). In order to produce age-adjusted preparation for children I needed help and I received excellent help. Thank you Hanna for making such an excellent MRI-model and Linda for making the fabulous story book.
- My friends and colleges in the doctoral seminar group, Health and care of Women and Children and the licentiate seminar group for invaluable help and constructive criticism during my time as a doctoral student. Special thanks to Professor Bengt Fridlund.

- Per Nyberg, Department of Health Sciences, Lund University, for invaluable help with statistics.
- Lena Jönsson for giving me help and support when writing about radiation doses in CT examinations, your help was so valuable.
- Håkan Mejstad for invaluable help with questionnaires and computer problems. Also thanks to Lars Rundgren for helping with, for instance, lay out of the story book.
- The staff at IT service and Medicinska fakultetens bibliotek for service and help.
- Christina Linde and Göran Jönsson for always giving an excellent service in practical matters.
- Alan Crozier, Richard Chock and Christina Nilsson-Posada for correcting my English.
- All colleagues and friends at the Division of Nursing for encouragement and interest. Special thanks to Bodil Andersson, Inga Persson, Lena Ritzman and Jenny Gårdling for support and patience with me during times of hard work. Thank you Bodil for all the support you given me through the years. Also special thanks to Elisabet Werntoft, my companion in many courses, for being such a nice and supporting friend through all these years of studies.
- All my friends for your support, interest and patience with me while I have "been in another world" from time to time. I hope to be able to spend more time with you in the future.
- My family, my sister Mona Jönsson and her husband Rune, and Niklas, Fia, Viktor and Sara, Linda, Ollie, Svante and Oskar, Christian, Martina and Lykke, thank you for all the support you have given me, you are very valuable to me.
- Professor Ingalill Rahm Hallberg for initiating licentiate education at the Division of Nursing which made this thesis possible.
- The Department of Health Sciences, Faculty of Medicine, Lund University, and the Swedish Childhood Cancer Foundation who supported this thesis.

## REFERENCES


Aldrich, J. E., & Williams, J. (2005). Change in patient doses from radiological examinations at the Vancouver General Hospital, 1991-2002. *Can Assoc Radiol J, 56*(2), 94-99.

Andersson, K. (1984). *Patienters upplevelser av trygghet och otrygghet*. Stockholm: Esselte Studieum.

Aroua, A., Trueb, P., Vader, J. P., Valley, J. F., & Verdun, F. R. (2007). Exposure of the Swiss population by radiodiagnostics: 2003 review. *Health Phys, 92*(5), 442-448.

Avrahami, E. (1990). Panic attacks during MR imaging: treatment with i.v. diazepam. *AJNR Am J Neuroradiol, 11*(4), 833-835.

Beauchamp, T. L., & Childress, J. (2008). *Principles of biomedical ethics* (6 ed.). Oxford: Oxford University Press.

Bhargavan, M., & Sunshine, J. H. (2005). Utilization of radiology services in the United States: levels and trends in modalities, regions, and populations. *Radiology, 234*(3), 824-832.

Bjork, M., Nordstrom, B., & Hallstrom, I. (2006). Needs of young children with cancer during their initial hospitalization: an observational study. *J Pediatr Oncol Nurs, 23*(4), 210-219.

Blanchard, T. K., Bearcroft, P. W., Dixon, A. K., Lomas, D. J., Teale, A., Constant, C. R., et al. (1997). Magnetic resonance imaging or arthrography of the shoulder: which do patients prefer? *Br J Radiol, 70*(836), 786-790.

Blount, R. L., Bachanas, P. J., Powers, S. W., Cotter, M. W., Franklin, A., Chaplin, W., et al. (1992). Training children to cope and parents to coach them during routine immunizations: Effects on child, parent, and staff behaviors. *Behavior Therapy, 23*, 689-705.

Bluemke, D. A., & Breiter, S. N. (2000). Sedation procedures in MR imaging: safety, effectiveness, and nursing effect on examinations. *Radiology, 216*(3), 645-652.

Borretzen, I., Lysdahl, K. B., & Olerud, H. M. (2007). Diagnostic radiology in Norway trends in examination frequency and collective effective dose. *Radiat Prot Dosimetry, 124*(4), 339-347.

Brandazzi, G. F. (2008). The European Association for Children in Hospital (EACH) charter. *Pediatrics, 121*, 97.

Brenner, D., Elliston, C., Hall, E., & Berdon, W. (2001). Estimated risks of radiation-induced fatal cancer from pediatric CT. *AJR Am J Roentgenol, 176*(2), 289-296.

Budoff, M., Cohen, M., Garcia, M., Hodgson, J., Hundley, G., Lima, J., et al. (2005). ACCF/AHA Clinical Competence statement on cardiac imaging with computed tomography and magnetic resonance. *Journal of American College and Cardiology, 46*, 383-402.

Burns, N., & Grove, S. K. (2001). *The practice of nursing research, conduct, critique, & utilisation* (4 ed.). Philadelphia: Saunders.

Bushong, S. C. (2008). *Radiologic science for technologists, Physics, Biology, and Protection* (9 ed.). St Louis: Elsevier Health Sciences.

