Høgskulen på Vestlandet

Masteroppgave

MAFYS602-O-2022-VÅR-FLOWassign

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Deltaker

Kandidatnr.:	412

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Antall ord *:	6836

Egenerklæring *: Ja

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Høgskulen på Vestlandet

MASTEROPPGAVE

Head and trunk accelerations during gait in persons with and without dizziness.

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Foreword

Dizziness has been a field of practice that has fascinated me ever since my second year in physiotherapy school. I remember the courses taught by Anne Lise Tamber over ten years ago, being told how the repositioning maneuvers for benign paroxysmal positional vertigo (BPPV) were the closest thing to magic clinicians could get within physiotherapy. Since this, I have encountered many patients with dizziness, and I have gained more and more experience from work within this field of practice, both in hospital, community based rehabilitation and in private practice. It seems true that the deeper you dive into a field of practice, the more you understand how little you actually know. I always wanted my work with this masters thesis to be within a practical and clinically relevant field of physiotherapy. I can heartily say I have learned a lot from this work, which was a goal I set before I started. I am therefore grateful to have been able to work with this project.

The past two years has taught me how little I knew about research method, statistics and dissemination of research. It has undoubtedly renewed my interest within the academic sides of the physiotherapy profession, and I hope to be able to use this knowledge in the future.

Even though the COVID pandemic has left its mark on this project, the basis of this project has remained the same. Prospects for completing this project as planned looked bleak at times, but we made it despite trouble with inertial sensors and lock-downs. I would like to thank my supervisors Bård Bogen and Mari Knapstad for their positive attitudes, knowledge and competency. Their will and ability to wisely answer not always wise questions during all hours of the day, all days of the week has been much appreciated.

And to my dear Silje, and my boys Theodor and Linus: I am extremely grateful for your support in making this journey possible. I am fully aware of the difficulties you have endured during my long stays in Bergen, stresses during examns and turning in papers – all combined with long days working at the clinic in order to make ends meet. Thank you.

ABSTRACT

Background: Neck pain is common in patients with dizziness, but the relationship between the two phenomena is not fully understood. Gait characteristics are known to differ between dizzy patients and healthy individuals, but little research regarding the role of the neck during walking exist. The purpose of this study was to examine movements of the head and trunk during different modes of gait, using wearable inertial sensors in persons with and without dizziness. The study further examined associations between gait parameters and neck function.

Methods: In this cross-sectional study, six patients with dizziness were recruited from the ear, nose and throat department of a hospital. They were matched with six healthy individuals to examine possible between-group differences during separate modes of gait (preferred, fast and dual task) using inertial sensors. Neck active range of motion was measured with a CROM device and neck pain pressure thresholds with a digital algometer. Independent sample t-tests were performed to examine between-group differences in sensor data and neck function. Pearson correlation analyses were performed to examine possible associations between gait parameters and neck function.

Results: Dizzy patients had a lower preferred gait velocity and step length than healthy controls and reduced acceleration of the lower trunk in the vertical and anteroposterior direction during preferred walking speed. They also had reduced acceleration of the head in the vertical and mediolateral direction compared to healthy controls during preferred and fast gait. We found moderate to strong associations between neck active range of motion and sensor data in both the lower trunk and head. The study found no differences between neck function in the two groups with regards to range of motion or pressure pain threshold.

Conclusion: Dizzy patients adopted a more conservative gait pattern compared to the healthy group. Sensor measurements demonstrated reduced movement of the low-back and head sensors in some directions in the dizzy group. Some associations were found between neck range of motion and sensor data, implying a link between neck mobility and some gait-related features. The significance of these findings is unclear, as the study had some limitations and a low study sample.

ABSTRACT

Bakgrunn: Nakkesmerter er vanlig hos pasienter med svimmelhet, men hvordan disse fenomenene påvirker hverandre er ikke forstått. Gangfunksjon er nedsatt hos svimle sammenliknet med friske, men lite forskning finnes omkring nakkens rolle i gange. Hensikten med denne studien var å undersøke ryggens og hodets bevegelser ved ulike gangforhold ved hjelp av kroppsbårne sensorer hos svimle, sammenliknet med friske, samt utforske mulige sammenhenger mellom disse og nakkefunksjon.

Metode: I denne tverrsnittsstudien ble det inkludert seks svimle fra Øre, nese- og halsavdelingen fra et sykehus. Disse ble matchet med friske kontrollpersoner for å kunne utforske mulige forskjeller mellom gruppene under ulike gangforhold (foretrukket, rask og "dual task" gange) ved hjelp av kroppsbårne sensorer. Aktiv bevegelighet i nakken ble målt ved hjelp av en CROM-enhet og smerteterskel for trykk ble utført ved hjelp av et algometer hos samtlige. Uavhengig t-test ble utført for å undersøke forskjeller mellom gruppene mellom sensordata og nakkefunksjon. Pearson korrelasjonsanalyse ble utført for å utforske mulige assosiasjoner mellom sensordata og nakkefunksjon.

Resultater: Svimle pasienter hadde en lavere foretrukket ganghastighet og redusert skrittlengde enn de friske. De hadde også redusert akselleras jon i korsrygg både i vertikal og anteroposterior retning ved foretrukket ganghastighet. De hadde også nedsatt hodeakselleras jon i vertikal og mediolateral retning sammenliknet med friske. Det ble funnet moderate til sterke korrelasjoner mellom aktiv nakkebevegelighet og sensordata fra både korsrygg og hode. Studien fant ingen forskjeller mellom nakkefunksjon i de to gruppene med hensyn til aktiv nakkebevegelighet eller smerteterskel for trykk.

Konklusjon: De svimle deltakerne i studien inntok et mer forsiktig gangmønster sammenliknet med de friske. Sensormålinger viser redusert bevegelse i korsrygg og hode I noen retninger hos de svimle. Noen assosiasjoner mellom nakkebevegelighet og sensordata ble funnet, noe som kan indikere en sammenheng mellom nakkemobilitet og visse gangrelaterte forhold. Det er uklart hva betydningen av funnene er, ettersom studien hadde et lite utvalg og visse metodologiske begrensninger.

