Assessment and treatment of dizzy patients in primary health care.

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Cover illustration
Example of exercise in vestibular rehabilitation.
Drawing by Sofia Bågenhammar.

Till min familj

"There can be few physicians so dedicated to their art that they do not experience a slight decline in spirit when they learn that their patient's complaint is dizziness"

WB Matthews, Practical Neurology, Oxford: Blackwell, 1963

Abstract

Dizziness is a common reason for visits to primary health care, especially among elderly patients. From a physiotherapeutic perspective, this thesis aims to study the assessment and treatment of dizzy patients in primary health care. Interventions in papers I, III and IV comprised a vestibular rehabilitation programme.

In paper I, patients with multisensory dizziness were randomized to intervention group or control group. At follow-up after six weeks and three months, the intervention group had improved their postural control while the control group had deteriorated. In paper II, the diagnostic panorama at a primary health care centre was studied, as well as balance measures and self-perceived handicap because of dizziness. Patients with multisensory dizziness performed more poorly on the balance measures than the other groups. Subjects 66 years or older had more disturbances in balance, but lower level of self-perceived handicap. The level of self-perceived handicap did not correlate with any of the balance measures. In paper III, patients with dizziness caused by whiplash associated disorder were randomized to intervention group or control group. At follow-up after six weeks and three months, the intervention group had improved in both balance measures and self-perceived handicap. In paper IV, patients with multisensory dizziness were studied. An intervention group was compared to a control group regarding balance measures, self-perceived handicap and the proportions of patients who fell. At the follow-up after three months, the intervention group had improved in two balance measures. There were no differences between the two groups in the proportions of patients who fell.

This thesis indicates vestibular rehabilitation as a feasible treatment for dizzy patients in primary health care. Since primary health care is considered the appropriate level of medical care for the majority of dizzy patients, this is also where vestibular rehabilitation is best provided, preferably by a trained physiotherapist.

List of publications

This thesis is based on the following publications, which will be referred to by their Roman numerals.

I. Ekvall Hansson E, Månsson N-O, Håkansson A. Effects of specific rehabilitation for dizziness among patients in primary health care. Clinical Rehabilitation 2004;18:558–565.

II. Ekvall Hansson E, Månsson N-O, Håkansson A. Balance performance and self-perceived handicap among dizzy patients in primary health care. Scandinavian Journal of Primary Health Care 2005;23:215–220.

III. Ekvall Hansson E, Månsson N-O, Ringsberg KA, Håkansson A. Dizziness among patients with whiplash associated disorder – a randomized controlled trial. Submitted.

IV. Ekvall Hansson E, Månsson N-O, Ringsberg KA, Håkansson A. Falls among dizzy patients in primary health care – an intervention study with control group. Submitted.

Abbreviations

CI	Confidence interval
COR	Cervico-ocular reflex
DHI	Dizziness Handicap Inventory
OR	Odds ratio
SD	Standard deviation
SOLEC	Standing one leg eyes closed
SOLEO	Standing one leg eyes open
VAS	Visual analogue scale
VOR	Vestibulo-ocular reflex
VR	Vestibular rehabilitation
WAD	Whiplash associated disorder

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Introduction

Dizziness

Dizziness is a common problem among patients in primary health care (Warner et al., 1992, Eaton and Roland, 2003a). Lifetime prevalence of dizziness is about 8% (Neuhauser et al., 2005). About 1–2% of the visits to a general practitioner in primary health care are caused by dizziness (Hansson et al., 2003). Considering the many visits to primary health care in total (11 714 800 in Sweden 2004) (www.skl.se, 2004), 1–2% is not negligible.

Almost 45% of all outpatients with dizziness are seen in primary health care (Sloane, 1989). It is the most common symptom in elderly patients (Sloane et al., 1989, Hobeika, 1999, Grimby and Rosenhall, 1995) and has been identified as a risk factor for falls (Moreland et al., 2003, Tinetti et al., 2000). The cause of dizziness is often benign, and life-threatening conditions are rare (Kroenke et al., 1992).

Dizziness is often used as a non-specific term to describe many sensations, including vertigo, presyncope, disequilibrium and lightheadedness (Luxon and Davies, 1997). Dizziness is also used as a more specific term: a feeling of unsteadiness or a mild intoxication or as if the ground is rocking or the affected person has to take side steps to maintain balance. These symptoms often occur in cases where dizziness has a multisensory cause (see page 11). Vertigo, on the other hand, is often described as a feeling of rotation; the room or surroundings are spinning around like a carousel. When vertigo occurs, especially in combination with nausea, the symptoms most likely have a vestibular cause. Presyncope is commonly described as a sensation of impending fainting or sense of falling. Lightheadedness is a much more vague description of dizziness, difficult to define (Warner et al., 1992).

Dizziness and disturbances in balance have an impact on everyday life, and thorough and elaborated assessment of the dizzy patient is important in order to provide proper rehabilitation (Cavanaugh, 1999).

Balance

Balance, postural control, equilibrium and postural performance are all definitions used to describe how we keep our body in an upright position and, when necessary, adjust this position. Nashner and co-workers' description of balance is: "sensing the position of the body's centre of mass and moving the body to adjust the position of the centre of mass over the base of support provided by the feet" (Nashner et al., 1988). Balance performance decreases with age (Mille et al., 2005, Jonsson et al., 2004b, Hatzitaki et al., 2005, Choy et al., 2003, Briggs et al., 1989, Bohannon et al., 1984, Balogun et al., 1994), and people with deafness have been shown to decrease in postural control (Möller et al., 1997)

In order to maintain balance, the vestibular system, the somato-sensory system and vision interact and register inputs from the surroundings, which are integrated and processed in the brainstem. The vestibulo-ocular reflex (VOR) coordinates eye and head movements, making it possible, for example, to walk and read signs at the same

time (Möller et al., 1997, Luxon and Davies, 1997). The cervico-ocular reflex (COR) interacts with VOR, providing information about head movements in relation to the trunk (Karlberg, 1995). Cognition of the processed input takes place in the thalamus and cortex (Brown, 1990).

Postural control is dependent on biomechanical components, such as decreased range of motion or decreased strength. Pain is also a biomechanical component, although of minor importance in postural control (Bennell and Hinman, 2005). Motor activity, such as compensatory stepping, is another component in postural control, and sensory components, such as deficit in physical senses of touch in the feet, are a third (Magnusson et al., 1990, Ragnarsdóttir, 1996), playing an important role in balance (Kristinsdottir et al., 2001a, Backlund Wasling et al., 2005).

Assessment of the dizzy patient

A thorough anamnesis is of importance to elucidate the origin of dizziness. The patient's description of the symptoms, their duration and when they occur, guides the examiner towards diagnosis. Clinical characteristics, such as duration, intensity, nausea, neurological symptoms, hearing loss and symptoms affected by head position can differentiate central vertigo from peripheral vertigo (Warner et al., 1992).

Even if the cause of dizziness is often benign, it is necessary to ascertain neurological status (Luxon and Davies, 1997). Examination of the ear, assessment of eye movements, function of the cerebellum and cranial nerves can well be used. Some form of clinical balance measure is advisable (Kammerlind et al., 2005), for example tandem stance and standing on one leg (see p 16, Balance Measures). The Unterberger-Fukuda stepping test is taken to signify peripheral vestibular dysfunction (Schneider et al., 1991). The Dix-Hallpike manoeuvre is a valid and reliable test for Benign Paroxysmal Positional Vertigo (BPPV) and takes minor effort to perform (Lanska and Remler, 1997, Dix and Hallpike, 1952b). Test of range of motion in the neck and palpation of muscles and tissues in the upper cervical region should also be a part of assessment (Karlberg et al., 1996b), since dysfunction of these muscles can cause vertigo.

Diagnoses of dizziness

In primary health care, a variety of patients are present, with a diversity of diagnoses. For dizziness, the ICD10 diagnosis R42 is commonly used (Hansson et al., 2003). However, a closer look at R42 reveals that this diagnosis probably contains a variety of more specified diagnoses. The following diagnoses are dealt with in this thesis:

Multisensory dizziness

This is considered to be the relevant diagnosis for elderly patients with dizziness (Drachman and Hart, 1972). The condition is characterized by pathology involving multiple sensory systems such as vision, hearing, peripheral vestibular function, balance and muscle function.

Impaired vestibular function has been found among healthy elderly as well as among elderly with wrist fractures and hip fractures (Kristinsdottir et al., 2001b,

Kristinsdottir et al., 1997, Kristinsdottir et al., 2000). In healthy elderly, deficits in vibration sense have also been found (Kristinsdottir et al., 1997) as well as impaired balance (Gustafson et al., 2000), and an age-related decline in neurons and in hair cells in the vestibular system has been found (Park et al., 2001, Rauch et al., 2001). Balance deficits have also been seen among 75-year-old women with signs of osteoporosis (Gerdhem et al., 2005).

The patient with multisensory dizziness often describes a feeling of unsteadiness which is accentuated when walking outdoors or on an uneven surface. Situations with many sensory inputs, such as in crowds, augment the symptoms. A typical feature of this condition is problems with walking. The treatment consists of vestibular rehabilitation (Kammerlind et al., 2001). Physical activity has also been recognized as beneficial for preventing falls among elderly patients (Gillespie et al., 2005).

Benign positional paroxysmal vertigo (BPPV)

One of the most common causes of vertigo is BPPV (Nuti et al., 1998). It can be present at any age, but is most common among people in the sixth and seventh decades (Hansson and Månsson, 2005, Hilton and Pinder, 2003) and is believed to be an underestimated cause of vertigo among elderly patients (Hansson et al., 2005).

In BPPV, head movements trigger the onset of symptoms, often when the patient is turning in bed or lying down from an upright position. There is a latency of a few seconds between the head movement and the symptoms, and vertigo ceases after about thirty seconds. The theory of the pathogenesis is that degenerative debris from the utricle floats free in the endolymph of, most often, the posterior canal (Schuknecht, 1969, Hilton and Pinder, 2003, Herdman et al., 1993, Barany, 1921). The debris causes an illusion of movement which, in turn, causes vertigo, nystagmus and nausea. The Dix-Hallpike manoeuvre confirms the diagnosis. It is performed with the patient sitting on the examiner's couch. The examiner turns the patient's head 45 degrees to the side and extends it slightly. The examiner then helps the patient to lie down quickly on the back with the head extended over the edge of the couch. If vertigo and nystagmus occur after a latency of a few seconds, and then cease again after 30 seconds to one minute, the test is positive (Dix and Hallpike, 1952b, Dix and Hallpike, 1952a, Lanska and Remler, 1997, Luxon and Davies, 1997). The condition is treated either with canalith repositioning manoeuvres or habituation exercise (Epley, 1992, Brandt and Daroff, 1980, Cawthorne, 1945, Cooksey, 1946, Semont et al., 1988, White et al., 2005).