Cameron, J. A., Bond, M. J., & Pointer, S. C. (1996). Reducing the anxiety of children undergoing surgery: parental presence during anaesthetic induction. *J Paediatr Child Health, 32*(1), 51-56.

Carr, M. W., & Grey, M. L. (2002). Magnetic resonance imaging. *Am J Nurs, 102*(12), 26-33.

Cassidy, K. L., Reid, G. J., McGrath, P. J., Finley, G. A., Smith, D. J., Morley, C., et al. (2002). Watch needle, watch TV: Audiovisual distraction in preschool immunization. *Pain Med, 3*(2), 108-118.

Cavender, K., Goff, M. D., Hollon, E. C., & Guzzetta, C. E. (2004). Parents' positioning and distracting children during venipuncture. Effects on children's pain, fear, and distress. *J Holist Nurs, 22*(1), 32-56.

Cengiz, M., Baysal, Z., & Ganidagli, S. (2006). Oral sedation with midazolam and diphenhydramine compared with midazolam alone in children undergoing magnetic resonance imaging. *Paediatr Anaesth, 16*(6), 621-626.

Chandromohan, D., Parikh, S., Akhtar, N., & Delgado, P. N. (2005). Review and update of MRI for clinicians. *Mo Med, 102*(2), 120-123.

Cohen, L. L., Bernard, R. S., Greco, L. A., & McClellan, C. B. (2002). A child-focused intervention for coping with procedural pain: are parent and nurse coaches necessary? *J Pediatr Psychol, 27*(8), 749-757.

Cohen, L. L., Blount, R. L., & Panopoulos, G. (1997). Nurse coaching and cartoon distraction: an effective and practical intervention to reduce child, parent, and nurse distress during immunizations. *J Pediatr Psychol, 22*(3), 355-370.

Dahlquist, L. M., Pendley, J. S., Landthrip, D. S., Jones, C. L., & Steuber, C. P. (2002). Distraction intervention for preschoolers undergoing intramuscular injections and subcutaneous port access. *Health Psychol, 21*(1), 94-99.

Dantendorfer, K., Amering, M., Bankier, A., Helbich, T., Prayer, D., Youssefzadeh, S., et al. (1997). A study of the effects of patient anxiety, perceptions and equipment on motion artifacts in magnetic resonance imaging. *Magn Reson Imaging, 15*(3), 301-306.

Davis, T. M. A., Maguire, T. O., Haraphongse, M., & Schamberger, M. R. (1994). Undergoing cardiac catheterization: The effects of informational preparation and coping style on patient anxiety during the procedure. *Heart and Lung, 23*, 140-150.

DeMasi, F. (2004). The psychodynamic of panic attacks: a useful integration of psychoanalysis and neuroscience. *The International Journal of Psycho-analysis, 85*, 311-336.

Depla, M. F., ten Have, M. L., van Balkom, A. J., & de Graaf, R. (2008). Specific fears and phobias in the general population: results from the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Soc Psychiatry Psychiatr Epidemiol, 43*(3), 200-208.

DePoy, E., & Gitlin, L. N. (1999). *Forskning - en introduktion*. Lund: Student-litteratur.

Dewey, M., Schink, T., & Dewey, C. F. (2007). Claustrophobia during magnetic resonance imaging: cohort study in over 55,000 patients. *J Magn Reson Imaging, 26*(5), 1322-1327.

Diler, R. S. (2003). Panic disorder in children and adolescents. *Yonsei Med J, 44*(1), 174-179.

Doerfler, L. A., Connor, D. F., Volungis, A. M., & Toscano, P. F., Jr. (2007). Panic disorder in clinically referred children and adolescents. *Child Psychiatry Hum Dev, 38*(1), 57-71.

Doering, S., Katzlberger, F., Rumpold, G., Roessler, S., Hofstoetter, B., Schatz, D. S., et al. (2000). Videotape preparation of patients before hip replacement surgery reduces stress. *Psychosom Med, 62*(3), 365-373.

Donnelly, L. F., Emery, K. H., Brody, A. S., Laor, T., Gylys-Morin, V. M., Anton, C. G., et al. (2001). Minimizing radiation dose for pediatric body applications of single-detector helical CT: strategies at a large Children's Hospital. *AJR Am J Roentgenol, 176*(2), 303-306.

Edwinson, M., Arnbjornsson, E., & Ekman, R. (1988). Psychologic preparation program for children undergoing acute appendectomy. *Pediatrics, 82*(1), 30-36.

Edwinson, M., & Lindahl, S. (1986). Preparation of children for urinary x-rays on the use of premedication. *World Pediatrics and Child Care, 1*, 183-186.

Eshed, I., Althoff, C. E., Hamm, B., & Hermann, K. G. (2007). Claustrophobia and premature termination of magnetic resonance imaging examinations. *J Magn Reson Imaging, 26*(2), 401-404.

Forsberg, C., & Bjorvell, H. (1993). Swedish population norms for the GHRI, HI and STAI-state. *Qual Life Res, 2*(5), 349-356.