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List of abbreviations

AP - Anteroposterior

ML - Mediolateral

V – Vertical

CGD – Cervicogenic Dizziness

BPPV – Benign Paroxysmal Positional Vertigo

DHI – Dizziness Handicap Inventory

VSS-SF – Vertigo Symptom Scale (Short form)

NDI – Neck Disability Index

CROM: Cervical Range of Motion (device)

ACC – Acceleration

ATT – Attenuation (of acceleration)

AROM – Active range of motion

PPT – Pressure Pain Threshold

HVL – Høgskolen på Vestlandet (Western Norway University of Applied Sciences)

RMS – Root Mean Square (expression of gravitational force)

G – Gravity

BMI – Body Mass Index

SEM – Standard Error of Measurement

UVH – Unilateral Vestibular Hypofunction

Description of tables and figures

Table 1 – Overview of participant characteristics

Table 2 – Dizziness characteristics, questionnaire responses of dizzy participants

Table 3 – Inertial sensor data and statistical analyses

Table 4 – CROM measurements and Pressure Pain Threshold data and statistical analysis

Figure 1 – Images depicting measurements made in the study

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1. Introduction

1.1 Background

Although much is known about dizziness and neck pain as separate entities, less is known about how the two phenomena may influence one another (1). This is of particular interest, given that the prevalence of neck pain appears higher in individuals with dizziness than in the normal population (2, 3). There are theories seeking to explain the relationship between the two, but they are still controversial and considered unproven (1). Studies have indicated that some movement characteristics during walking, differs in persons suffering from dizziness and those that do not (4-6). For instance, individuals who are dizzy reduce head movements by locking their head-on-trunk while walking to reduce dizziness-related symptoms (7). It is plausible that less movement of the neck over time could lead to neck pain. Thus, this study seeks to explore the relationship of some aspects of dizziness, gait and neck pain and function.

1.1.1 Dizziness

Dizziness is a major source of morbidity and of health services utilization (8). Dizziness affects about 15 to over 20 percent of adults yearly, and it impacts health-related quality of life, limits daily activities and work participation (9). Patients with dizziness are frequently encountered both in primary care and referral settings (8). Diagnosis and management of dizziness is a complex field of practice, not only because of its subjective nature, but also as it can originate from different organs, with a range of known causes (8).

Although a broad term, dizziness is often sub-divided into four main categories: «Vertigo» – a sensation of movement of self or environment, «presyncope» – a feeling of light-headedness or fainting, or «disequilibrium» – a feeling of imbalance or postural instability. The remaining types of dizziness are described as «other» - such as vague and floating sensations, with or without being accompanied by somatic symptoms (such as headache or gastrointestinal symptoms). The classification was

first presented by Drachman and Hart (10), and has been the basis of defining and classifying dizziness (8). However, the Committee for the Classification of Vestibular Disorders of the Bárány Society is currently developing an international classification of vestibular disorders concerning symptom classification including all forms of dizziness-related symptoms: vertigo, dizziness, vestibulo-visual and postural (11).

1.1.2 Dizziness and neck pain

The role of the neck with regards to dizziness and balance is thought mainly to ensure that the head is stable during different tasks (i.e., walking). Head stabilization is necessary to receive accurate inputs from the vestibular, somatosensory and visual system, and the cervical proprioceptive system acts as an important part of the postural system, in close conjunction with the visual and vestibular sensory systems (12). Several studies report that dizziness and neck pain often co-exist (2, 3, 13, 14), and there are indications that the presence of neck pain is higher in persons suffering from dizziness than the normal population (3). Furthermore, there is evidence that prevalence of neck pain increases over time in people experiencing dizziness (3). It is also established that neck pain in persons suffering from dizziness is both a predictor of persisting symptoms (3) as well as a risk factor for higher symptom severity (2). There is, however, little knowledge on how exactly neck pain impacts patients with dizziness, and vice versa (1). This raises many questions that may have implications for management of these symptoms.

There are theories of both how development of neck pain resulting from dizziness as well as dizziness resulting from neck pain. There is some evidence that cervical afferent dysfunction (i.e. following neck injury) plays an important role in the development of dizziness and associated symptoms such as unsteadiness, visual disturbances, altered balance, eye and head movement (12). It is theorized that asymmetrical or disturbed inputs from cervical proprioceptors may lead to a sensation of dizziness or imbalance (15). Other theories seek to explain the onset of neck pain resulting from compensatory movements adopted in order to reduce

symptoms of dizziness and associated symptoms by decreasing demands of the visual, vestibular and cervical proprioceptive systems (such as head on trunk “locking” (6)). Although controversial, cervicogenic dizziness (CGD) is a clinical syndrome characterized by the presence of dizziness and associated neck pain (1, 16). It lacks clear diagnostic criteria and has no diagnostic test, but is nonetheless proposed as dizziness arising from dysfunction of the neck (17). This implies that the cervical spine plays a role in some forms of dizziness.

1.1.3 Dizziness, neck pain and gait

Clinicians may observe altered gait patterns in patients with dizziness. This pertains not only to spatiotemporal gait parameters such as reduced velocity (4), stride length and cadence (18), but also altered movement of the trunk, head and neck (4, 5). For instance, studies have found that individuals with unilateral vestibular hypofunction (UVH) constrain their head and trunk movements when walking (5), effectively locking their head-on-trunk movements compared to healthy controls (19). These alterations are thought to be a result of individuals with dizziness seeking to increase gaze stability, which is essential for maintaining balance while ensuring propulsion (4, 20). In addition, there is evidence that gait play a key role in vestibular rehabilitation, especially with regards to restoring gaze stability following vestibular hypofunction (21).

Some evidence points to altered dynamic neck function during gait in dizzy patients (6). Compensatory, small rotations of the head have been observed in healthy persons while walking, possibly to offset translational and rotational motion of the head (22). This, in conjunction with evidence that dizzy persons may adopt head stabilization as a trunk strategy (4) may account for gait-related differences between dizzy and healthy populations. Another study (6) showed that individuals with unilateral UVH made fewer, smaller and slower head movements than healthy subjects, and that they did not decouple their head movements relative to their trunk movements during walking.

Research has shown that the body through complex active and passive mechanisms attenuates forces from inferiorly located body parts, so that the head is not subjected to the same oscillations and accelerations as that of the lower body (20, 22). The body's ability to attenuate forces through active (skeletal muscles) and passive (such as ligaments, joints and intervertebral discs) is considered important to maintain head stability during walking, thereby ensuring gaze stability (20). This ability to dampen forces in a smooth and controlled manner seems to be reduced in persons with dizziness, perhaps resulting from reduced coordination of the trunk (4, 5, 19). While attenuation of forces through the trunk during gait have been examined in dizzy populations previously (5), none, to our knowledge, have included measurement of attenuation between the lower trunk and head in patients with dizziness. This may be important, especially given research suggesting different strategies being utilized by dizzy persons in stabilizing their head and neck from that of healthy individuals (4). One may also speculate that the effects of altered movement of the head and neck (i.e., head-on-trunk "locking") over time could lead to a decrease in neck function as well as neck pain.

1.2 Purpose

The purpose of this study is to examine movements of the head and trunk using wearable inertial sensors during gait in persons with dizziness, compared to healthy controls. Possible associations between head and trunk acceleration and cervical active range of motion (AROM) and pressure pain threshold (PPT) in the cervical region. We wish to assess these associations to see if gait-related differences between healthy and dizzy persons to some extent could be explained by neck disability. This study serves as a pilot for a more comprehensive post-doctoral study, and the aim of the present study is to evaluate procedures, and to generate hypotheses for further research.

The findings from this study could potentially increase our understanding about how the body attenuates movement through the trunk and neck to decrease or limit

symptoms of dizziness. Results of this study may also increase our understanding of how dizziness is associated with neck pain and function. This may in turn have implications for treatment especially with regards to ambulation, in this patient group.