Peripheral vestibular lesion

Typical for this condition is a sudden, one-sided deficit in vestibular function, in clinical practice often called vestibular neuronitis. The onset is acute, with continuous vertigo, lasting for more than 24 hours. The patient is frequently nauseous and vomiting is common but there is no hearing loss or other neurological signs (Warner et al., 1992). The aetiology is often unknown, although viral infection is suggested to be the cause (Eaton and Roland, 2003b). In elderly patients, indication of vascular lesions has been found (Aquilonius and Fagius, 1994).

Vestibular rehabilitation is beneficial both for reducing the time to recovery and for treatment of prolonged symptoms (Dannenbaum et al., 2004, Cohen and Kimball, 2003).

Neurological causes of dizziness

Dizziness can occur after a stroke or concomitant with migraine or brainstem vascular disease. Infections in the nervous system (i.e. meningitis), metabolic dysfunctions (hyperventilation), inflammatory disease, intoxication and tumours are other neurological causes of dizziness (Luxon and Davies, 1997) and dizziness occurs often among patients with epilepsy and with dementia (Henriksson, 1983). One-third of patients with multiple sclerosis experience vertigo some time during the course of the disease (Warner et al., 1992). These patients have also responded positively to vestibular rehabilitation (Brown et al., 2006, Cowand et al., 1998).

Dizziness of cervical origin

The muscles of the neck are abundantly provided with proprioceptors. This proprioceptive system provides sensory input for control of posture, spatial orientation and coordination of eye, head and body (Karlberg et al., 1996a). The cervico-ocular reflex (COR) interacts with the vestibulo-ocular reflex (VOR) but seems to be a secondary contributor to the stabilization of visual field (Norré, 1990).

Persons with cervico-brachial pain have been shown to have more disturbances in balance than healthy subjects (Karlberg et al., 1995) and their disturbed postural control differs from that in patients with vestibular neuronitis (Karlberg et al., 1996a).

The theory behind dizziness of cervical origin is that elevated tension in the muscles in the upper cervical region causes an increase in sensory input from the proprioceptive system of the neck, which, in turn, creates a conflict, since other proprioceptive systems do not provide the same increase in sensory input. The brain cannot manage such a mismatch of information and the patient experiences dizziness, which occurs at the same time as the neck pain (Karlberg, 1995). Physical therapy aimed at decreasing pain and muscle tension in the upper cervical region has been shown to relieve symptoms (Karlberg et al., 1996b).

Whiplash associated disorders (WAD) and dizziness

Almost 25% of persons with WAD have dizziness as one symptom (Drottning et al., 1995). Muscular tension is associated with WAD and therefore the same theory as in dizziness of cervical origin is applicable (Karlberg et al., 1995, Treleaven et al., 2005). Instability in the neck can also cause dizziness (Hinoki, 1985). Abnormal electro-nystagmographic findings have been reported (Oosterveld et al., 1991), and those who develop dizziness later also have signs of vestibular damage immediately after the injury (Bergenius et al., 2000). Psychosocial factors matter in the development of dizziness associated with WAD (Bergenius et al., 2000) and post-traumatic dizziness can result in chronic symptoms (Marzo et al., 2004).

Phobic postural vertigo (PPV)

The diagnosis of PPV is based on six typical features: 1) Dizziness and subjective disturbance of balance in an upright static position and during motion, despite normal

clinical balance tests. 2) Postural vertigo described as fluctuating unsteadiness, often taking the form of attacks or sometimes the perception of illusory body perturbations for mere fractions of seconds. 3) Vertigo attacks that can occur spontaneously but which, after specific questioning, are found to be almost invariably associated with particular constellations of perceptional stimuli or social situations. There is a tendency for rapid conditioning, generalization and avoidance behaviour to develop. 4) Anxiety and distressing vegetative symptoms accompanying and subsequent to the vertigo attack, and elicited by direct questioning. 5) Typically, an obsessive-compulsive personality in patients who often have affective lability and mild depression. 6) Frequently, onset of the condition follows periods of particular stress or after the patient has experienced an illness, usually a vestibular disorder.

The first three of these features are compulsory, but the rest are often found in most patients (Brandt et al., 1994).

Balance Measures

Assessment of the dizzy patient includes various balance measures, of which a wide range is available (Berg et al., 1992, Bohannon et al., 1984, Ekdahl et al., 1989, Jarnlo and Thorngren, 1991, Johansson and Jarnlo, 1991, Ledin et al., 1990/91, Lundin-Olsson et al., 1997, Mathias et al., 1986). Which of these to use depends on the context and on the condition of the patient. “Stops walking when talking” has been shown to detect fallers from non-fallers in elderly people living in sheltered accommodation (Lundin-Olsson et al., 1997). Functional reach, one-legged standing, the balance scale and “Get-up and Go” test have all proved to be valid and reliable balance measures in elderly patients (Mathias et al., 1986). The modified figure of eight has shown high reliability and satisfactory concurrent validity when used on elderly, community-dwelling women (Jarnlo and Nordell, 2003).

The measures used in this thesis are:

The Romberg test

In this test, the patient stands with feet together and the time in seconds is counted, either up to 30 seconds or up to 60 seconds (figure 1). The test can be performed with eyes open and with eyes closed (Ringsberg et al., 1998).

Tandem standing

The test is performed with one foot placed right in front of the other. Time up to 30 seconds is registered (figure 2). The preferred foot is used and three attempts are allowed; the results from the best attempt are used. The test consist of two parts, one with eyes open and one with eyes closed (Ledin et al., 1990/91). The test is considered to be a static balance measure, but has an initial, dynamic phase (Jonsson et al., 2005).

Standing one leg eyes open (SOLEO) and eyes closed (SOLEC)

The patient stands on one leg, hands resting on the sacrum (figure 3). Time up to 30 seconds is registered. Three attempts are allowed, and the results from the best attempt are used (Jarnlo and Thorngren, 1991).

SOLEO and SOLEC are both considered to be static balance measures with an initial dynamic phase (Jonsson et al., 2004a). SOLEO has been found to have high interrater reliability, but limited concurrent validity (Giorgetti et al., 1998, Harrison et al., 1994).

Walking heel to toe on a line

A five-metre long and five-centimetre wide line on the floor is used, where the patient walks heel to toe (Ledin et al., 1990/91). Steps outside the line are counted (figure 4).

Figure of eight

Two circles with an inner diameter of 1.5 meter and an outer diameter of 1.65 meter, which gives a 15-centimetre step width. Two additional circles are placed, so that the four circles form a figure of eight. The patient walks twice in the figure (figure 5). The number of steps outside the circles can be counted, or the time to perform the measure (Johansson and Jarnlo, 1991). In this thesis, number of steps outside the circle is used. The figure has been modified to an eight with a single, 4 cm broad line with an inner diameter of 1.63 cm (Jarnlo and Nordell, 2003).

Stops walking when talking

The patient walks about 30 metres in a corridor. At a certain spot, the assessor starts to talk with the patient. If the patients stops the test is considered positive (Lundin-Olsson et al., 1997).

Figure of eight, walking heel to toe and stops walking when talking are all dynamic balance measures.

Figure 1. The Romberg test.

Figure 2. Tandem standing.

Figure 3. Standing one leg eyes open.

Figure 4. Walking heel to toe on a line.

Figure 5. Figure of eight.

Self-perceived handicap

Dizziness has an impact on everyday life, which balance measures or vestibulometric techniques do not necessarily detect, and self-perceived handicap because of dizziness can correlate with functional impairment (Perez et al., 2003, Withney et al., 2004). To measure self-perceived handicap, various self-rating scales are available. The Activities-specific Balance Confidence (ABC) scale can detect loss of balancing confidence in highly functioning seniors (Powell and Myers, 1995). The Vertigo Handicap Questionnaire (VHQ) was developed from the hypothesis that psychological distress contributes to handicap in vertiginous patients (Yardley and Putman, 1992). Changes in health-related quality of life, measured with SF-36, have been seen in patients with benign paroxysmal positional vertigo (Gamiz and Lopez-Escamez, 2004).

The measures used in this thesis are:

Visual analogue scale (VAS)

VAS has been tested for validity and reliability when used in measuring pain (Carlsson, 1983, Price et al., 1983) but has also been used for self-estimating of vertigo and unbalance among elderly patients with non-peripheral vertigo (Kammerlind et al., 2001).

Table 1 The Dizziness Handicap Inventory

Instructions: The purpose of this scale is to identify difficulties that you may be experiencing because of your dizziness or unsteadiness. Please answer "yes," "no," or "sometimes" to each question. Answer each question as it pertains to your dizziness or unsteadiness problem only.

P1	Does looking up increase your problem?
E2	Because of your problem, do you feel frustrated?
F3	Because of your problem, do you restrict your travel for business or recreation?
P4	Does walking down the aisle of a supermarket increase your problem?
F5	Because of your problem, do you have difficulty getting into or out of bed?
F6	Does your problem significantly restrict your participation in social activities such as going out to dinner, going to movies, dancing, or to parties?
F7	Because of your problem, do you have difficulty reading?
P8	Does performing more ambitious activities like sports, dancing, household chores such as sweeping or putting dishes away increase your problem?
E9	Because of your problem, are you afraid to leave your home without having someone accompany you?
E10	Because of your problem, have you been embarrassed in front of others?
P11	Do quick movements of your head increase your problem?
F12	Because of your problem, do you avoid heights?
P13	Does turning over in bed increase your problem?
F14	Because of your problem, is it difficult for you to do strenuous housework or yardwork?
E15	Because of your problem, are you afraid people may think you are intoxicated?
F16	Because of your problem, is it difficult for you to go for a walk by yourself?
P17	Does walking down a sidewalk increase your problem?
E18	Because of your problem, is it difficult for you to concentrate?
F19	Because of your problem, is it difficult for you to walk around your house in the dark?
E20	Because of your problem, are you afraid to stay home alone?
E21	Because of your problem, do you feel handicapped?
E22	Has your problem placed stress on your relationships with members of your family or friends?
E23	Because of your problem, are you depressed?
F24	Does your problem interfere with your job or household responsibilities?
P25	Does bending over increase your problem?