Forsner, M. (2006). *Att vara barn i sjukdom och sjukvård: barns berättelser om sina upplevelser av sjukdom och sjukvårdsrädsla.* Thesis for Doctoral Degree, Umeå University, Umeå.

Forstner, R. (2007). Radiological staging of ovarian cancer: imaging findings and contribution of CT and MRI. *Eur Radiol, 17*(12), 3223-3235.

Francis, J. M., & Pennell, D. J. (2000). Treatment of claustrophobia for cardiovascular magnetic resonance: use and effectiveness of mild sedation. *J Cardiovasc Magn Reson, 2*(2), 139-141.

Fricke, B. L., Donnelly, L. F., Frush, D. P., Yoshizumi, T., Varchena, V., Poe, S. A., et al. (2003). In-plane bismuth breast shields for pediatric CT: effects on radiation dose and image quality using experimental and clinical data. *AJR Am J Roentgenol, 180*(2), 407-411.

Friday, P. J., & Kubal, W. S. (1990). Magnetic resonance imaging: improved patient tolerance utilizing medical hypnosis. *Am J Clin Hypn, 33*(2), 80-84.

Fromm, E. (2006). *Att ha eller att vara?* (4 ed.). Stockholm: Natur och Kultur.

Frush, D. P., Slack, C. C., Hollingsworth, C. L., Bisset, G. S., Donnelly, L. F., Hsieh, J., et al. (2002). Computer-simulated radiation dose reduction for abdominal multidetector CT of pediatric patients. *AJR Am J Roentgenol, 179*(5), 1107-1113.

Goo, H. W., & Suh, D. S. (2006). Tube current reduction in pediatric non-ECG-gated heart CT by combined tube current modulation. *Pediatr Radiol, 36*(4), 344-351.

Goswami, U. (2004). Neuroscience and education. *Br J Educ Psychol, 74*(Pt 1), 1-14.

Grey, S. J., Price, G., & Mathews, A. (2000). Reduction of anxiety during MR imaging: a controlled trial. *Magn Reson Imaging, 18*(3), 351-355.

Hall, P., Adami, H. O., Trichopoulos, D., Pedersen, N. L., Lagiou, P., Ekbom, A., et al. (2004). Effect of low doses of ionising radiation in infancy on cognitive function in adulthood: Swedish population based cohort study. *BMJ, 328*(7430), 19.

Hallowell, L. M., Stewart, S. E., de Amorim, E. S. C. T., & Ditchfield, M. R. (2008). Reviewing the process of preparing children for MRI. *Pediatr Radiol, 38*(3), 271-279.

Hallstrom, I., & Elander, G. (2001a). A comparison of patient needs as ranked by patients and nurses. *Scand J Caring Sci, 15*(3), 228-234.

Hallstrom, I., & Elander, G. (2001b). Needs during hospitalization: definitions and descriptions made by patients. *Nurs Ethics, 8*(5), 409-418.

Hallstrom, I., & Elander, G. (2007). Families' needs when a child is long-term ill: a literature review with reference to nursing research. *Int J Nurs Pract, 13*(3), 193-200.

Hallstrom, I., Runesson, I., & Elander, G. (2002). Observed parental needs during their child's hospitalization. *J Pediatr Nurs, 17*(2), 140-148.

Hallström, I., & Lindberg, T. (Eds.). (2009). *Pediatrisk omvårdnad*. Stockholm: Liber.

Harned, R. K., 2nd, & Strain, J. D. (2001). MRI-compatible audio/visual system: impact on pediatric sedation. *Pediatr Radiol, 31*(4), 247-250.

Harris, L. M., Cumming, S. R., & Menzies, R. G. (2004). Predicting anxiety in magnetic resonance imaging scans. *Int J Behav Med, 11*(1), 1-7.

Harris, L. M., Robinson, J., & Menzies, R. G. (1999). Evidence for fear of restriction and fear of suffocation as components of claustrophobia. *Behav Res Ther, 37*(2), 155-159.

Hart, D., & Wall, B. F. (2004). UK population dose from medical X-ray examinations. *Eur J Radiol, 50*(3), 285-291.

Hathaway, D. (1986). Effect of preoperative instruction on postoperative outcomes: a meta-analysis. *Nurs Res, 35*(5), 269-275.

Havnesköld, L., & Risholm-Motander, P. (2009). *Utvecklingspsykologi* (3 ed.). Stockholm: Liber.

The Higher Education Ordinance (Högskoleförordningen), (1998:1003; Cap.6, Sup.2).

Hjelm-Karlsson, K. (1988). *Dispelling the fear of the unknown. Effects of information to patients undergoing intravenous pyelography.* Thesis for Doctoral Degree, Uppsala University, Uppsala.

Hoffmann, T., & Worrall, L. (2004). Designing effective written health education materials: considerations for health professionals. *Disabil Rehabil, 26*(19), 1166-1173.

Huda, W., Chamberlain, C. C., Rosenbaum, A. E., & Garrisi, W. (2001). Radiation doses to infants and adults undergoing head CT examinations. *Med Phys, 28*(3), 393-399.

Huda, W., Lieberman, K. A., Chang, J., & Roskopf, M. L. (2004). Patient size and x-ray technique factors in head computed tomography examinations. I. Radiation doses. *Med Phys, 31*(3), 588-594.