1.3 Research question

Does acceleration of the head and trunk during gait differ between persons with dizziness from healthy persons, and is acceleration of the trunk and head associated with variables relating to neck function?

2. Method

2.1 Study design

This is an exploratory cross-sectional study involving individuals who have been admitted to the balance lab at the Ear, nose and throat (ENT) department at Haukeland University Hospital (Bergen, Norway), and persons who do not suffer from neck pain or dizziness. The persons without dizziness were recruited to investigate whether there are differences in how healthy persons and persons with dizziness move with regards to acceleration of the trunk and head.

Participants in the study was assessed in the rehabilitation laboratory of Western Norway University of Applied Sciences, Bergen (HVL). The laboratory is suitable for studying gait and movement, with ample floor space and necessary equipment readily available.

2.2 Scientific perspective

This study is conducted within a quantitative and biomedical framework. Biomedicine is rooted in the natural sciences, where it is assumed that naturally occurring phenomena can be quantified, analyzed statistically and interpreted meaningfully (23). Examples of this is quantification of small and complex features of gait, such as measuring acceleration – aiming to capture the physics of movement through inertial sensors - or assessing pressure pain threshold, a highly subjective measure, by a measure of force in Newton. Traditionally, it was assumed that this approach led the researcher to conduct research in a neutral and objective manner, separate from context (24). A more modern view is that the researcher always views and interprets the world with his or her own understanding, and that this influences how the research is interpreted. This is a post-empirical framework for research and requires the researcher to be aware of preconceptions and biases (24). Further, quantitative research often fails to capture the breadth of human experiences, in which relevant and meaningful information about the phenomena being studied may be lost (23).

2.3 Study sample

Participants were recruited from the balance lab at Haukeland University Hospital (Bergen, Norway). Candidates for participation were approached by a member of the research team, who conveyed their contact information to the person responsible for testing at the rehabilitation lab. This person contacted eligible participants by telephone. All dizzy participants were assessed by an otolaryngologist. Participants with significant neurological or orthopedic conditions affecting gait were excluded from the study. Each patient was attempted to be matched with a person without dizziness and/or neck pain by age (decade) and gender. The controls were primarily recruited from the staff of Western Norway University of Applied Sciences (HVL). Control persons who had experienced dizziness or neck pain at least three months prior to data collection were excluded from the study, in addition to the same exclusion criteria that applied to the patients with dizziness.

Contact information of 14 dizzy candidates eligible for participation were conveyed to the member of the research team responsible for testing. Of these, six agreed to participate in the study. Eight candidates declined or could not participate. The inclusion and testing took place between February 15th and April 30th, 2022.

2.4 Outcome variables

Variables in this study included accelerations in three directions (anteroposterior, mediolateral and vertical) captured using body worn sensors on the low back and head. Cervical active range of movement (AROM) in degrees of total movement in each plane and lastly pressure pain threshold measured with an algometer in the neck.

2.4.1 Head and back sensors

Inertial sensors i.e. accelerometers, have been extensively used in the study of human kinematics (25). Even more so today, as technology allows for less obtrusive instrumentation (lighter and smaller, wirelessly transmitted data as opposed to wiring and so on). The use of inertial sensors in general appears both accurate and reliable in measuring human kinematics, but its validity relies upon what parts of the body is being studied and the task being performed (25).

A few similar studies have been conducted to assess trunk and/or neck function during gait (5, 19, 20, 26, 27). Several authors have previously reported trunk accelerometric gait analysis to be a reliable method in healthy adults (27, 28) as well as in patients with unilateral vestibular deficiency (5). Excellent agreement between wearable inertial sensors and a 3D motion capture system has been reported (29), indicating that measurement of head and trunk coordination is using accelerometers is a valid method.

Acceleration of the head and trunk were measured using triaxial accelerometers (MTx, Xsens Technologies B.V., Enschede, Netherlands). The sensors were worn by the participants on both the head and lower back, attached with snugly fitting elastic bands. Accelerations were measured in anteroposterior, mediolateral and vertical planes, sampled at 128 Hz. The sensors transmitted signals with the use of Bluetooth technology to a laptop. Through low-back sensor data, gait parameters such as cadence, step-length and gait velocity were collected and processed in a MATLAB-based in-house software (TRASK). Acceleration data from the back and head sensors were also processed with TRASK. The results from the inertial sensors are expressed and reported as root mean square (RMS) gravity in each of the measured directions. The sensors also feature gyroscopes and inclinometers, allowing for correction of gravity.

2.4.2 Active Range of Motion (AROM)

With the aim of objectively measuring cervical Active Range of Motion in this study, a Cervical Range-of-Motion (CROM) device was utilized. The device consists of three fluid-dampened inclinometers attached to a light-weight plastic frame. The frame rests on the nose and ears, secured with fastening straps. Of all the inclinometers, two are un-adjustable gravity inclinometers (for measuring flexion/extension and side-bending), the last being adjustable, compass-like, with the use of magnets to control for thoracic motion during rotation.

Researchers studying measurement properties of the CROM device, found it to be a valid and reliable tool for active range of motion measurements in individuals with (30) and without neck pain (31-34). Standard Error of Measurement (SEM) is small in all ROM directions (30).

2.4.3 Pressure pain threshold

Pressure pain threshold is a commonly used method to evaluate pain threshold in musculoskeletal medicine, such as in patients with fibromyalgia or myofascial pain, and region-specific pain such as neck pain (35). Studies have shown that women have lower PPT than males. Evidence suggests correlation between PPT and self-reported neck pain (36). Neck PPT in dizzy patients have previously been studied using a digital algometer (15, 37). The authors found the method to yield reliable measurements, and that it correlates significantly with other subjective means of measuring PPT.

To assess point pressure threshold in the upper and lower cervical spine, we used a Wagner FDX-25 digital force gage (Wagner Instruments, Greenwich, CT). The algometer has a linear response between 0 and 1 300 kPa and is fitted with a 1cm² rubber tip.

2.4.4 Background variables

Height and weight of each participant was taken to find Body Mass Index (BMI), as studies have shown that higher BMI may alter gait patterns (38). Year of birth and gender was noted. Dizzy participants were required to fill out a dizziness history form. This form included a comprehensive overview of details relating to their symptoms of dizziness and head pain. In addition, the dizzy participants completed Norwegian versions of the Neck Disability Index (NDI), (VSS-SF) and the Dizziness Handicap Index questionnaires (DHI). The dizziness history form is listed as appendix 1. The NDI, VSS-SF and DHI can be found in appendix 2-4.

It is suggested that self-report instruments may be valuable in dizziness-related research as it captures the more personal experience of symptoms (39). Dizzy participants were required to complete the Dizziness Handicap Inventory (DHI),

Vertigo Symptom Scale Short Form (VSS SF) and the Neck Disability Index (NDI). All questionnaires have been previously translated to Norwegian (39-41).