A yes response is scored 4 points, a sometimes response is scored 2 points and a no response is scored 0 points. From Jacobsson GP, Newman CW. The Development of the Dizziness Handicap Inventory. Arch Otolaryngol Head Neck Surg 1990;116:424–427. Copyright © (1990), American Medical Association. All rights reserved. Printed with permission from JAMA&Archives.

The Dizziness Handicap Inventory (DHI)

DHI was developed to evaluate the self-perceived handicapping effects imposed by vestibular system disease (Jacobsson and Newman, 1990) (table 1). DHI has been translated into Swedish and the Swedish version has been tested for reliability (Jacobsson and Newman, 1990, Jarlsäter and Mattsson, 2003). Mean values for different diagnoses are also available (Kammerlind et al., 2005). The inventory comprises 25 different items, organized in three different dimensions: functional,

emotional and physical. The total maximum score is 100 points; for the functional dimension it is 32 points, the emotional 40 points and the physical 28 points. The higher the score, the greater the level of self-perceived handicap.

Vestibular rehabilitation

The central nervous system is plastic, and vestibular compensation in peripheral as well as central vestibular disorder is therefore possible (Suarez et al., 2003, Luxon and Davies, 1997). The first exercise programme was developed by Cawthorne and Cooksey in the forties (Cooksey, 1946, Cawthorne, 1945). Vestibular rehabilitation programmes of today are based on these Cawthorne-Cooksey exercises. In Sweden, Boris Silfverskiöld was a pioneer (Silfverskiöld, 1988). Vestibular rehabilitation is used on various diagnoses of dizziness, not only on peripheral vestibular lesions (Cohen, 2006, Brandt et al., 1994, Kammerlind et al., 2001, Gottshall et al., 2005).

To facilitate rearrangement and recruitment of control capacities, the patient should increasingly be exposed to unstable body positions (Dieterich, 2004). To achieve this, vestibular rehabilitation programmes (VR) often includes exercises with repetitive eye, head and trunk movements and postural instability, created by standing on, for example, foam and turning the head from side to side, walking on a slope and turning the head from side to side, standing on a trampoline and moving the eyes from side to side. The exercises can be performed with open or closed eyes, depending on what each patient is able to perform (figures 6–11).

The interventions in papers I, III and IV comprised vestibular rehabilitation programme at group session, for approximately 50 minutes, twice a week for six (paper II and III) or nine weeks (paper IV). The programme started with a ten-minute warm-up phase, which was followed by exercises aimed to stimulate the vestibular system, as described above.

Vestibular rehabilitation programmes are most effective when customized to the individual patient and supervised by a trained physical therapist (Badke et al., 2004, Telian and Shepard, 1996). Vestibular rehabilitation has also shown to reduce falls among frail elderly people in retirement villages (Lord et al., 2003) and in older patients with vestibular deficits (Macias et al., 2005). It is both feasible and effective on dizziness in primary health care (Yardley et al., 2004).

Figure 6. Example of exercise in a vestibular rehabilitation programme. Standing on foam with eyes closed and turning the head from side to side.

Figure 7. Standing on a trampoline, eyes closed and slightly flexing the knees and turning the head from side to side simultaneously.

Figure 8. Standing on a sport mat, walking on the spot and turning the head from side to side to side.

Figure 9. Standing on a balance pad and moving the eyes from side.

Figure 10. Walking forward and backward while turning the head from side to side.

Figure 11. Sitting on a ball, feet on foam, eyes closed and bouncing slightly while turning the head from side to side.

Aims

General aim

Since dizziness is a common problem, which seems to be insufficiently elucidated in primary health care, the general aim of this thesis is to evaluate, from a physiotherapeutic perspective, the assessment as well as feasibility and effect of vestibular rehabilitation as a treatment for dizzy patients in primary health care.

Specific aims

- To study the effect of specific rehabilitation for dizziness among patients, 50 years and older with multisensory dizziness, on clinical balance measures and the apprehension of dizziness, measured with visual analogue scale (paper I).

- To study the diagnostic panorama at a primary health care centre and to study balance measures of dizzy patients and measures of self-perceived handicap and to analyse whether these measures correlate (paper II).

- To study whether vestibular rehabilitation can have an effect on balance measures and self-perceived handicap among patients with whiplash associated disorder and dizziness as one symptom (paper III).

- To study whether vestibular rehabilitation can reduce falls among elderly, dizzy patients in primary health care and to study which factors, if any, increased the risk of falls (paper IV).

Study area

Malmö is the third largest city in Sweden with about 270 000 inhabitants. Health care is provided by 20 different primary health care centres, about 60 doctors in private practice, both general practitioners (GPs) and doctors with other specialities as well as an University Hospital. At most of the 20 different primary health care centres, physiotherapists are present. In addition, about 90 physiotherapists work in private practice in Malmö.

The "Granen" health care centre has a population base of about 13 000 people. Nine GPs and three physiotherapists work there, along with nurses, secretaries, laboratory staff and nurses in child health care. Over the years, one part of the physiotherapy department at Granen has developed towards a specialization in assessment and treatment of dizzy patients, where patients from the whole city, as well as from other parts of Skåne, are referred to the department.

Study population

Effects of specific rehabilitation for dizziness (paper I)

A total of 57 patients were assessed for eligibility in the study. Two patients did not fulfil the criteria for inclusion, three did not come to the first visit, two did not want to participate and eight patients did not complete the study. Forty-two patients completed the study, 30 women and 12 men, 50 to 87 years old (median age 77). Median age was somewhat higher in the dropout group (84 years) than in the study group (77 years). Figure 12 shows a flow chart of the study.

Balance performance and self-perceived handicap (paper II)

Data were collected from the medical records of 119 patients, 73 women and 46 men, aged from 22 to 90 years (mean 61, median 65), at the physiotherapy department at primary health care centre Granen in Malmö. Eighty-one patients were referred from primary health care; 39 from the health care centre where the physiotherapist works and 43 from thirteen of the other primary health care centres in the city. Thirty-four patients were referred from the local hospital, 18 from otolaryngologists at the ENT department and 16 from the orthopaedic department. Otolaryngologists in private practice referred three patients. Figure 13 shows a flow chart of the study.

Dizziness among patients with WAD (paper III)

Patients were recruited from general practitioners and physiotherapists in primary health care, orthopaedic physicians in private practice, administrators of rehabilitation at the regional social insurance office and the Orthopaedic Clinic of Malmö University Hospital. A total number of 29 patients met the inclusion criteria of the study, 20 women and nine men, median age 40, range 22–76 years. Twenty-eight were graded as WAD grade II and one as WAD grade III. Median duration of dizziness was two years, range from one month to 15 years. Twenty patients had been dizzy since the accident, five since one to two weeks after the accident, four since about six months after the accident. Time since accident varied from six months to 15 years (median one year). Fifteen subjects were working, nine were on sick leave or retired, and five were undergoing some form of rehabilitation. Sixteen were randomized to the training group and thirteen to the control group. There were eight dropouts in the training group and three in the control group. Figure 14 shows a flow-chart of the study.

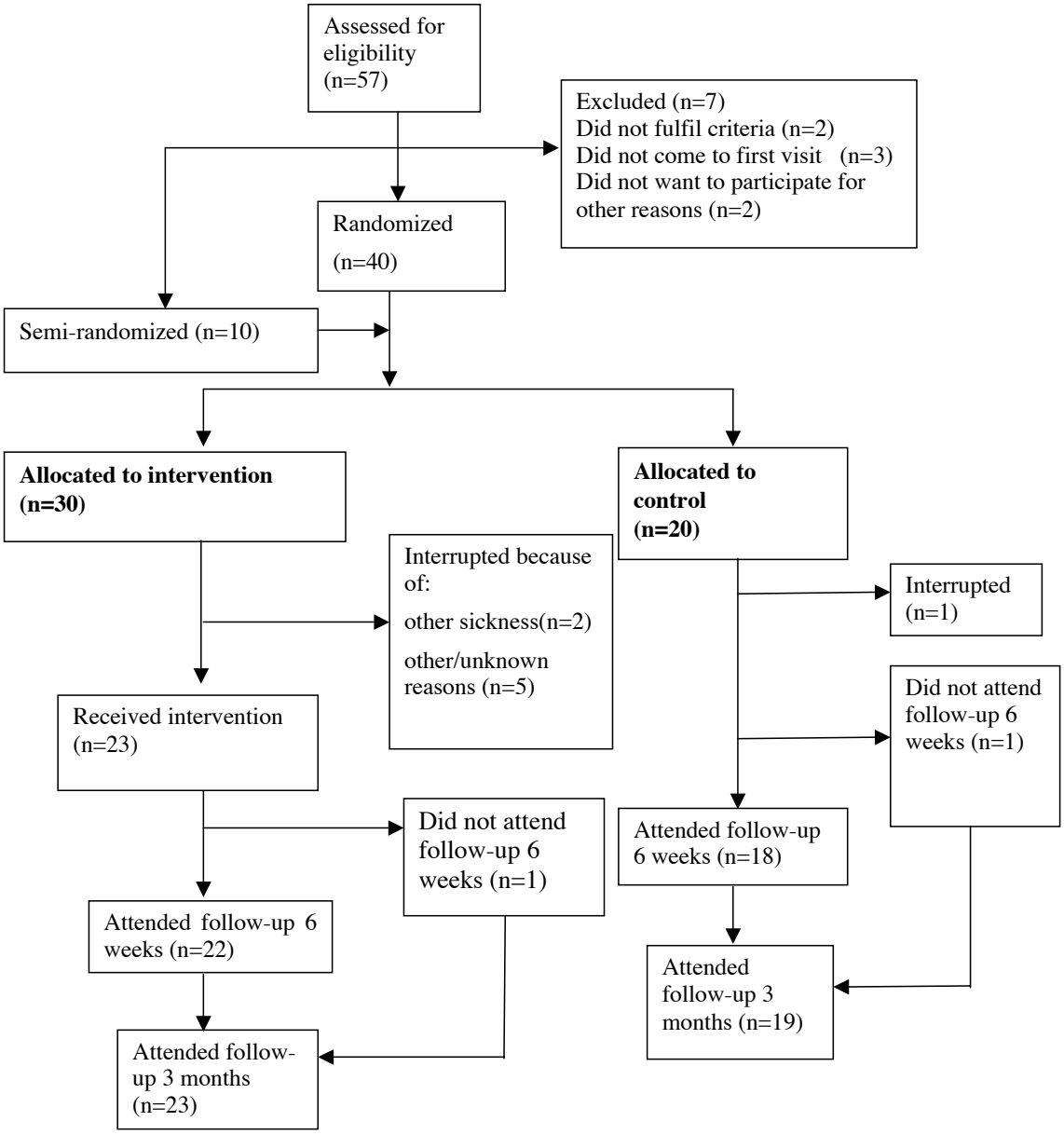

Figure 12. Flow-chart of paper I.