ICRP. (2001). *Managing patient dose in computed tomography* (No. 87): International Commission on Radiological Protection.

ICRP. (2007). *Recommendations of the International Commission on Radiological Protection* (No. 103): International Commission on Radiological Protection.

Iwata, S., Okumura, A., Kato, T., Itomi, K., & Kuno, K. (2006). Efficacy and adverse effects of rectal thiamylal with oral triclofos for children undergoing magnetic resonance imaging. *Brain Dev, 28*(3), 175-177.

Jay, S. M., Elliott, C. H., Ozolins, M., Olson, R. A., & Pruitt, S. D. (1985). Behavioral management of children's distress during painful medical procedures. *Behav Res Ther, 23*(5), 513-520.

Johnson, J. E. (1973). Effects of accurate expectations about sensations on the sensory and distress components of pain. *J Pers Soc Psychol, 27*(2), 261-275.

Johnson, J. E., Fuller, S. S., Endress, M. P., & Rice, V. H. (1978). Altering patients' responses to surgery: an extension and replication. *Res Nurs Health, 1*(3), 111-121.

Johnson, J. E., & Leventhal, H. (1974). Effects of accurate expectations and behavioral instructions on reactions during a noxious medical examination. *J Pers Soc Psychol, 29*(5), 710-718.

Johnson, J. E., Leventhal, H., & Dabbs, J. M., Jr. (1971). Contribution of emotional and instrumental response processes in adaptation to surgery. *J Pers Soc Psychol, 20*(1), 55-64.

Johnson, J. E., Morrissey, J. F., & Leventhal, H. (1973). Psychological preparation for an endoscopic examination. *Gastrointest Endosc, 19*(4), 180-182.

Johnson, J. E., Rice, V. H., Fuller, S. S., & Endress, M. P. (1978). Sensory information, instruction in a coping strategy, and recovery from surgery. *Res Nurs Health, 1*(1), 4-17.

Kain, Z. N., Mayes, L. C., O'Connor, T. Z., & Cicchetti, D. V. (1996). Preoperative anxiety in children. Predictors and outcomes. *Arch Pediatr Adolesc Med, 150*(12), 1238-1245.

Kain, Z. N., Wang, S. M., Mayes, L. C., Krivutza, D. M., & Teague, B. A. (2001). Sensory stimuli and anxiety in children undergoing surgery: a randomized, controlled trial. *Anesth Analg, 92*(4), 897-903.

Karantanas, A. H., Yarmenitis, S., Papanikolaou, N., & Gourtsoyiannis, N. (2007). Preoperative imaging staging of rectal cancer. *Dig Dis, 25*(1), 20-32.

Karlsson, P., Holmberg, E., Lundell, M., Mattsson, A., Holm, L. E., & Wallgren, A. (1998). Intracranial tumors after exposure to ionizing radiation during infancy: a pooled analysis of two Swedish cohorts of 28,008 infants with skin hemangioma. *Radiat Res, 150*(3), 357-364.

Katz, R. C., Wilson, L., & Frazer, N. (1994). Anxiety and its determinants in patients undergoing magnetic resonance imaging. *J Behav Ther Exp Psychiatry, 25*(2), 131-134.

Kazdin, A. E. (2009). *Research design in clinical psychology* (4 ed.). Upper Saddle River: Pearson Education.

Keengwe, I. N., Hegde, S., Dearlove, O., Wilson, B., Yates, R. W., & Sharples, A. (1999). Structured sedation programme for magnetic resonance imaging examination in children. *Anaesthesia, 54*(11), 1069-1072.

Kilborn, L. C., & Labbe, E. E. (1990). Magnetic resonance imaging scanning procedures: development of phobic response during scan and at one-month follow-up. *J Behav Med, 13*(4), 391-401.

Klein, R. G. (2009). Anxiety disorders. *J Child Psychol Psychiatry, 50*(1-2), 153-162.

Korzeniewski, S. J., Birbeck, G., DeLano, M. C., Potchen, M. J., & Paneth, N. (2008). A systematic review of neuroimaging for cerebral palsy. *J Child Neurol, 23*(2), 216-227.

Kvaal, K. (2005). *Assessment of anxiety in geriatric patients.* University of Oslo, Oslo.

Lawrentschuk, N., Gani, J., Riordan, R., Esler, S., & Bolton, D. M. (2005). Multidetector computed tomography vs magnetic resonance imaging for defining the upper limit of tumour thrombus in renal cell carcinoma: a study and review. *BJU Int, 96*(3), 291-295.

Lazarus, R. (1991). *Emotions & Adaptation*. Oxford: Oxford University Press.

Leventhal, H., Brown, D., Shacham, S., & Engquist, G. (1979). Effects of preparatory information about sensations, threat of pain, and attention on cold pressor distress. *J Pers Soc Psychol, 37*(5), 688-714.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, Califonia: Sage publications, Inc.

Lukins, R., Davan, I. G., & Drummond, P. D. (1997). A cognitive behavioural approach to preventing anxiety during magnetic resonance imaging. *J Behav Ther Exp Psychiatry, 28*(2), 97-104.