The Dizziness Handicap Inventory (DHI-N) is a self-report tool used to assess the impact of dizziness on quality of life (QoL). It was originally designed for individuals with vestibular deficits, but has also been used in other forms of dizziness (40). DHI consists of 25 items, encompassing physical, functional and emotional sub-domains of self-perceived handicap. It is scored by summarizing ordinal scale responses, resulting in a number between 0-100 – higher scores indicating more severe handicap. The Norwegian version has been found to demonstrate satisfactory measurement properties as both a discriminative and evaluative instrument (40).

Vertigo Symptom Scale Short-Form (VSS-SF) is a shortened version of the original VSS. It is designed to measure symptom severity within the last month. It consists of 15 items, each scored on a five-point scale (range 0-4). Symptom severity is expressed by the sum of item scores ranging from 0-60, with higher scores indicative of more severe symptoms. The Norwegian version of the VSS-SF has been found to demonstrate satisfactory psychometric properties and high internal consistency (39). Scoring may be sub-divided in two sub-scales – autonomic (VSS-A) and vertigo-balance (VSS-V) to distinguish autonomic-anxiety dimensions from classic dizziness-related dimensions. The questionnaire has been found to discriminate between dizzy and non-dizzy individuals.

The Neck Disability Index (NDI) is a commonly used self-report tool in clinical research when assessing neck disability (41). It covers a range of impairments, activities and participatory problems reported by patients with neck pain. It consists of 10 items, each scored on a 6-point scale (range 0-5), with higher scores indicating higher disability. The total sum score will suggest five different categories of disability ranging from no disability (0-4) to complete disability (35-50). It can be scored in raw points or doubled and expressed as percentage. A comprehensive review have

found the NDI to be valid, reliable and responsive (42). The Norwegian version used in the present study has received criticism for lack of unidimensionality (41).

2.5 Test procedure

All participants were given information about the study prior to filling out informed consent forms. Participants then filled out the three questionnaires and the dizziness history form.

Accelerometers were then secured to the head and the low back (approximately the L5 spinous process) using snugly fitted elastic belts. Participants were instructed to walk a six-meter distance three times for practice purposes. Gait assessment was then performed with a two-meter dynamic start and stop to include only steady state walking. The assessor started and stopped measurements when subjects passed a colored cone contrasted to the floor. Participants were asked to walk at their preferred pace, a fast pace (as if walking to catch the bus) and lastly in a dual task condition. The task given was subtracting a double-digit number by threes aloud, prioritizing walking (i.e., not stopping to calculate the next number). Each gait task was repeated four times. Fast gait was included to stress gait function and elicit enhanced differences in acceleration (20). Dual task gait was chosen in order to split attention, perhaps amplifying between-group differences in acceleration profiles.

Active cervical ROM was then measured using a CROM device. The examiner first demonstrated the movements. Each participant was then orally instructed to actively move into end-range flexion, extension, side-bending left and right and rotation to both sides without application of overpressure. End-range values were then noted. All measures were performed twice, in the same order. For analysis, total range of movement was calculated, i.e., movement in both directions were added together. We did not control for thoracic motion in the sagittal (flexion/extension) and frontal plane (side-bending) i.e., by using straps in the present study.

Lastly, pressure pain threshold was examined using an algometer, participants being seated with low-back support. Assessors applied the tip of the algometer 2 finger widths laterally from the C2 spinous process on both sides, and over the facet joints of the C5-C6 segment anterior to the upper trapezius muscle on both sides. Pressure was applied approximately 5-25 N pressure per 5 seconds. Participants were asked to say «yes» when the sensation was perceived as pressure to being the slightest painful, and the value of the algometer was then noted. Measurements were performed twice, using the skin marks the PPT left from the first test for optimal placement (37). There were two different assessors. The complete test procedure is described in detail in appendix 4. See figure 1 for images depicting testing conditions.

Figure 1 - Images describing test procedure

Images (from left to right): Sensor placement, gait assessment, PPT measurement, CROM device
Person in photo did not participate in the study

2.6 Statistical analysis

Data analyses were performed using SPSS (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp). Alfa levels were set to 0.05, and analyses were two-tailed. Analysis of mean RMS (g) acceleration values at the low back and head, as well as between-group data, was made using independent sample t-test to determine whether there were statistically significant differences

between mean values. Expression of attenuation was calculated by subtracting RMS (gravity) of the back sensor from the head sensor, as done in a previous study (5). We used Pearson's correlation to explore associations between data on gait acceleration, attenuation between the low back and head, neck AROM and PPT.

2.7 Ethical considerations

The study was approved by the Regional Committee for Medical and Health Research Ethics of South-Eastern Norway (169388). Care was taken during planning of this study so that it adhered to the principles of the Helsinki Declaration. Sensitive data was stored in locked research servers in accordance with HVL's guidelines on data storage. Participation in the study involved no health risk, and the only disadvantage was time spent during traveling and testing. All subjects received oral and written information about the study and were required to give written informed consent prior to participation (forms listed as appendix 3-4). All participants were assured anonymity and informed they at any time could withdraw from the study with no reason, without consequence. There were also informed of the right to view personal data having been collected as well as their right to have their records corrected. No ethical challenges arose during this study.

3. Results

3.1 Results – Participant characteristics of the study sample

Data from all 12 participants were analyzed: six dizzy patients and six healthy controls. Group composition was even with regards to gender and number of participants. Mean age (43.16, SD 10.2 vs 41.67, SD 9.28) and BMI (27.53, SD 3.1 vs 24.73, SD 2.59) differed slightly, but the difference was not statistically significant. Sum scores for DHI, VSS-SF and NDI were 28, (SD 16.97), 12.5 (SD 7.63) and 5.33 (SD 4.07), respectively. Participant characteristics are listed in table 1.

Table 1 - Participant characteristics

	Dizzy (N=6)	Healthy (N=6)	p
Gender (% female)	50	50	
Age, mean (SD)	43.16 (10.2)	41.67 (9.28)	0.81
BMI (kg/cm²), mean (SD)	27.53 (3.1)	24.73 (2.59)	0.15
DHI, mean (SD), 0-50	28 (16.97)		
VSS-SF total score, mean (SD) 0-60	12.5 (7.63)		
VSS-A, mean (SD)	7.33 (5.02)		
VSS-D, mean (SD)	5.17 (2.79)		
NDI, mean (SD) 0-50	5.33 (4.07)		

Abbreviations: N: Sample size, BMI: Body Mass Index (kg/cm²), DHI: Dizziness Handicap Inventory, VSS-SF: Vertigo Symptom Scale, VSS-A: Vertigo Symptom Scale Autonomic/Anxiety sub-scale, VSS-D: Vertigo Symptom Scale Dizziness-balance sub-scale, NDI: Neck Disability Index, SD: Standard deviation

P values calculated with independent sample t-test

There was large heterogeneity within the group of dizzy persons. In addition, the study sample was small, so the dizziness history is presented for each individual (Table 2). There were some similarities within the dizzy group with regards to their dizziness history, the most prominent being that 67 % experienced a gradual onset of symptoms and 83 % described their type of dizziness as spinning (vertiginous). Five out of six participants (83 %) experienced otologic symptoms (decreased hearing and tinnitus). 67 % had experienced neck pain during the four weeks prior to testing.