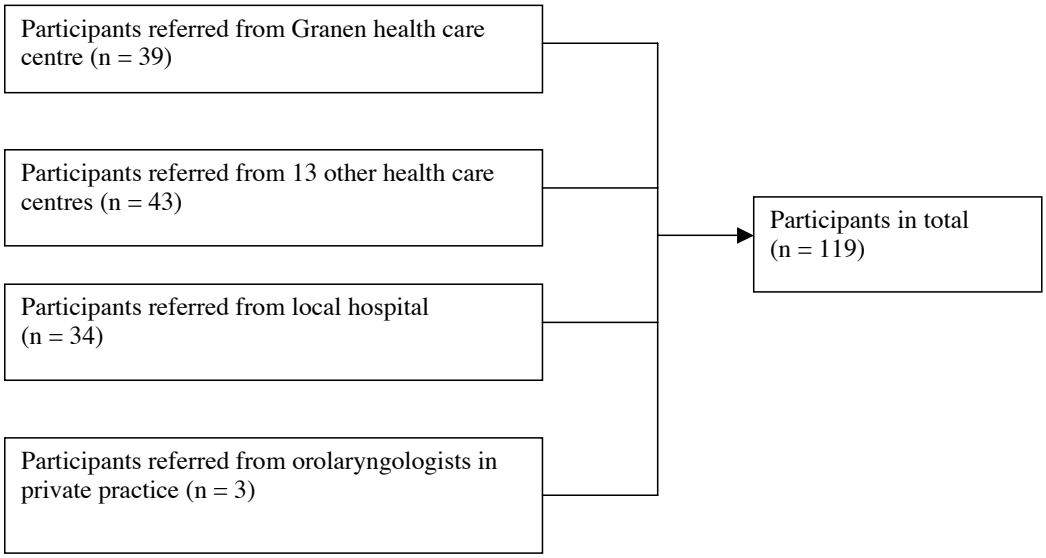

Figure 13: Flow-chart of paper II.

Falls among dizzy patients in primary health car (paper IV)

A total of thirty-five patients were referred to physiotherapy because of multisensory dizziness. Of these, thirty-one met the inclusion-criteria and agreed to participate in the study and were included in the intervention group. A search in the computerized medical records of six health care centres found a total of 276 patients, 65 years and older, with the diagnosis R42. Of these, 47 responded to the letter and were assessed by a physiotherapist. Of these, 27 fulfilled the inclusion criteria for the study and agreed to participate in the study. In total, 58 patients participated, 31 in the intervention group and 27 in the control group. Thirty-nine were women and 19 were men, aged 65–93 years, median 84 years. Figure 15 shows a flow-chart of the study.

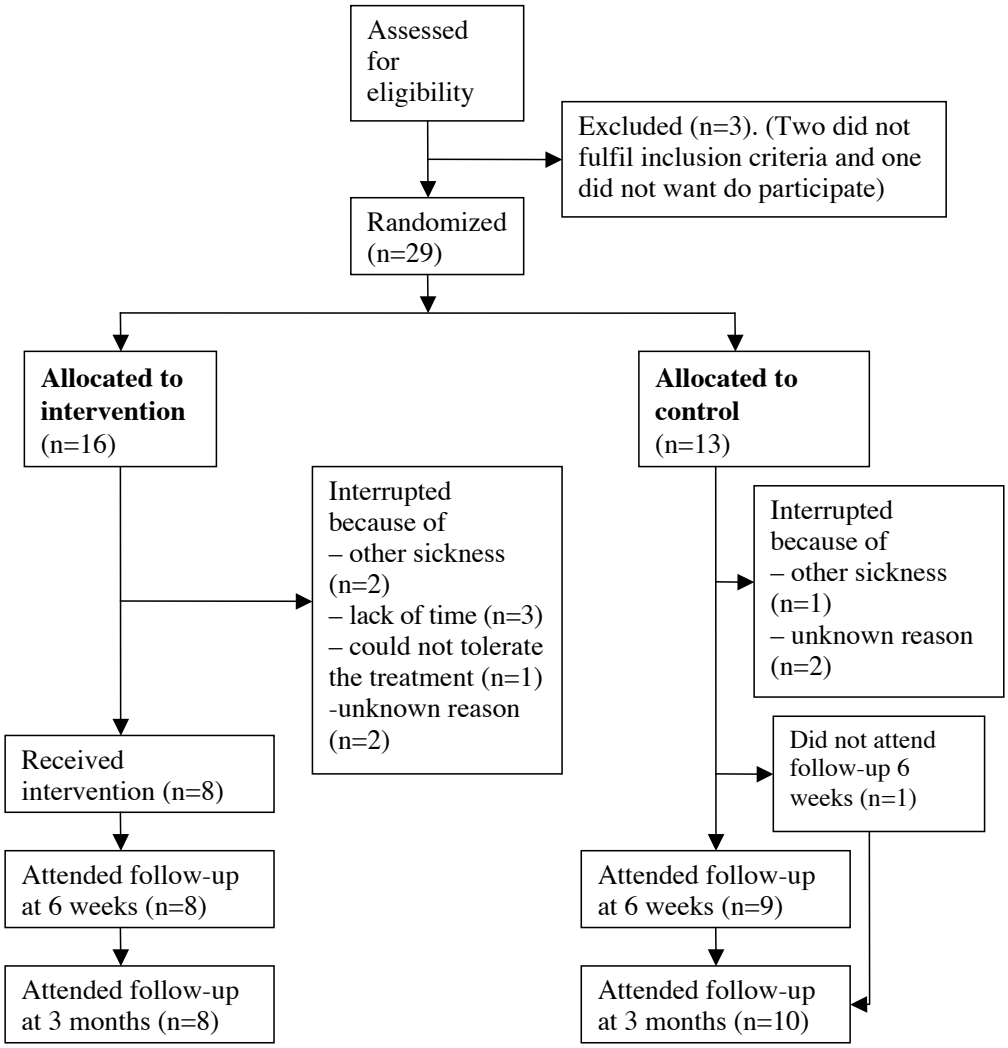

Figure 14: Flow-chart of paper III.

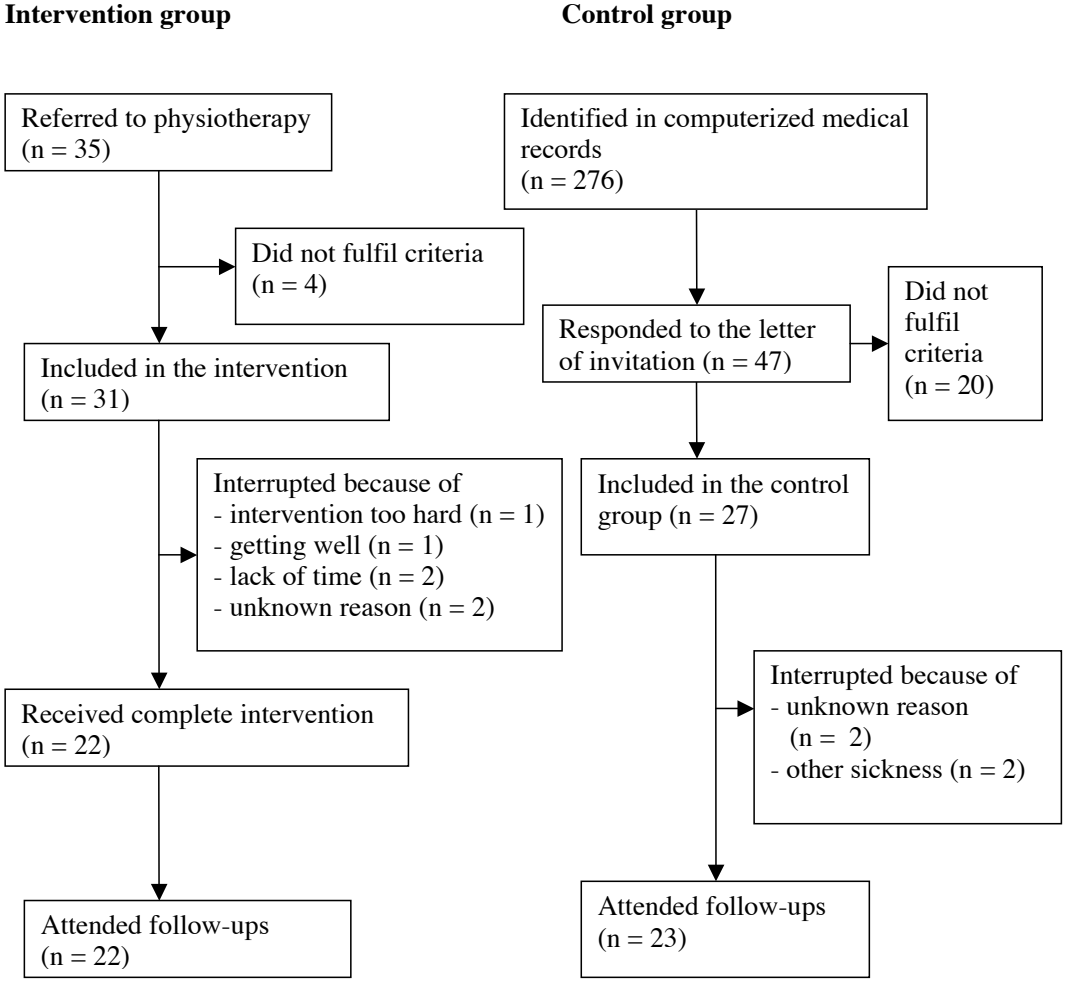

Figure 15: Flow-chart of paper IV.