MacKenzie, R., Sims, C., Owens, R. G., & Dixon, A. K. (1995). Patients' perceptions of magnetic resonance imaging. *Clin Radiol, 50*(3), 137-143.

Maguire, D., Walsh, J. C., & Little, C. L. (2004). The effect of information and behavioural training on endoscopy patients' clinical outcomes. *Patient Educ Couns, 54*(1), 61-65.

Malviya, S., Voepel-Lewis, T., Eldevik, O. P., Rockwell, D. T., Wong, J. H., & Tait, A. R. (2000). Sedation and general anaesthesia in children undergoing MRI and CT: adverse events and outcomes. *Br J Anaesth, 84*(6), 743-748.

McGlynn, F. D., Karg, R., & Lawyer, S. R. (2003). Fear responses to mock magnetic resonance imaging among college students: toward a prototype experiment. *J Anxiety Disord, 17*(3), 335-347.

McIsaac, H. K., Thordarson, D. S., Shafran, R., Rachman, S., & Poole, G. (1998). Claustrophobia and the magnetic resonance imaging procedure. *J Behav Med, 21*(3), 255-268.

McLean, D., Malitz, N., & Lewis, S. (2003). Survey of effective dose levels from typical paediatric CT protocols. *Australas Radiol, 47*(2), 135-142.

McNally, R. J. (1990). Psychological approaches to panic disorder: a review. *Psychol Bull, 108*(3), 403-419.

McRobbie, D. W., Moore, E. A., Graves, M. J., & Prince, M. R. (2007). *MRI, from picture to proton* (2 ed.). Cambridge: Cambridge University Press.

Merckelbach, H., & Muris, P. (2001). Specific Phobias. In E. L. J. Griez, C. Faravelli, D. Nutt & D. Zohar (Eds.), *Anxiety disorders* (Vol. Cap 6): John Wiley & Sons Ltd.

Merleau-Ponty, M. (2002). *Phenomenology of perception* (2 ed.). London: Taylor & Francis.

Mikulaninec, C. E. (1987). Effects of mailed preoperative instructions on learning and anxiety. *Patient Educ Couns, 10*(3), 253-265.
Mirowitz, S. A. (1999). MR imaging artefacts, challenges and solutions. *Magnetic Resonance Imaging Clinics of North America, 7*, 717-732.
Mitchell, M. (1997). Patients' perceptions of pre-operative preparation for day surgery. *J Adv Nurs, 26*(2), 356-363.
Moran, D. (2008). *Introduction to phenomenology* (2 ed.). London: Routledge.
Morrison, P., & Burnad, P. (1997). *Caring and communication, the interpersonal relation in nursing* (2 ed.). London: Macmillan.
Murphy, K. J., & Brunberg, J. A. (1997). Adult claustrophobia, anxiety and sedation in MRI. *Magn Reson Imaging, 15*(1), 51-54.
Myhr, G., Nordlid, K., Ajörnerud, B., & Lihaug, E. G. (2002). *Fokus på MRI og bruk av kontrastmidler* (2 ed.). Oslo: Amersham Health.
Nazemi, H., & Dager, S. R. (2003). Coping strategies of panic and control subjects undergoing lactate infusion during magnetic resonance imaging confinement. *Compr Psychiatry, 44*(3), 190-197.
NOBAB. (2003). Nordisk standard för barn och ungdomar inom hälso- och sjukvård. *Nordisk förening för syke barns behov*.
Ollendick, T., King, N., & Muris, P. (2002). Fears and phobias in children: phenomenology, epidemiology and aetiology. *Child and Adolescent Mental Health, 7*, 98-106.
Ottosson, J.-O. (2010). *Psykiatri* (7 ed.). Stockholm: Liber.
Overbeek, T., Vermetten, E., & Griez, E. L. J. (2001). *Epidemiology of anxiety disorders*: John Wiley & Sons Ltd.
Pages, J., Buls, N., & Osteaux, M. (2003). CT doses in children: a multicentre study. *Br J Radiol, 76*(911), 803-811.
Palermo, T. M., Tripi, P. A., & Burgess, E. (2000). Parental presence during anaesthesia induction for outpatient surgery of the infant. *Paediatr Anaesth, 10*(5), 487-491.
Parsons, M. W., Yang, Q., Barber, P. A., Darby, D. G., Desmond, P. M., Gerraty, R. P., et al. (2001). Perfusion magnetic resonance imaging maps in hyperacute stroke: relative cerebral blood flow most accurately identifies tissue destined to infarct. *Stroke, 32*(7), 1581-1587.
Paterson, A., Frush, D. P., & Donnelly, L. F. (2001). Helical CT of the body: are settings adjusted for pediatric patients? *AJR Am J Roentgenol, 176*(2), 297-301.
Piira, T., Sugiura, T., Champion, G. D., Donnelly, N., & Cole, A. S. (2005). The role of parental presence in the context of children's medical procedures: a systematic review. *Child Care Health Dev, 31*(2), 233-243.
Pineiro, R., Pendlebury, S., Johansen-Berg, H., & Matthews, P. M. (2002). Altered hemodynamic responses in patients after subcortical stroke measured by functional MRI. *Stroke, 33*(1), 103-109.
Polit, D. F., & Beck, C. T. (2006). *Essentials of nursing research: methods, appraisal and utilization* (6 ed.). Philadelphia: Lippincott William & Wilkins.
Pramling, I. (1983). *The child's conception of learning.* Göteborgs universitet, Göteborg.