Table 2 - Presentation of patient history, questionnaire responses (dizzy participants)

Participant number	1	2	3	4	5	6
DHI-score (0-60)	46	20	40	2	14	46
VSS-SF total score (0-60)	15	15	15	0	6	24
VSS-SF Autonomic-anxiety sub-scale	7	7	6	0	3	8
VSS-SF Vertigo/balance sub-scale	8	8	9	0	3	16
NDI-score (0-50)	5	13	1	1	7	5
Neck pain last 2 weeks (NRS, 0-10)	0	4	0	0	1	2
Dizziness, neck pain history						
Education (years)	Higher education> 5 yrs	Higher education 3 yrs	Higher education >5 yrs	Higher education >5 yrs	Higher education >5 yrs	Higher education >5 yrs
PA (times/wk)	1	>3	>3	>3	<1	2
Dizziness past 4 weeks	Yes	Yes	Yes	No	Yes	Yes
Neck pain past 4 weeks	Yes	Yes	No	Yes	Yes	No
Years with dizziness	6	1	0	2	0	1
Years with neck pain	4	Did not list	Did not list	Did not list	0	Did not list
Onset dizziness (sudden/gradual)	Gradual	Gradual	Gradual	Gradual	Sudden	Sudden
Precipitating cause/event	Head injury	Stress	Other disease	No obvious cause	Stress	Other
Frequency of symptoms, duration of symptoms	Constant	Several longer attacks*	Several longer attacks*	Several periods	Several short attacks**	Several longer attacks*
Type of dizziness	Spinning, nautic	Spinning, unsteady/↓balance	Spinning, near syncope	Nautic, unsteadiness/↓balance	Spinning, unsteadiness/↓balance	Spinning
Symptoms accompanying dizziness	↑LS, ↑SS, Syncope, Vis, Tinn, EP	Nau, ↑LS, ↑SS, Vom, Fall, HL, Tinn	HL, Tinn, EP	Nau, HA, LS, Vis, EP	Nau, Vom	Nau, HA, Vom, ↑LS, ↑SS, HL, Tinn, EP
Trigger events/events that worsen symptoms	PE, migraine, loud noises	PE	Lying down, PE, Pr, Loud noises	Lying down, PE, Pr, Migraine, Loud noises		PE, migraine
Hearing loss and tinnitus	Tinn, bilateral	↓ hearing unilateral, Tinn bilateral	↓ hearing unilateral, Tinn unilateral		↓ hearing unilateral, Tinn unilateral	↓ hearing unilateral, Tinn bilateral
Onset neck pain (sudden/gradual)	Gradual	Gradual		Gradual	Gradual	
Precipitating cause/event	No obvious cause	Stress, posture-related		No obvious cause	Stress	
Constant/recurring pain	Recurring	Recurring		Recurring	Recurring	
Symptoms accompanying neck pain	Tinnitus, dizziness, ↑SS	HA, Tinn, Dizziness, ↑SS, Vis		EP		

Abbreviations: DHI: Dizziness Handicap Inventory, VSS-SF: Vertigo Symptom Scale-Short Form, NDI: Neck Disability Index, NRS: Numeric Rating Scale, PA (frequency): Physical activity (Heart rate increase, slight sweat, minimum. 30 minutes), *: >20 minute duration, **:<20 minute duration, Nau: Nausea, LS: Increased Light sensitivity, SS: Sound sensitivity, VD: Visual disturbances, Tinn: Tinnitus, EP: Ear pressure, Vom: Vomiting, Fall: Falling, HA: Headache, PE: Physical effort, Pr: Pressure activity (e.g., blowing nose, valsalva maneuver), HL: Hearing loss. ↓: Decreased, ↑: Increased

3.2 Results - sensor measurements

We successfully collected data from all trials for all participants. Results from sensor measurements are listed in table 3.

As for spatial and spatiotemporal gait parameters, dizzy patients walked significantly slower than healthy individuals during preferred walking speed (mean 0.24 meters per second, p=0.012, 95% CI 0.06-0.41). There was no statistically significant difference between groups during fast (mean 0.22m/s, p=0.06, 95% CI -0.02-0.45) or dual task walking (mean 6.05 m/s, p=0.463, 95 % CI -0.32-0.16). Dizzy subjects had lower step length compared to healthy controls during preferred gait speed (mean difference 0.22m, p=0.023, 95% CI 0.02-0.18). We found no between-group differences in cadence.

Inertial sensor data analysis showed several statistically significant between-group differences. Vertical acceleration in the dizzy group were significantly lower than in the healthy controls for preferred and fast gait conditions for both low-back (p=0.014 and p=0.003) and head sensors (p=0.006 and p=0.01). Mediolateral acceleration of the head was significantly lower in dizzy subjects, both in the preferred and fast walk setting (p=0.049 and p=0.007, respectively). Anteroposterior acceleration in the low back was significantly lower in dizzy patients only in preferred walking speed (p=0.041). We found no significant between-group differences in dual task gait.

Regarding forces being attenuated from the back through the head (back sensor RMS minus head sensor RMS), there were no statistically significant differences between groups in the gait conditions being studied. Amount of attenuation through the trunk and neck were greatest in the anteroposterior direction, followed by mediolateral and lastly the vertical direction, in all modes of gait. Attenuation was largest in the fast walk setting, followed by that of preferred walking speed, and lastly dual task walking with respect to all axes being studied.