Methods

An overview of methods used in the four studies is shown in table II.

Table II. Overview of the studies.

	design	statistical methods	participants	outcome measures
Paper I	Randomized controlled trial	ANOVA	42 patients with multisensory dizziness	Stops walking when talking, SOLEO, SOLEC The Romberg test, eyes open, eyes closed Walking heel to toe Figure of eight VAS
Paper II	Retrospective study	Means and SD Pearson correlation	119 patients with dizziness	Tandem stance, eyes open Tandem stance, eyes closed SOLEO, SOLEC Walking heel to toe Figure of eight DHI
Paper III	Randomized controlled trial	Mann-Whitney CI	29 patients with WAD and dizziness	Tandem stance, eyes open Tandem stance, eyes closed SOLEO, SOLEC Walking heel to toe Figure of eight DHI
Paper IV	Intervention study with control group	ANOVA Kaplan-Meier Odds Ratio	58 patients with multisensory dizziness	Tandem stance, eyes open Tandem stance, eyes closed SOLEO, SOLEC Walking heel to toe Figure of eight DHI

Effects of specific rehabilitation for dizziness (paper I)

This was a single-blind randomized controlled trial where the intervention consisted of specific rehabilitation for dizziness. Letters with information about the study and a request for referrals of patients were sent to all general practitioners and physiotherapists at all health care centres in Malmö, Sweden. The general practitioners and physiotherapist were located at 22 different public primary health care centres and in about 10 private clinics. Patients aged from 50 years with dizziness of central origin or multisensory dizziness were included in the study.

The diagnoses were attached by the general practitioner who referred the patient to the study. After the initial testing the patients were randomized into either the intervention group or the control group. An independent person performed the randomization process by using a random number table.

The same person performed initial testing as well as tests after six weeks and after three months. An independent person performed the intervention. The intervention comprised specific rehabilitation, e.g. vestibular rehabilitation, twice a week for six weeks.

All patients were measured at baseline, after six weeks and after three months with the balance measures "Stops walking when talking" (Lundin-Olsson et al., 1997), the Romberg test (Ringsberg et al., 1998), SOLEO and SOLEC (Jarnlo and Thorngren, 1991), walking heel to toe on a line (Ledin et al., 1990/91), and walking in a figure of eight (Johansson and Jarnlo, 1991). To get an idea of how the patients experienced dizziness, the visual analogue scale (VAS) was used (Kammerlind et al., 2001).

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Balance performance and self-perceived handicap (paper II)

In this retrospective study, data were compiled from computerized medical records of patients with dizziness. Patients from the whole city are admitted to the physiotherapy-department at Granen health care centre. A standardized assessment, including anamnesis, examination with balance measures, the Dix-Hallpike manoeuvre and the Dizziness Handicap Inventory (DHI) was used. Data was obtained retrospectively from computerized medical records of patients visiting the physiotherapy department during the period from June 2003 to May 2004. For all patients presenting dizziness as a symptom, data were collected, including age, gender, diagnoses of dizziness, duration of dizziness, results of balance measures and results of DHI.

Balance measures used in this study were: Tandem standing with eyes open and with eyes closed (Ledin et al., 1990/91), SOLEO and SOLEC (Jarnlo and Thorngren, 1991), walking heel to toe on a five-metre long line (Ledin et al., 1990/91) and walking twice in a figure of eight (Johansson and Jarnlo, 1991). Self-perceived handicap because of dizziness was measured with DHI (Jacobsson and Newman, 1990).

Different causes of dizziness in primary health care were described as well as outcome of balance measures and measures of self-perceived handicap. Analyses of the correlation between different balance measures and the patients' self-perceived handicap were performed as well as an analysis of differences between older and younger persons.

Dizziness among patients with WAD (paper III)

This was a randomized controlled study, where the intervention consisted of vestibular rehabilitation. Patients were recruited from general practitioners and physiotherapists in primary health care, orthopaedic physicians in private practice, administrators of rehabilitation at the regional social insurance office, all in Malmö and the Orthopaedic Clinic of Malmö University Hospital, Sweden. Criteria for inclusion in the study were the diagnosis WAD and dizziness reported as a symptom. Patients with benign paroxysmal positional vertigo were excluded. The recruitment started in March 2002 and was, for practical and financial reasons, terminated in December 2004.

After initial assessment, including anamnesis, examination with balance measures, the Dix-Hallpike manoeuvre (Luxon and Davies, 1997), and the Dizziness Handicap Inventory (DHI) (Jacobsson and Newman, 1990), the patients were randomized, by an independent person using a random number table, into either an intervention group or a control group. The same independent person also carried out the intervention. All assessments were performed by the same person, who was blind to the randomization.

All patients were assessed at baseline, after six weeks and after three months. The balance measures used in this study were: Tandem standing with eyes open and with eyes closed (Ledin et al., 1990/91), SOLEO and SOLEC (Jarnlo and Thorngren, 1991), walking in a figure of eight (Johansson and Jarnlo, 1991) and walking heel to toe on a line (Ledin et al., 1990/91). In SOLEO and SOLEC, both left and right legs were tested and the results were summed up and then divided by two. In tandem standing, SOLEO and SOLEC, three trials were allowed and the best result was used. To establish the level of self-perceived handicap experienced by the patients, the Dizziness Handicap Inventory (DHI) was used (Jacobsson and Newman, 1990).

The intervention comprised a vestibular rehabilitation programme, at group sessions in a physiotherapy centre, for approximately 50 minutes, twice a week for six weeks. The programme started with a ten minutes warm-up phase. This was followed by exercises aimed to stimulate the vestibular system, using eye, head and trunk movements.

The control group was tested at the same intervals as the intervention group, but received no intervention. After assessment at three months, the patients in the control group were offered the same training as the intervention group.

Falls among dizzy patients (paper IV)

In this intervention study with a control group, the intervention group was recruited among patients, 65 years and older, with dizziness, which was referred for physiotherapy by their general practitioner (GP). These patients came from 13 different health care centres. The control group was recruited from six different health care centres. Searches were made in the computerized medical records of the six centres, for patients, 65 years and older, who had visited their GP because of dizziness (using the International Classification of Disease, tenth revision, diagnosis of dizziness: R42). The six centres were chosen because of their high degree of elderly persons living in the catchment area. The patients found in the search received a letter with an invitation to the study. The inclusion criterion was multisensory dizziness among patients aged 65 years and older. Patients were excluded if there was another reason for dizziness, such as benign paroxysmal positional vertigo. The time for inclusion was one and a half years in both groups.

The physiotherapist who performed assessment and follow-ups was aware of which group the patient belonged to at baseline. In order to blind the physiotherapist at the follow-ups, information about which group the patient belonged to was not available to her. Another, independent, physiotherapist conducted the intervention.

All patients were assessed at baseline and after three months. The measures used in this study were: Tandem standing with eyes open and with eyes closed (Ledin et al., 1990/91), SOLEO and SOLEC (Jarnlo and Thorngren, 1991), walking in a figure of eight (Johansson and Jarnlo, 1991) and walking heel to toe on a line (Ledin et al., 1990/91). In SOLEO and SOLEC, both left and right legs were tested and the results were summed up and then divided by two. In tandem standing, SOLEO and SOLEC, three trials were allowed and the best result was used.

To find out the level of self-perceived handicap experienced by the patients, the Dizziness Handicap Inventory (DHI) was used (Jacobsson and Newman, 1990). The patients filled in the inventory at baseline, after three months and after twelve months.

Follow-up was done, by telephone, in all patients after 6, 9 and 12 months. At these follow-ups, and at assessment after 3 months, questions about whether the patient had fallen were asked. The falls were registered in a classification system from St. Louis, called Older Adult Service and Information System (OASIS) (Lach et al., 1991). The system classifies falls into four different categories: extrinsic falls factors, intrinsic falls factors, non-bipedal falls and non-classifiable falls. At the follow-up at 12 months, the patients also filled out the DHI, which was administered this time by post.

The intervention comprised a vestibular rehabilitation programme, at group sessions in a physiotherapy centre, for approximately 50 minutes, twice a week for nine weeks. The vestibular rehabilitation programme started with a warm-up phase which lasted for about ten minutes. This was followed by exercises aimed to stimulate the vestibular system, using eye, head and trunk movements.

Statistical methods

Effects of specific rehabilitation for dizziness (paper I)

Calculation of the sample size, considering other studies in which clinical balance measures were used (Lundin-Olsson et al., 1997, Ledin et al., 1990/91, Jarnlo and Thorngren, 1991, Johansson and Jarnlo, 1991), was performed. We estimated the smallest significant difference between the two groups to be 1 SD. To give the study a power of 80% a sample size of 40 patients was needed.

The One-way ANOVA was used to compare differences between the two groups. The differences compared were means of improvement/deterioration.

Balance performance and self-perceived handicap (paper II)

Means and standard deviation for the measures was calculated and the Pearson correlation was performed to calculate correlations between different variables.

Dizziness among patients with WAD (paper III)

Considering standard deviation and clinically relevant difference, when this was known (Bohannon et al., 1984, Jacobsson and Newman, 1990, Kronhed and Möller, 1998), a power of 80% and a significance level of 0.05, a sample size of 40 persons was required (Altman, 1991).

Since the sample size was small (less than 20 persons in each group), Mann-Whitney was used to test for differences between the groups and 95% confidence intervals were calculated for the median differences of the median changes. The results were analysed on an intention-to-treat basis, using last observation carried forward (Unnebrink and Windeler, 2001). An on-treatment analysis was also performed for comparison.

Falls among dizzy patients (paper IV)

Several different power calculations were performed, using standard deviation and clinically relevant difference of the various balance measures and of DHI (Bohannon et al., 1984, Jacobsson and Newman, 1990, Kronhed and Möller, 1998). To get a power of 80% and a significance level of 0.05, a sample size between 40 and 55 persons was required. Calculating on about 50% less falls in the intervention group, a sample size of 60 persons was required (Altman, 1991).