Pressdee, D., May, L., Eastman, E., & Grier, D. (1997). The use of play therapy in the preparation of children undergoing MR imaging. *Clin Radiol, 52*(12), 945-947.
Quirk, M. E., Letendre, A. J., Ciottone, R. A., & Lingley, J. F. (1989a). Anxiety in patients undergoing MR imaging. *Radiology, 170*(2), 463-466.
Quirk, M. E., Letendre, A. J., Ciottone, R. A., & Lingley, J. F. (1989b). Evaluation of three psychologic interventions to reduce anxiety during MR imaging. *Radiology, 173*(3), 759-762.
Royal College of Nursing. (2005). *Informed consent in health and social care research. http://www.rcn.org.uk/__data/assets/pdf_file/0010/78607/002267.pdf* o.
Rudack, C., Jorg, S., Kloska, S., Stoll, W., & Thiede, O. (2007). Neither MRI, CT nor US is superior to diagnose tumors in the salivary glands--an extended case study. *Head Face Med, 3*, 19.
Runeson, I., Hallstrom, I., Elander, G., & Hermeren, G. (2002). Children's needs during hospitalization: an observational study of hospitalized boys. *Int J Nurs Pract, 8*(3), 158-166.
Salmela, M., Salantera, S., & Aronen, E. T. (2010). Coping with hospital-related fears: experiences of pre-school-aged children. *J Adv Nurs, 66*(6), 1222-1231.
Selim, M. A. (2001). Effect of pre-instruction on anxiety levels of patients undergoing magnetic resonance imaging examination. *East Mediterr Health J, 7*(3), 519-525.
The Swedish Healt and Medical Services Act (Hälso- och sjukvårdslagen), (1982:763).
Shaw, C. (1999). A framework for the study of coping, illness behaviour and outcomes. *J Adv Nurs, 29*(5), 1246-1255.
Shellock, F. G. (2002). Magnetic resonance safety update 2002: implants and devices. *J Magn Reson Imaging, 16*(5), 485-496.
Shields, L., Pratt, J., & Hunter, J. (2006). Family centred care: a review of qualitative studies. *J Clin Nurs, 15*(10), 1317-1323.
Shrimpton, P. C., & Wall, B. F. (2000). Reference doses for paediatric computed tomography. *Radiat Prot Dosimetry, 90*, 249-252.
Simon, E. P. (1999). Hypnosis using a communication device to increase magnetic resonance imaging tolerance with a claustrophobic patient. *Mil Med, 164*(1), 71-72.
Spielberger, C. D. (1983). *State-Trait Anxiety Inventory (Form Y)*. Redwood City: Mind Garden, Inc.
Södra Regionvårdnämnden. (2010). Local prices and compensations in the Southern Health care region, 2010. Retrieved 03032010, from http://www.srvn.org
Tak, J. H., & van Bon, W. H. (2006). Pain- and distress-reducing interventions for venepuncture in children. *Child Care Health Dev, 32*(3), 257-268.
Taylor, S. (1995). Anxiety sensitivity: theoretical perspectives and recent findings. *Behav Res Ther, 33*(3), 243-258.
Theocharopoulos, N., Damilakis, J., Perisinakis, K., Tzedakis, A., Karantanas, A., & Gourtsoyiannis, N. (2006). Estimation of effective doses to adult and pediatric patients from multislice computed tomography: A method based on energy imparted. *Med Phys, 33*(10), 3846-3856.

Thompson, M. B., & Coppens, N. M. (1994). The effects of guided imagery on anxiety levels and movement of clients undergoing magnetic resonance imaging. *Holist Nurs Pract, 8*(2), 59-69.

Thorpe, S., Salkovskis, P. M., & Dittner, A. (2008). Claustrophobia in MRI: the role of cognitions. *Magn Reson Imaging, 26*(8), 1081-1088.

Tyc, V. L., Fairclough, D., Fletcher, B., Leigh, L., & Mulhern, R. K. (1995). Children's distress during magnetic resonance imaging procedures. *Child Health Care, 24*(1), 5-19.

Uman, L. S., Chambers, C. T., McGrath, P. J., & Kisely, S. (2008). A systematic review of randomized controlled trials examining psychological interventions for needle-related procedural pain and distress in children and adolescents: an abbreviated cochrane review. *J Pediatr Psychol, 33*(8), 842-854.

UNICEF. (1989). Convention on the Rights of the Child. http://www2.ohchr.org/english/law/crc.htm.

Walker, J. A. (2002). Emotional and psychological preoperative preparation in adults. *Br J Nurs, 11*(8), 567-575.

Wallace, L. M. (1984). Psychological preparation as a method of reducing the stress of surgery. *J Human Stress, 10*(2), 62-77.