Table 3 - Inertial sensor results and data analysis

		Gait condition	Healthy participants (n=6)	Dizzy participants (n=6)	Between-group difference			
			Mean (SD)	Mean (SD)	Mean	P	95% CI	
							Lower	Upper
	Velocity (meters/second)	Preferred	1.55 (0.17)	1.31 (0.08)	0.24	**0.012**	0.06	0.41
		Fast	1.98 (0.21)	1.77 (0.15)	0.22	0.064	-0.02	0.45
		Dual task	1.41 (0.18)	1.49 (0.20)	-0.08	0.463	-0.32	0.16
	Step length (meters)	Preferred	0.81 (0.07)	0.72 (0.06)	0.01	**0.023**	0.02	0.18
		Fast	0.86 (0.06)	0.84(0.07)	0.02	0.558	-0.06	0.11
		Dual task	0.74 (0.09)	0.83 (0.2)	-0.09	0.323	-0.29	0.11
	Cadence (steps/minute)	Preferred	116.23 (10.87)	110.18 (4.45)	6.05	0.236	-4.63	16.74
		Fast	137.91 (0.21)	126.05 (0.15)	11.86	0.06	-0.6	24.32
		Dual task	113.95 (4.78)	108.47 (14.3)	5.48	0.394	-8.24	19.2
Acceleration RMS (g)								
Back	Mediolateral	Preferred	1.66 (0.2)	1.44 (0.23)	0.22	0.108	-0.06	0.49
		Fast	3.16 (1.14)	2.35 (0.37)	0.81	0.129	-0.28	1.9
		Dual task	1.48 (0.22)	1.44 (0.25)	0.04	0.77	-0.26	0.34
	Anteroposterior	Preferred	2.08 (0.3)	1.69 (0.27)	0.39	**0.041**	0.02	0.76
		Fast	3.07 (0.6)	2.56 (0.45)	0.47	0.156	-0.21	1.15
		Dual task	1.85 (0.26)	1.73 (0.16)	0.12	0.345	-0.15	0.4
	Vertical	Preferred	3.09 (0.49)	2.41 (0.26)	0.68	**0.014**	0.17	1.19
		Fast	4.91 (0.37)	4.25 (0.21)	0.66	**0.003**	0.27	1.04
		Dual task	2.61 (0.58)	2.65 (0.7)	-0.05	0.9	-0.88	0.78
Head	Mediolateral	Preferred	0.96 0.11)	0.75 (0.2)	0.21	**0.049**	0,00	0.42
		Fast	1.46 (0.17)	1.05 (0.24)	0.41	**0.007**	0.14	0.68
		Dual task	1.04 (0.28)	0.93 (0.22)	0.11	0.472	-0.22	0.43
	Anteroposterior	Preferred	0.73 (0.16)	0.73 (0.19)	0,00	0.98	-0.23	0.23
		Fast	1.05 (0.18)	1.05 (0.24)	0,00	0.995	-0.28	0.27
		Dual task	0.75 (0.26)	0.88 (0.34)	-0.13	0.469	-0.52	0.26
	Vertical	Preferred	3.17 (0.46)	2.38 (0.25)	0.8	**0.006**	0.3	1.3
		Fast	4.91 (0.39)	4.19 (0.41)	0.72	**0.01**	0.21	1.23
		Dual task	2.73(0.59)	2.67 (0.87)	0.05	0.902	-0.9	1.01
Attenuation								
	Mediolateral	Preferred	0.7 (0.21)	0.69 (0.22)	0.01	0.958	-0.27	0.29
		Fast	1.7 (1.05)	1.3 (0.44)	0.4	0.41	-0.63	1.43
		Dual task	0.44 (0.29)	0.51 (0.19)	-0.07	0.636	-0.38	0.24
	Anteroposterior	Preferred	1.35 (0.39)	0.96 (0.42)	0.39	0.125	-0.13	0.91
		Fast	2.01 (0.52)	1.54 (0.54)	0.47	0.155	-0.21	1.15
		Dual task	1.1 (0.3)	0.85 (0.35)	0.25	0.209	-0.17	0.68
	Vertical	Preferred	-0.08 (0.15)	0.03 (0.07)	-0.11	0.139	-0.28	0.05
		Fast	0.0 (0.26)	0.06 (0.25)	-0.06	0.677	-0.39	0.27
		Dual task	-0.12 (0.1)	-0.02 (0.26)	-0.1	0.404	-0.38	0.17

Abbreviations: RMS (g): Root Means Square (gravity), N: Sample size, SD: Standard deviation, CI: Confidence interval, P value: Calculated with independant sample t-test

Bold indicates statistically significant differences ($p < 0,05$)

3.3 Results - Neck Active Range of Motion and Pain Pressure Threshold

We successfully collected AROM measurements for participants. For one participant, PPT was only performed once, and for one other participant, no measurements were taken. In both instances, the reason was algometer malfunction (the device had not been sufficiently charged).

We did not find statistically significant differences between groups with regards to AROM or PPT measurements. There was a tendency for total rotation in dizzy patients being lower than in healthy participants (p=0.057, 95% CI -45.2 – 0.75). AROM and PPT results are presented in table 4.

Table 4 - Results and data analysis, neck active range of motion and neck pressure pain threshold

AROM (degrees)	Healthy subjects (N=6)	Dizzy subjects (N=6)	Between-group difference			
			Mean	P	95 % CI	
					Lower	Upper
Flexion/Extension	130.17 (SD 19.1)	126.25 (SD 14.82)	-3.92	0.757	-31.32	23.48
Lateral flexion L+R	89.58 (SD 17.1)	87.67 (SD 14.85)	-1.92	0.845	-23.14	19.31
Rotation L+R	138.75 (SD 20.48)	116.5 (SD 14.82)	-22.25	0.057	-45.25	0.75
PPT (Newton)	Healthy subjects (N=6)	Dizzy subjects (N=5)				
LN (L)	34.33 (SD 8.73)	44.86 (SD 15.06)	10,54	0.18	-5.85	26.92
LN (R)	30.92 (SD 6.51)	40.94 (SD 15.91)	10.02	0.243	-9.37	29.42
UN (L)	26.28 (SD 6.0)	29.04 (SD 2.98)	2.76	0.376	-3.94	9.46
UN (R)	24.89 (SD 5.25)	28.95 (SD 8.38)	4.06	0.35	-5.29	13.4

Abbreviations: N: Sample size, °: Degrees of movement reported as mean (SD), PPT: Pressure Pain Threshold reported as mean (SD), UN = Upper neck, LN = Lower neck, R=Right, L=Left

P values calculated with independent t-test, SD: Standard deviation, CI: Confidence Interval

3.4 Associations between acceleration variables, attenuation, CROM and PPT

We assessed correlation between variables by conducting Pearson correlation coefficient analysis of sensor, AROM and PPT data. We observed associations between some variables. PPT lower neck correlated strongly with PPT upper neck (r=0.72, p=0.013) but not any other variables. Neck rotation correlated moderately

with anteroposterior and vertical acceleration (r=0.69, p=0.012) and (r=0.68, p=0.016) of the low back in preferred gait speed. Neck rotation also correlated moderately with vertical acceleration of the head in the preferred gait speed (r=0.69, p=0.013) and fast gait speed (r=0.6, p=0.04).

Attenuation in the anteroposterior direction (preferred speed only) correlated moderately with lateral flexion (r=0.63, p=0.028) and rotation (r=0.61, p=0.032). Attenuation in the mediolateral direction during dual task gait correlated with lateral flexion (r=0.65, p=0.02). Results of the correlation analyses listed as appendix 7.

The correlations were calculated for both the dizzy and healthy individuals, as one group. As such, we do not know whether the dizzy or the healthy individuals contribute most to the correlation. In further studies, this will be analyzed separately

4. Discussion

The aim of the present study was to explore differences in acceleration of the lower trunk and head between healthy and dizzy subjects during different gait conditions. Another aim was to explore possible associations between trunk and head acceleration with neck AROM and neck PPT. The underlying goal of the study was to assess a method for examining gait in dizzy patients and explore whether there are tendencies in the findings that may generate specific research questions for future study.

4.1 Strengths and limitations of the study

Only 43 percent of eligible participants were included and tested, and the sample size had low statistical power. Thus, the generalizability of the findings is limited. We examined all forms of dizziness, instead of specific diagnoses or dizziness-

subgroups like some studies have (5, 19, 26). The combination of low sample size and a fairly high variability in results from DHI, VSS-SF and NDI (as well as presence of neck pain) indicate high heterogeneity among participants, also limiting the study's generalizability. In sum, this suggests that the study's internal and external validity may be questioned.