The One-way ANOVA was used to calculate differences between the groups, with an intention-to-treat analysis, using last observation carried forward (Unnebrink and Windeler, 2001). To compare distributions of falls in the two groups Kaplan-

Meier was used on an on-treatment basis. Continuous data from baseline measures were then dichotomized using the median as cut-off value, creating one group with poor outcome and one with good. Using the dichotomized variables, the odds ratios (OR) was calculated for the balance measures and measure of self-perceived handicap that increased the risk of falls. One combined variable was then created, using the dynamic balance measure with the highest OR, the static balance measure with the highest OR and the DHI scale with the highest OR. Using three different cut-points dividing the whole group with poor outcome into one, two or three tests, OR for this new variable were calculated.

Results and Comments

Effects of specific rehabilitation for dizziness (paper I)

Results

In this study, patients with multisensory dizziness were randomized to intervention or control group. At baseline, 97% (41) of those who completed the study could stand for 60 seconds in the Romberg test with their eyes open and 80% (34) with their eyes closed. No patient stopped in the "Stops walking when talking" test.

Statistically significant differences were found between the two groups, comparing the results at baseline and after six weeks regarding SOLEC on right foot ($p=0.011$). Mean value for standing on one leg with eyes closed had increased in the intervention group by 1.4 seconds, and decreased by 1.11 seconds in the control group.

In SOLEC after three months, the difference between the groups was statistically significant (right foot, $p=0.033$ and left foot $p=0.035$). In both cases, the intervention group had improved while the control group had deteriorated.

In total, the intervention group improved their ability to stand on one leg with eyes closed significantly more than the control group. The intervention group improved in 16 (80%) of the tests and deteriorated in one (5%) while the control group improved in six (30%) tests and deteriorated in 11 (55%). The results are displayed in Table III.

Comments

The Romberg test and the "Stops walking when talking test" seem to be less suitable for detecting balance deficits in this group of patients. SOLEC seems to be more appropriate. Also, the visual analogue scale seems to be inappropriate for assessing the experience of dizziness among patients in primary care.

Table III. Results of Paper I: Differences between intervention group and control group after six weeks and three months respectively (millimetres, seconds and steps).

Measure	Difference between baseline and 6 weeks/3 months		
	Intervention group	Control group	p
VAS (mm)			
6 weeks	–7.7	–3.8	0.60
3 months	–5.1	+5.1	0.20
Stops walking when talking (yes/no)			
6 weeks	0	0	–
3 months	0	0	–
SOLEO right foot (seconds)			
6 weeks	1.5	–0.6	0.37
3 months	0.0	–2.5	0.33
SOLEO left foot (seconds)			
6 weeks	–4.4	2.2	0.38
3 months	3.6	2.3	0.52
SOLEC right foot (seconds)			
6 weeks	1.4	–1.1	**0.011**
3 months	1.1	–1.0	**0.033**
SOLEC left foot (seconds)			
6 weeks	1.4	–0.4	0.065
3 months	2.0	–0.6	**0.035**
Figure of eight (steps)			
6 weeks	1.1	0.4	0.72
3 months	2.0	–0.9	0.10
Walking heel to toe (steps)			
6 weeks	1.2	0.2	0.28
3 months	1.7	1.6	0.97
Romberg (seconds)			
6 weeks	0.4	–1.9	0.19
3 months	0.4	0.0	0.36
Romberg blindfolded (seconds)			
6 weeks	3.2	–3.7	0.27
3 months	3.3	–0.7	0.36

Intervention group 6 weeks: (n=22), 3 months: (n=23). Control group 6 weeks: (n=18), 3 months: (n=19).

Balance performance and self-perceived handicap (paper II)

Results

In this study, data from medical records of patients with dizziness were compiled. Diagnoses found in the study were: multisensory dizziness with age as one important factor (40%), peripheral vestibular disorder, including vestibular neuronitis and benign paroxysmal positional vertigo (24%), dizziness as a symptom caused by whiplash associated disorder (21%), where the symptoms occurred in relation to a trauma, dizziness of unspecific origin, where no cause of dizziness could be found with methods available in primary health care (6%), phobic postural vertigo (5%) and dizziness of cervical origin, i.e. neck pain and concomitant dizziness with increased muscle tension and/or muscle stiffness in high-cervical muscles and no vestibular disease (4%). Characteristics of the different diagnostic groups are displayed in table IV.

The group with multisensory dizziness performed worse on the balance measures than the other groups. This group had the highest median age. Otherwise there were only small differences between the groups. Means and standard deviations (SD) for the different balance measures are displayed in table V.

The group with PPV had the highest total scores on DHI (mean 73) as well as emotional score (mean 29), while the vestibular group had the lowest total score (mean 35) and the lowest emotional score (mean 10), implying that the PPV group had a greater level of self-perceived handicap.

The score on DHI did not correlate with balance measures. In other words, a poor outcome in balance measures did not necessarily result in a high score in DHI, and vice versa. As expected, the different dimensions of DHI correlated with each other and so did the different balance measures.

When the study group was divided into two different subgroups, subjects 65 years or younger (n=61) and 66 or older (n=58), significant differences were found in all balance measures ($p<0.0001$ for all), the older group performing worse. The majority of the older group consisted of patients with multisensory dizziness (47/58). Statistically significant differences were found between the two groups in DHI, total score ($p=0.047$). In these measurements, the younger group had higher scores, thus implying a higher level of self-perceived handicap in younger persons.

Table IV. Median age and gender of the study group in paper II, distributed by diagnoses.

Diagnosis	N (%)	median age	females/males
Multisensory	47 (40)	81	30/17
Periph vestib disorder	29 (24)	51	19/10
Whiplash associated disorder (WAD)	25 (21)	40	14/11
Unspecific origin	7 (6)	57	4/3
Phobic postural vertigo (PPV)	6 (5)	55	4/2
Cervical origin	5 (4)	49	2/3
Total	119 (100)	65	73/46

Comments

The diagnostic panorama in this study cannot be applied to primary health care in general, since patients are admitted to this particular physiotherapy department from the whole city of Malmö. However, the concentration of dizzy patients gave us a unique opportunity to compile data. Multisensory dizziness is probably just as common in primary health care as our study suggests. Also, dizziness and WAD are probably likewise as common, even if the patients seldom occur in the same concentration as in the present study.

Adaptation of decrease of function, stretched out over time, can be one reason why elderly with dizziness had a lower level of self-perceived handicap but a larger deficit in balance measures than the younger group. Younger patients were found in the group with WAD and the group with peripheral vestibular disorder, where the onset of symptoms is more sudden. A sudden onset of symptoms creates a larger difference between now and then, which might explain the higher level of self-perceived handicap among these patients, despite the better performance in balance measures.

Table V. Paper II. Means and standard deviations (SD) for balance measures, calculated in seconds (tandem standing and standing one leg) and steps (figure of 8 and walking heel to toe). In static measures, the closer to 30 seconds, the better the balance; in dynamic measures, the closer to zero steps, the better the balance.

	Static measures				Dynamic measures	
	tandem standing		standing one leg		Figure	Walking
Diagnosis	Eyes open	Eyes closed	Eyes open	Eyes closed	of 8	heel to toe
Multi-sensory	16 (12)	3.0 (4.8)	5.9 (6.8)	1.0 (1.4)	14 (13)	7.5 (4.5)
WAD	25 (9.3)	10 (10)	21 (12)	7.9 (8.9)	2.9 (11)	1.6 (3.0)
Peripheral vestibular disorder	27 (6.0)	7.0 (8.5)	21 (10)	4.9 (4.9)	2.3 (6.4)	1.6 (2.6)
Cervical	30 (0.0)	13 (11)	22 (12)	10 (12)	1.6 (3.5)	1.2 (2.7)
Unspecific	29 (3.0)	14 (12)	23 (11)	2.5 (1.4)	1.6 (3.0)	1.4 (1.9)
PPV	30 (0.0)	22 (7.1)	24 (12)	5.7 (6.7)	0.3 (0.8)	0.7 (1.6)

Dizziness among patients with WAD (paper III)

Results

Twenty-nine patients with WAD and dizziness were randomized to either intervention group or control group. There were statistically significant differences between the two groups in SOLEO both at six weeks ($p<0.02$) and at three months ($p=0.000$). In tandem standing, there was a statistically significant difference at three months ($p<0.033$), in tandem standing blindfolded at six weeks ($p<0.045$). There were no statistically significant differences between the two groups either in figure of eight or walking heel to toe. There were statistically significant differences between the groups in DHI total score ($p<0.047$) as well as in DHI functional score ($p<0.005$) between baseline and six weeks. In DHI physical score, there were statistically significant differences between the groups between baseline and six weeks ($p<0.033$) as well as baseline and three months ($p<0.04$). Median differences (95% CI) between intervention and control groups and statistically significance of the difference are displayed in table VI.

Table VI. Results in paper III. Intention-to-treat analysis of median changes from baseline to 6 weeks and 3 months. Median differences (95% CI) between intervention and control groups and statistical significance of the difference. In static balance measures, displayed in the upper part of the table, increase means improvement. In dynamic balance measures and DHI, displayed in the lower part of the table, decrease means improvement.