Wallace, L. M. (1986). Communication variables in the design of pre-surgical preparatory information. *Br J Clin Psychol, 25 ( Pt 2)*, 111-118.

Walsh, D., & Shaw, D. (2000). The design of written information for cardiac patients: a review of the literature. *Journal of Clinical Nursing, 9*, 658-667.

Van de Walle, R., Lemahieu, I., & Achten, E. (1997). Magnetic resonance imaging and the reduction of motion artifacts: review of the principles. *Technol Health Care, 5*(6), 419-435.

van Manen, M. (1997). *Researching lived experience: human science for an action sensitive pedagogy* (2 ed.). Ontario: Althouse press.

Ware, D. E., Huda, W., Mergo, P. J., & Litwiller, A. L. (1999). Radiation effective doses to patients undergoing abdominal CT examinations. *Radiology, 210*(3), 645-650.

Varni, J. W., Quiggens, D. J. L., & Ayala, G. X. (2000). Development of the Pediatric Hematology/Oncology Parent Satisfaction Survey *Children's Health Care, 29*(3), 243-255.

Verdun, F. R., Gutierrez, D., Vader, J. P., Aroua, A., Alamo-Maestre, L. T., Bochud, F., et al. (2008). CT radiation dose in children: a survey to establish age-based diagnostic reference levels in Switzerland. *Eur Radiol*.

Westbrook, C., Kaut Roth, C., & Talbot, J. (2005). *MRI in Practice* (3 ed.). Oxford: John Wiley and Sons.

WHO. (1994). ICP/HLE 121, A declaration on the promotion of patiens' rights in Europe. Retrieved 0920, 2005

Willis, D., & Barry, P. (2010). Audiovisual interventions to reduce the use of general anaesthesia with paediatric patients during radiation therapy. *J Med Imaging Radiat Oncol, 54*(3), 249-255.

Wilson-Barnett, J. (1984). Interventions to alleviate patients' stress: a review. *J Psychosom Res, 28*(1), 63-72.

Voepel-Lewis, T., Malviya, S., Prochaska, G., & Tait, A. R. (2000). Sedation failures in children undergoing MRI and CT: is temperament a factor? *Paediatr Anaesth, 10*(3), 319-323.

Von Ungern-Sternberg, B., & Habre, W. (2007). Pediatric anesthesia - potential risks and their assessment: part I. *Paediatr Anaesth, 17*(3), 206-215.

Youssefzadeh, S., Eibenberger, K., Helbich, T., Dorffner, R., Dantendorfer, K., Breitenseher, M., et al. (1997). Reduction of adverse events in MRI of the breast by personal patient care. *Clin Radiol, 52*(11), 862-864.

Zalis, M., & Singh, A. K. (2004). Imaging of inflammatory bowel disease: CT and MR. *Dig Dis, 22*(1), 56-62.

Zelikovsky, N., Rodrigue, J. R., Gidycz, C. A., & Davis, M. A. (2000). Cognitive behavioral and behavioral interventions help young children cope during a voiding cystourethrogram. *J Pediatr Psychol, 25*(8), 535-543.

**Appendix I**

## Vill Du veta mer om undersökningen?

**När Du kommer** till MR-avdelningen anmäler Du Dig i receptionen. Personalen där tar då emot det gröna papperet som Du troligtvis fått hemskickad tillsammans med kallelsen. Vill Du lyssna på musik under undersökningen kan Du välja ur avdelningens utbud, eller lämna den CD Du ev. har med Dig till personalen i receptionen. De kommer också, som en säkerhetsåtgärd, att fråga om metallföremål och hjälpa Dig att låsa in metallföremål och värdesaker i ett skåp.

**Undersökningen går till så** att Du får ligga upp på undersökningsbordet och röntgensjuksköterskan, som genomför undersökningen, hjälper Dig att lägga Dig bekvämt tillrätta, ibland med hjälp av kuddar som stöd så att Du kan ligga stilla under bildtagningen. Beroende på vilket organ som ska undersökas placeras en s.k. spole nära det aktuella organet. Vid undersökning av ryggen ligger spolen under madrassen, och märks alltså inte. Vid undersökning av huvudet är spolen konstruerad så att ett ”visir” fälls ned framför ansiktet. Du kommer att få öronproppar eller hörlurar och en ringklocka (ser ut som en gummiboll) i handen. När Du ligger bekvämt förs undersökningsbordet in i magnetkameran.

**Hur känns det då?** Som med det mesta så upplever olika personer undersökningen på olika sätt. En del har inga besvär alls vid undersökningen. Vissa patienter upplever det trånga utrymmet som besvärligt medan andra tycker att det höga ljudet besvärar dem. Ljudet varierar under undersökningen, både i styrka och hastighet. Det kan beskrivas som ett knackande eller bankande ljud. Några menar att undersökningsbritsen vibrerar i takt med det bankande ljudet.

**Vad kan man göra åt detta?** För att Du ska kunna få kontakt med personalen under undersökningen får Du *gummibollen* (ringklockan) i handen. Om Du trycker på den så kommer det att höras en tydlig signal i manöverrummet där personalen sitter. Dessutom markeras på datorskärmen (som används för undersökningen) att Du har tryckt på ringklockan. Personalen kommer alltså att både se och höra att Du vill prata med dem.