There was an equal distribution of gender in the dizzy and healthy groups, and the average age was close to similar. Average BMI was higher in the dizzy group, although not statistically significantly so. Gait characteristics may be influenced by obesity (38), specifically in mediolateral direction, and this is something that should be taken into consideration when interpreting the results. However, it is likely that with a larger sample size, any such differences would be evened out, and we do not suggest that BMI should be an exclusion criterium unless it severely impedes mobility.

With regards to measurement properties of the tools used to measure participants of this study, most have been found valid and reliable. Patient reported outcome measures used in this study were all standardized and found to have acceptable measurement properties (with exception of the dizziness history form). This may be regarded as a strength of this study. It is also our belief that attaining not only physical measurements for our study, but also capturing the experience of dizziness, which is subjective in its nature (8), contributes to a broader picture of the patient group, and may be considered a strength of this study. Neck AROM measurements were obtained by use of the CROM device, also validated and found reliable. We did not control for compensatory thoracic flexion/extension or side-bending through use of straps (30), but used the same chair for all data collection and attempted to correct compensatory movements observed. In addition, we minimized possible errors by performing repeated measurements and in the same order. Pressure pain threshold measurements by using a pressure algometer has shown to be reliable in measuring PPT in dizzy patients (37), but the study assessed PPT in the prone position. For convenience purposes, we performed PPT with the patients seated. This could account for some degree of error in this data, as postural neck muscles may have been active, at least partially, during testing. Another limitation to performing seated

PPT measurements is that the assessor optimally would have to apply the same amount of force as produced through the algometer to stabilize the subject's head and neck. A question with regards to accuracy of palpation could also be raised, given low reliability in palpatory identification of bony landmarks (43). The same tester performed two tests on each participant, and skin marks were still visible after the first test, which likely lead to smaller within-subject variations.

A possible source of error in this study is how data collection in the different walking conditions were timed by the assessors. It is possible that timing may have been unprecise, in that assessors visually determined when subjects passed the floor marker. This error could have been accounted for by using a photoelectric switch to time each gait trial. We believe this error source is small, but as the walking distance was relatively short, it could account for some error in the data. We believe, however, that this error source is minimized by conducting several trials (four) of each gait condition. We have not identified any research concerning error from using photoelectric cells that automatically starts and stops measurements. The method requires some more equipment and more time to set up a test, but for further studies this method should be used, to minimize sources of error.

Another limitation to this study may be the number of sensors used (two) and the placement of the sensors (low-back and head). While this setup will measure acceleration in both locations and resulting attenuation of forces between them, it will not give specific data regarding acceleration and possible attenuation occurring at the neck. Some authors (20) state that the role of the neck in attenuating forces is only in the anteroposterior axis. While our sensor setup measure attenuation of the neck and trunk as a whole, we cannot be certain of where exactly attenuation occurs, only that it occurs somewhere between the two sensors. Thus, adding another sensor to the cervicothoracic junction may give specific data on acceleration and attenuation profile of the neck in this patient group. The results in our study relating to lower trunk and head accelerations are only partially comparable to that of previous studies due to differences in sensor placement and study sample. Only one study (26) used similar sensor placement while comparing gait between patients with

BPPV and healthy persons. Another study (3), examining patients with vestibular neuritis, used sensors in the lower and upper trunk, not accounting for acceleration of the head.

Another point of discussion involves the walking conditions in which we assessed acceleration between the low back and head. There are many other possible ways to assess this. Different walking speeds have previously been examined, with the main finding of increased gait velocity implying higher acceleration of the lower trunk and head (20). Another study that used accelerometers to assess head and trunk coordination in healthy subjects, directed participants to focus their gaze while walking (22). We did not instruct participants in our study where to look or whether or not to focus their gaze on something (marking on the wall, on the floor in front of them etc.) while walking. Our aim with this, was to examine head and trunk movement as subjects would normally walk, without giving excessive instructions. Different strategies for gaze fixation between subjects may therefore have been employed. It is possible that instructions regarding gaze fixation during gait trials could both enhance differences in head/trunk acceleration between groups as well as limit differences between groups. It has been suggested that individuals with dizziness may seek to limit dizziness-associated symptoms by stabilizing their gaze (4), and thus, it could be worth exploring this in future research.

4.2 Discussion of results

In summary, we found that dizzy participants had lower gait velocity and shorter step length than healthy subjects. We also found significantly decreased low-back acceleration in the anteroposterior (preferred speed) and vertical direction (fast and preferred speeds) in the dizzy group. We found significantly lower head acceleration in the mediolateral and vertical directions among the dizzy participants (preferred and fast gait speeds). We did not observe significant differences between groups with regards to attenuation of forces from the low back to the head in any of the gait

conditions being studied. Correlation analyses revealed some moderate to strong correlations between acceleration data and neck AROM measurements, primarily.

Several studies have previously examined acceleration at various levels of the spine and/or head during gait using inertial sensors (5, 6, 19, 20, 22, 26, 27, 29), but few have examined patients with dizziness. One recently published study (26) used similar sensor placement and examined gait in similar population groups (patients with BPPV and healthy controls). They found that their dizzy subjects walked with lower cadence, step length and velocity than healthy controls, which mostly align with results of our study (for preferred gait speed). Another study found similar differences with regards to preferred gait velocity using 3D motion capture in patients with vestibular deficiences (4). This, in conjunction with findings of reduced vertical and anteroposterior acceleration of the lower trunk, implies that dizzy patients adopted a more conservative gait than healthy controls. There are several plausible reasons for this more cautious gait pattern, either balance difficulties, decreased head and/or gaze stability or fear avoidance behaviors or a combination of these (4, 19).

In our study, anteroposterior acceleration was reduced in the lower trunk but not of the head of the dizzy participants. This contrasts the findings of a study (26) that found reduced acceleration of the head in this direction in dizzy subjects. The different findings between the studies may be because they studied patients with BPPV, or that their study had a larger sample size (n=54) and therefore higher statistical power than the present study (n=12). Significantly lower mediolateral acceleration of the head in the dizzy group (both fast and preferred walking speeds) in our study contradicts those of the abovementioned study, which observed no between-group differences in this direction. However, our findings align with results from a study (5) finding evidence that dizzy persons significantly improved trunk attenuation in this direction following a period of vestibular rehabilitation, implying that mediolateral acceleration of the upper trunk was reduced pre-intervention. Vertical acceleration was found to be lower in the dizzy group in our study in both head and low-back sensors (preferred and fast walking). These findings align with the study (26) that also found significantly decreased vertical acceleration in the dizzy group in both trunk and head sensors.