	6 weeks					3 months				
	Median changes		Interv vs control			Median changes		Interv vs control		
Measure	***Interv*** (n=16)	***Contr*** (n=12)	***Median*** diff	(CI)	*p*	***Interv*** (n=16)	***Contr*** (n=13)	***Median*** diff	(CI)	*p*
SOLEO* (seconds)	±0	–2	+2	(0.0 – 3.0)	**0.02**	±0	–2	+2	(0.0 – 4.0)	**0.000**
SOLEC (seconds)	±0	±0	±0	(–1.0 – 2.5)	0.96	±0	±0	±2	(0.0 – 8.0)	0.15
Tandem standing (seconds)	±0	±0	±0	(0.0 – 13.0)	0.30	±0	±0	±0	(0.0 – 7.0)	**0.033**
T standing blindf. (seconds)	±0	–1	+1	(0.0 – 6.0)	**0.045**	±0	±0	+1	(–1.0 – 6.0)	0.23
Figure of eight (steps)	±0	±0	+1	(–2.0 – 0.0)	0.32	±0	±0	±0	(0.0 – 1.0)	0.53
Walking heel to toe (steps)	±0	±0	±0	(0.0 – 1.0)	0.35	±0	±0	±0	(0.0 – 1.0)	0.27
DHI total (points)	–1	±0	–6	(–16.0 – 0.0)	**0.047**	±0	±0	–4	(–14.0 – 0.0)	0.18
DHI functional (points)	–1	±0	–6	(–10.0 – –2.0)	**0.005**	±0	±0	–2	(–6.0 – 0.0)	0.13
DHI emotional (points)	±0	±0	±0	(–6.0 – 4.0)	0.98	±0	±0	±0	(–4.0 – 2.0)	0.59
DHI physical (points)	±0	±0	–2	(–4.0 – 0.0)	**0.033**	±0	±0	–2	(–4.0 – 0.0)	**0.04**

*) *SOLEO stands for standing one leg eyes open, SOLEC for standing one leg eyes closed DHI stands for Dizziness Handicap Inventory.*

Comments

Several strategies to recruit patients were tried. Despite these efforts, there were only a total number of 29 participants in the study. There were also 11 dropouts in the study. This may to some extent reflect the difficulties this group of patients have to live with; a variety of symptoms, of which dizziness is one. In some cases dizziness may have been a minor problem, overshadowed by other symptoms. It may also reflect the difficulties of performing randomized, controlled trials on this group of patients, especially with this type of intervention.

Our findings indicate differences between the two groups in static balance measures and in DHI. These balance measures and DHI are probably appropriate when assessing patients with WAD in primary health care. It is also interesting to note that vestibular rehabilitation did not influence the emotional scale of DHI, whereas particularly the functional scale but also the physical scale showed statistically significant differences. Since we measured seconds, steps and points, the CI intervals often include zero. All measures had an upper limit, that is, the patients could not improve if they reached the upper limit at baseline. Therefore, even if the CI intervals include zero, the results are probably valid in terms of clinical importance in SOLEO after six weeks and three months, in tandem standing blindfolded after six weeks, in DHI functional after six weeks and in DHI physical after six weeks as well as after three months.

Falls among dizzy patients (paper IV)

Results

Fifty eight patients with multisensory dizziness were included in the study, 31 in the intervention group and 27 in the control group. At baseline, there were no statistically significant differences between the groups considering age, gender, use of walking aid, balance measures or self-perceived handicap. Five patients in the intervention group had fallen at least once during the 12-month period, two patients reported one fall, one had fallen twice, one three times and one as many as fifteen times. In the control group, seven patients had fallen, four reported one fall, two had fallen three times and one eight times. According to OASIS, 31 of the falls were classified as intrinsic falls, 26 of them caused by vertigo, and 9 of the falls were classified as extrinsic falls. Six patients had to seek medical care after a fall, only one because of a fracture. There was no statistically significant difference between the two groups in the proportion of patients who had fallen after the 12-month period (Kaplan-Meier log rank p=0.86).

At measures after three months, statistically significant difference between the two groups were found in SOLEC (p=0.038) and in walking heel to toe (p=0.044). There were no statistically significant differences between the two groups in DHI, neither after three months nor after 12 months (table VII).

A poor outcome in tandem stance with eyes open (static balance measure) almost doubled the risk of falls, OR=1.96, CI: 1.22–3.15. The dynamic balance measure with the highest OR was walking heel to toe on a line, OR=1.30, CI: 0.84–2.02. The DHI scale with the highest OR was the functional scale, OR=1.78, CI: 0.97–3.20. When these three tests were combined, the risk of falls increased by 230%, OR=3.30, CI:

1.23–8.84, if the patient had poor outcome in all three tests. If the patient had poor outcome in at least two of the tests, the risk increased by 76%, OR=1.76, CI: 1.06–2.96. If the patient had poor outcome in at least one of the tests, the risk increased by 22%, OR=1.22, CI: 1.04–1.43. The sensitivity of the combined test with poor outcome in all three tests was 54% and specificity 82%, while the positive and negative predictive value were 50% and 85% respectively.

Vestibular rehabilitation seemed to be a feasible treatment for this group of patients in primary health care.

Comments

In this study, we were only able to provide training for the intervention group twice a week for nine weeks. In the UK, training at a fall-risk centre is often provided for a longer period, up to one year (www.profane.eu.org). It is possible that a longer period of training would improve balance more among the participants and maybe result in fewer falls. Once again this reflects the difficulties of performing clinical research in primary health care, since, for practical and financial reasons, we could only provide training for a shorter period of time.

Table VII. Results of paper IV. Intention-to-treat analysis of mean changes from baseline to three months and in DHI at baseline to twelve months. Mean differences (95% CI) between intervention and control groups and statistical significance of the difference. In static balance measures, displayed in the upper part of the table, increase means improvement. In dynamic balance measures and DHI, displayed in the lower part of the table, decrease means improvement.

	3 months					12 months				
	Mean changes		Interv vs control			Mean changes		Interv vs control		
Measure	Interv (n=31)	Contr (n=27)	Mean diff	(CI)	*p*	Interv (n=31)	Contr (n=27)	Mean diff	(CI)	*p*
SOLEO* (seconds)	+1	–1	+2	(–0.5 – 3.7)	0.14					
SOLEC (seconds)	+1	±0	+1	(0.2 – 1.1)	**0.038**					
Tandem standing (seconds)	+3	±0	+3	(–1.7 – 8.1)	0.23					
T standing blindf. (seconds)	+3	–1	+4	(–0.3 – 7.2)	0.09					
Figure of eight (steps)	+2	+2	±0	(–4.2 – 3.8)	0.93					
Walking heel to toe (steps)	–1	+1	–2	(–3.8 – 0.0)	**0.044**					
DHI total (points)	–3	–3	±0	(–5.7 – 5.1)	0.99	+2	+2	±0	(–7.2 – 9.3)	0.84
DHI functional (points)	–1	±0	–1	(–2.9 – 1.5)	0.58	+2	+1	+1	(–2.9 – 4.9)	0.74
DHI emotional (points)	–2	±0	–2	(–3.9 – 1.1)	0.36	±0	+1	+1	(–3.9 – 2.7)	0.69
DHI physical (points)	±0	–2	+2	(–1.1 – 4.6)	0.19	+1	±0	+1	(–3.8 – 2.0)	0.55

*) SOLEO stands for standing one leg eyes open, SOLEC for standing one leg eyes closed DHI stands for Dizziness Handicap Inventory

General Discussion

The general aim of this thesis was to study, from a physiotherapeutic perspective, the assessment and treatment of dizzy patients in primary health care. The main findings are that older patients with multisensory dizziness and patients with whiplash associated disorder and dizziness as a symptom, benefits from vestibular rehabilitation. Elderly with dizziness have more disturbances in balance than younger people with the same symptoms, but a lower level of self-perceived handicap. Balance measures and self-perceived handicap do not necessarily correlate. Vertigo is a common cause of falls among dizzy, elderly patients in primary health care. Tandem standing eyes open and eyes closed, standing one leg eyes open and eyes closed, walking in a figure of eight and walking heel to toe on a line, seem to be suitable balance measures when assessing dizzy patients in primary health care. Also, the Dizziness Handicap Inventory seems to be appropriate for measuring self-perceived handicap related to dizziness.

Methodological considerations

Randomized controlled trials are considered the proper way to study outcome of interventions. However, when the intervention comprises some form of physiotherapy, the investigator has to face several difficulties. First, it is impossible to blind the patients, since they always know whether they have received physiotherapy or not. In the first study, a placebo treatment in form of easy fitness exercises, without any head or trunk movements, was initially used. The patients in this group soon found out that this treatment would not be beneficial for their dizziness, and refused to participate. Second, when studying physiotherapeutic interventions, one has to describe the intervention well, which, in the case of vestibular rehabilitation, was first done by Cawthorne and Cooksey (Cawthorne, 1945, Cooksey, 1946) and then by Brandt and Daroff (Brandt and Daroff, 1980). Thirdly, in primary health care, the patients are heterogeneous with a diversity of diagnoses, which makes it hard to standardize the intervention programme. Fourthly, dizziness is a complex symptom and vestibular rehabilitation requires the patient to get even dizzier in order to get better, which can be an obstacle for the patient and maybe one of the reasons for dropout in a study. In our fourth study, we wanted to do a follow-up one year after baseline. This made it hard to run a randomized controlled trial, since the patients in the control group then would have to wait one year to be able to participate in the intervention. We therefore chose to do an intervention study with a control group instead.

The intervention in papers I, III and IV consisted of a vestibular rehabilitation programme in group sessions. Vestibular rehabilitation programmes are most effective when individualized for each patient and supervised by a trained physical therapist (Telian and Shepard, 1996). Therefore it is possible that the outcome of the intervention in papers I, III and IV would have been more distinct if we had used customized programmes for the individual patient instead of a programme in group sessions.

In paper I, we used a random number list to randomize the patients to either intervention group or control group. We needed 40 patients to the study, so the random number list consisted of 40 numbers. We did not calculate with dropouts or more participants than 40. When the forty-first patient came up for randomization, we gave

the patient the number of the first dropout. We have no reason to believe that this has affected the outcome of the study.

In paper II, data from computerized medical records of 119 dizzy patients were compiled. The patient had visited the Granen primary health care centre in Malmö, where patients from the whole of Malmö are referred. This concentration of dizzy patients provided a unique opportunity to compile information about this condition. However, the diagnostic panorama cannot be applied to primary health in general. The results of balance performance and self-perceived handicap and their correlations can be generalized in those diagnostic groups with a sufficient number of patients, i.e. the group with multisensory dizziness, the group with peripheral vestibular vertigo and the group with WAD.

In paper III, there were a total of 11 dropouts. The results were therefore analysed on an intention-to-treat basis (Unnebrink and Windeler, 2001). Several strategies to recruit patients were tried: letters to general practitioners and physiotherapists in primary health care, personal visits to several primary health care centres, letters to privately practising orthopaedists, general practitioners and physiotherapists, letters to administrators of rehabilitation at regional social insurance offices and searches in the database of the orthopaedic hospital clinic, all in Malmö, Sweden. Despite these efforts, the sample size in this study is small, the group is heterogeneous and it took more than two and a half years to assemble the twenty-nine participants in the study. These difficulties in recruiting sufficient numbers of patients might be one explanation for the lack of randomized controlled trials about vestibular rehabilitation for patients with WAD and dizziness (Sterner and Gerdle, 2004).