Det finns också ett *högtalarsystem* som gör att Du och personalen kan prata med varandra under undersökningen. Mellan undersökningsrummet och manöverrummet finns ett stort fönster som gör att personalen kan se Dig under hela undersökningen. Om Du vill kan Du också få en *spegel* som gör att Du kan titta ut ur maskinen.

*Musik* brukar de flesta patienter uppskatta, även om den hörs lite dåligt just när bilderna tas. Om Du vill får Du gärna *ha med Dig en anhörig eller vän* inne i undersökningsrummet. Det kan dessutom vara bra att veta att det är *ljust* och bra *ventilation* i magnetkameran. Eftersom det är ett starkt ljud under bildtagningen kommer Du att få *öronproppar* eller *hörlurar*. Öronproppar används vid undersökning av huvud eller halsrygg, eftersom hörlurar vid dessa undersökningar stör bildkvaliteten.

En del patienter vill ha lugnande medel vid undersökningen. Tror Du att Du behöver detta bör Du ringa till avdelningen och ev. få en annan tid (det krävs att lite längre tid bokas in för undersökningen). Tänk på att Du då inte kan köra bil efter undersökningen.

**Varför det trånga utrymmet?** Vid en MR-, eller magnetkameraundersökning krävs ett starkt statiskt magnetfält. Det starka magnetfältet skapas i magnetkameran och patienten måste alltså ligga i maskinen. Maskinen ser ut som en tunnel som är öppen i båda ändar. För att få bra bildkvalité kan inte tunneln vara alltför stor. I princip kan man säga att ju trängre tunnel desto bättre bildkvalité.

**Varför s.k. spole?** För att skapa bilder krävs, förutom magnetfältet, radiovågor som kroppen ”svarar” på. För att skicka ut och ta emot dessa signaler krävs en spole som är placerad nära det undersökta organet.

**Varför det kraftiga ljudet?** När signalerna samlas in från kroppen måste datorn kunna härleda varifrån i kroppen signalen kommer och därmed kunna skapa en bild. För att kunna göra detta slås svaga tidsvarierade magnetfält (s.k. gradienter) av och på under själva bildtagningen. Det är dessa gradienter som skapar ”oljudet” i maskinen. Vid varje undersökning tas flera bildserier av varierande slag. Det innebär att knackningarna varierar både i styrka, frekvens och hur länge de håller på. Vilka och hur många bildserier som tas varierar beroende på vilket organ som undersöks. Detta innebär att *undersökningstiden* varierar (mellan 30 till 60 minuter). Varje undersökning inleds med att snabba (några sekunder) s.k. översiktsbilder tas. Övriga bildserier tar vanligtvis mellan 2 till 6 minuter, och det är viktigt att Du då försöker ligga stilla.

**Varför inga smycken mm?** Eftersom det är ett starkt magnetfält kan:

- lösa magnetiska metallföremål dras in i magnetkameran
- metallföremål som inte är magnetiska (t.ex. guld) störa bildkvaliteten
- klockor förstöras och bankkort avmagnetiseras.

Om Du har någon med Dig in i undersökningsrummet kan den personen alltså ha byxor med blixtlås på sig men inte t.ex. klocka eller plånbok.

Ibland tillför **kontrastmedel** ytterligare information vid undersökningen. Om Du ska ha kontrastmedel vid undersökningen kommer Du att få en tunn plastslang i en ven på armen. (Vid kontrastundersökning av tarmen ges kontrasten som ett litet lavemang.) Kontrastmedlet har ingen annan effekt än att den kan ge ytterligare information vid viss bildtagning. Kontrastmedlet är ett speciellt MR-kontrastmedel och är inte samma som vid röntgen-undersökningar (dvs inte jodkontrastmedel).

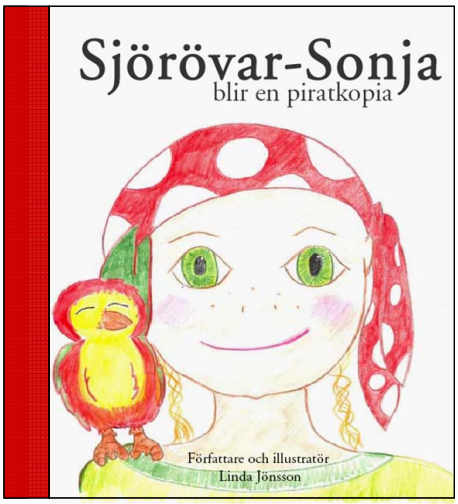
**Är undersökningen farlig?** MR har studerats ingående med avseende på risker/biologiska effekter och anses vara oskadlig för patienten.

Röntgenläkare, som är experter på att granska MR-bilder, kommer att inom några dagar att granska Dina bilder. **Svaret på undersökningen** kommer därefter att skickas till den läkare som skrivit remissen (vanligtvis inom en till tre veckor).

Lund 2003

**Appendix II**

Model of MRI scanner




Story book


Booklet