Paper IV is an intervention study with a control group, although without randomization. Therefore, there is a difference in the method of inclusion for the intervention group and the control group. Patients in the intervention group were referred by their GPs and the control group were found through searches in computerized medical records. Even though there were no statistically significant differences between the two groups in baseline measures, the groups are probably more heterogeneous than would have been the case if we had used a randomization procedure.

When calculating the sample size, we estimated 50% more falls in the control group. Considering the results of only 7% more falls in the control group, this estimate was too generous.

Considerations of the results

The results in paper I indicate that vestibular rehabilitation improves the ability to stand on one leg with eyes closed among elderly, dizzy patients in primary health care. The Romberg test and “stops walking when talking” seem to be less suitable for use in primary health care. The visual analogue scale did not detect differences in the experience of dizziness, which has been the case among elderly patients with non-peripheral vertigo in tertiary care (Kammerlind et al., 2001).

The results in paper II shows that self-perceived handicap and balance performance do not necessarily correlate. Dizziness is often combined with anxiety with impact on everyday life (Godemann et al., 2004), which balance measures may not detect. The experience of the symptom is to a high degree subjective and,

consequently, different coping strategies are probably used by different persons. Therefore, self-perceived handicap is of interest; the fact that it is possible to have a poor outcome in balance measures and a low rate of self-perceived handicap, and vice versa, probably reflects the importance of individual traits. Contrary to the findings in the present study, correlation between functional impairment and perceived handicap has been shown in a tertiary balance outpatient centre, among patients with vestibular dysfunction (Withney et al., 2004). The conflicting results may be due to the use of different balance measures and a marked difference in the selection of subjects, i.e. patients from primary health care with a variety of diagnoses versus patients from tertiary outpatient centre with vestibular dysfunction only. On the other hand, two other studies, both from balance clinics, found no correlation between balance measures and self-perceived handicap (Loughran et al., 2006, Kammerlind et al., 2005).

In paper III, the results indicate differences between the intervention group and the control group in static balance measures and in DHI. These balance measures and DHI are probably appropriate when assessing patients with WAD in primary health care. It is also interesting to note that vestibular rehabilitation did not influence the emotional scale of DHI, whereas particularly the functional scale but also the physical scale showed statistically significant differences. Since we measured seconds, steps and points, the CI intervals often includes zero. All measures had an upper limit, that is, the patients could not improve if they reached the upper limit at baseline. Therefore, even if the CI intervals include zero, the results are probably valid in terms of clinical importance in SOLEO after six weeks and three months, in tandem standing blindfolded after six weeks, in DHI functional after six weeks and in DHI physical after six weeks as well as after three months.

In paper IV, the intervention group improved their ability to stand on one leg with eyes closed and to walk heel to toe on a line. Vertigo was the most common cause of falls and vestibular rehabilitation seemed to be a feasible treatment for this group of patients in primary health care. Different studies give divergent results on risk of falls and the relation to physical activity. Vestibular rehabilitation has been shown to reduce the risk of falls, measured with the Berg balance scale among elderly patients in a tertiary vestibular therapy centre. However, the study had no control group (Macias et al., 2005). Multifactorial intervention for patients with recurrent falls has been reported to decrease the number of falls but not the number of patients who fell (Davison et al., 2005). Similar to our study, an exercise programme for frail older people has been shown to improve mobility, but not reduce the risk of falls (Jensen et al., 2004). Other researchers, however, have demonstrated that physical activity can reduce the risk of falls (Sherrington et al., 2004). In paper IV, the intervention group trained twice a week for nine weeks at group sessions. It is possible that a longer period of training could have improved the results. The Prevention of Falls Network Europe (PROFANE) recommends physical activity in order to reduce falls, although for a longer period than in our study (www.profane.eu.org).

Implications for clinical practice and future research

Vestibular rehabilitation has been shown to be effective for treatment of patients with vestibular deficits but, in this thesis, also for elderly patients with multisensory dizziness and for patients with WAD and dizziness.

Since primary health care is considered the appropriate level of medical care for the majority of dizzy patients, it is also in primary health care that vestibular rehabilitation is most suitably provided, preferably by a trained physiotherapist. However, physiotherapists in primary health care are probably not used to an adequate extent for dizzy patients. Also, close cooperation between GP and physiotherapist probably facilitates optimal assessment and treatment of dizzy patients.

When assessing dizzy patients in primary health care, both static and dynamic balance measures as well as measures of more subjective dimensions of dizziness are important. Means and standard deviations for the measures used in this thesis can be used in future research.

More research is needed in order to confirm the relationship between vestibular rehabilitation and improvements in balance, both in elderly patients and in patients with WAD and dizziness.

Conclusions

The main conclusions that can be drawn from this thesis are as follows:

- Elderly with multisensory dizziness can improve their balance with vestibular rehabilitation (papers I and IV).
- Vestibular rehabilitation is a feasible treatment in primary health care (papers I, III and IV).
- Self-perceived handicap because of dizziness and balance performance do not necessarily correlate (paper II).
- Elderly with dizziness seem to have more disturbances in balance than younger people with the same symptoms, but a lower level of self-perceived handicap (paper II).
- Multisensory deficits seem to be a common cause of dizziness among patients in primary health care (paper II).
- Tandem Romberg with eyes open and with eyes closed, standing one leg eyes open and eyes closed, walking in a figure of eight and walking heel to toe on a line seem to be appropriate measures when assessing dizzy patients in primary health care (papers I–IV).
- Means and standard deviations for these balance measures are presented for different groups of dizzy patients and can be used in future studies on balance and dizziness (paper II).
- The Dizziness Handicap Inventory can be useful when measuring self-perceived handicap among dizzy patients in primary health care (papers II–IV).
- Vestibular rehabilitation can decrease self-perceived handicap and increase postural control among patients with whiplash associated disorder and dizziness as a symptom (paper III).
- Vertigo is a common cause of falls among elderly patients with dizziness (paper IV).
- Elderly, dizzy patients with poor outcome in one dynamic and one static balance measure and in DHI functional scale simultaneously are at high risk of falling (paper IV).

Sammanfattning på svenska

Yrsel är ett vanligt förekommande symtom hos patienter som besöker primärvården. Det är det vanligaste symtomet hos äldre patienter och har identifierats som en riskfaktor för fall och nedsatt funktion i innerörats balansorgan har hittats hos patienter med höftfrakturer och handledsfrakturer. Man har också påvisat att 25 % av patienterna med kvarstående besvär efter whiplash associated disorder (WAD), har yrsel. Orsaken till yrsel är oftast godartad och livshotande tillstånd är sällsynta. Det övergripande syftet med denna avhandling var att, från ett sjukgymnastiskt perspektiv, studera undersökning och behandling av yra patienter i primärvården.

I avhandlingen studerades två olika grupper med äldre patienter med multifaktoriell yrsel, en grupp patienter med WAD och yrsel samt en grupp bestående av samtliga yra patienter som sökte sjukgymnastikmottagningen på vårdcentralen Granen i Malmö under en period av 1 år. Balans mättes med Rombergs test seende och blundande, tandemstående seende och blundande, enbensstående seende och blundande, gång på linje, balansåtta samt ”Stops walking when talking”. Subjektivt upplevande av yrsel mättes med visuell analog skala samt med ”Dizziness Handicap Inventory” (DHI). Interventionen i artiklarna I, III och IV bestod av vestibulär rehabilitering.

I artikel I studerades 42 patienter, 50 år och äldre, med multifaktoriell yrsel. Patienterna valdes slumpvis antingen till interventionsgrupp eller till kontrollgrupp. Patienterna i interventionsgruppen förbättrade sin förmåga att stå på ett ben och blunda. Ingen patient stannade i testet ”Stops walking when talking” och 97 % av patienterna klarade Rombergs test vid intest. Man kan därför anta att dessa två test lämpar sig något sämre vid undersökning av patienter med multifaktoriell yrsel i primärvården.

I artikel II gjordes en retrospektiv sammanställning av data från journaler från patienter som besökt sjukgymnastmottagningen på vårdcentralen Granen på grund av yrsel. De diagnoser som hittades var multifaktoriell yrsel, perifer vestibulär sjukdom, yrsel som symtom vid WAD, ospecifik yrsel, fobisk postural yrsel och cervikal yrsel. Gruppen med multifaktoriell yrsel hade sämst utfall på balanstesten, medan gruppen med fobisk yrsel hade sämst utfall på DHI. Resultatet på DHI korrelerade inte med resultatet på balanstest, det vill säga, dålig balans betyder inte nödvändigtvis hög grad av självskattat handikapp på grund av yrsel och vice versa. När studiegruppen delades in i två grupper, en med patienter 65 år och yngre och en med patienter 66 år och äldre, hittades statistiskt signifikanta skillnader i alla balanstest, där den äldre gruppen presterade sämre. Det fanns också statistiskt signifikanta skillnader mellan grupperna avseende DHI, där den yngre gruppen hade högre grad av självskattat handikapp på grund av yrsel.

I artikel III studerades 29 patienter med WAD och yrsel mellan 22 och 76 år gamla. Dessa valdes slumpvis till interventionsgrupp eller kontrollgrupp. Vid uppföljning hade interventionsgruppen förbättrat sin förmåga att stå på ett ben, sin förmåga att stå i tandemstående blundande samt hade sänkt sin grad av självskattat handikapp av yrsel, jämfört med kontrollgruppen.

I artikel IV studerades 58 patienter med multifaktoriell yrsel i åldersgruppen 63 till 93 år. Trettioen patienter ingick i interventionsgruppen och 27 i kontrollgruppen. Vid uppföljningen hade interventionsgruppen förbättrat sin förmåga att stå på ett ben och blunda samt sin förmåga att gå häl till tå på en fem meter lång linje. Det fanns inga skillnader mellan grupperna i proportionen av hur många som fallit. Den vanligaste orsaken till fall var yrsel. Att ha dålig förmåga att stå i tandemstående fördubblade risken för att ramla.

Avhandlingen pekar på vestibulär rehabilitering som en genomförbar och lämplig behandling för yra patienter i primärvården. Äldre personer med yrsel kan förbättra balansen genom vestibulär rehabilitering och personer med WAD och yrsel kan förbättra både balansen och självskattat handikapp.

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