To our knowledge, this is the first study to explore attenuation of forces between the low back to the head in patients with dizziness. A previous study examined attenuation between the lower and upper trunk in persons with UVH and found that attenuation of forces between the upper and lower trunk were largest in the anteroposterior axis, followed by the mediolateral and the vertical axis (5). Our study found similar attenuation profiles between the lower trunk and head in both groups. Another study (20), assessing attenuation of the trunk and neck in healthy individuals, concluded that little attenuation occurs in the neck except for minor contributions in the AP-direction and that the trunk is mainly responsible for attenuation between the lower trunk and head. We did not see evidence that anteroposterior acceleration of the head was any different between dizzy and healthy subjects, nor did we observe significant differences in attenuation in this direction for any mode of gait examined. This suggests that the dizzy subjects in our study attenuated the same amount of acceleration as the healthy controls.

Between-group differences in lower trunk and head sensors indicate that dizzy persons reduced their head movements compared to the healthy group. While this difference may not be explained by significantly reduced attenuation of acceleration forces in this study, our data suggests that dizzy individuals reduce head movements primarily through reducing acceleration of inferiorly located body segments. This is particularly evident in the vertical direction, as the trunk and neck's ability to attenuate forces is negligible (5, 20), and where the dizzy patients primarily reduced head acceleration through lowering acceleration of the low-back. Healthy participants seemed to tolerate more head acceleration in the vertical and mediolateral plane in both preferred and fast walking speeds compared to our dizzy participants. This is consistent with research indicating dizzy persons reduce head and neck movement in order to increase head stability and ensure gaze stability (4, 6) and thus, reduce movement provoked dizziness symptoms.

Correlation analysis revealed that active neck rotation and lateral flexion correlated moderately with both AP acceleration of the low back and AP attenuation in preferred walking speed, but not in fast or dual task walking speed. This may indicate that the neck plays a role in either attenuating or counteracting forces in this movement

plane, further supported by a study suggesting the neck segment only assists in stabilizing the head in the AP-direction (20). Correlations between vertical head acceleration (preferred and fast walking) and neck rotation was also found. This relationship implies that AROM is linked with head acceleration, which is plausible given that patients with dizziness often seek to limit head movements (4, 6). Trunk and neck segmental interactions have previously revealed that gaze direction and head stability is achieved in part by small, compensatory head rotations in healthy individuals (44). As mentioned earlier, we saw a tendency towards less neck rotation in our dizzy participants. Seeing this finding in conjunction with results of the correlation analyses, especially sensor data, may be an area of interest for future studies. One may therefore speculate if a need to reduce head and neck movements over time could lead to deficits in neck range of motion. It is plausible, in light of this study's results, that reduction in neck range of motion, particularly rotation and lateral flexion, implies reduced tolerance for vertical and mediolateral head acceleration, perhaps through compensatory movements of the trunk and neck over time. However, this needs to be further studied.

4.3 Implications

This study highlights that dizzy patients adopt a more conservative gait pattern than healthy participants. This may highlight the importance in considering spatiotemporal gait parameters in vestibular rehabilitation, as decreased gait velocity implies reduced acceleration of the lower trunk, which in turn may contribute to limiting head and neck movements. Correlations between neck mobility and accelerations of the lower trunk and head during gait may offer insight towards increased understanding of why neck pain and reduced neck function may occur in persons with dizziness.

Future research regarding this subject should consider following up on these findings with longitudinal or experimental data. Future studies may assess the limitations of this study in the planning of research. A summarized evaluation of the pilot is listed in appendix 6.

5. Conclusion

The findings of this study indicate that dizzy persons adopted a more conservative gait than the healthy controls with regards to spatiotemporal gait parameters. The study also found reduced acceleration of the low-back in anteroposterior (preferred gait) and vertical directions (preferred and fast gait) in the dizzy participants. We also found that mediolateral and vertical acceleration of the head was lower in the dizzy group in preferred and fast walking. This reduction in movement of the head, may indicate either reduced tolerance for movement or as a result of a more conservative gait pattern employed in the dizzy participants. There were no significant between-group differences in attenuation of forces between the head and back sensors in any of the gait trials measured. Lastly, the study found some correlations between neck mobility and accelerations of both lower trunk and head sensors. The sample size was low in this study and it had some methodological limitations, and the findings should be interpreted accordingly.

6. List of references

1. Reiley AS, Vickory FM, Funderburg SE, Cesario RA, Clendaniel RA. How to diagnose cervicogenic dizziness. Arch Physiother. 2017;7(1):12-.
2. Knapstad MK, Nordahl SHG, Skouen JS, Ask T, Goplen FK. Neck pain associated with clinical symptoms in dizzy patients—A cross-sectional study. Physiother Res Int. 2020;25(2):e1815-n/a.
3. Wilhelmsen K, Ljunggren AE, Goplen F, Eide GE, Nordahl SHG. Long-term symptoms in dizzy patients examined in a university clinic. BMC Ear Nose Throat Disord. 2009;9(1):2-.
4. Mamoto Y, Yamamoto K, Imai T, Tamura M, Kubo T. Three-dimensional Analysis of Human Locomotion in Normal Subjects and Patients with Vestibular Deficiency. Acta Otolaryngol. 2002;122(5):495-500.
5. Wilhelmsen K, Nordahl SH, Moe-Nilssen R. Attenuation of trunk acceleration during walking in patients with unilateral vestibular deficiencies. J Vestib Res. 2010;20(6):439-46.
6. Paul SS, Dibble LE, Walther RG, Shelton C, Gurgel RK, Lester ME. Reduced Purposeful Head Movements During Community Ambulation Following Unilateral Vestibular Loss. Neurorehabil Neural Repair. 2018;32(4-5):309-16.
7. Wilhelmsen K, Kvåle A. Examination and treatment of patients with unilateral vestibular damage, with focus on the musculoskeletal system: a case series. Phys Ther. 2014;94(7):1024-33.
8. Sloane PD, Coeytaux RR, Beck RS, Dallara J. Dizziness: state of the science. Ann Intern Med. 2001;134(9 Pt 2):823-32.
9. Neuhauser HK. The epidemiology of dizziness and vertigo. Handb Clin Neurol. 2016;137:67-82.
10. Drachman DA, Hart CW. An approach to the dizzy patient. Neurology. 1972;22(4):323-34.
11. Bisdorff A, Von Brevern M, Lempert T, Newman-Toker DE. Classification of vestibular symptoms: towards an international classification of vestibular disorders. J Vestib Res. 2009;19(1-2):1-13.

12. Treleaven J. Dizziness, Unsteadiness, Visual Disturbances, and Sensorimotor Control in Traumatic Neck Pain. J Orthop Sports Phys Ther. 2017;47(7):492-502.
13. Iglebekk W, Tjell C, Borenstein P. Pain and other symptoms in patients with chronic benign paroxysmal positional vertigo (BPPV). Scand J Pain. 2013;4(4):233-40.
14. Knapstad MK, Goplen F, Skouen JS, Ask T, Nordahl SHG. Symptom severity and quality of life in patients with concurrent neck pain and dizziness. Disabil Rehabil. 2020;42(19):2743-6.
15. Knapstad MK, Goplen FK, Ask T, Skouen JS, Nordahl SHG. Associations between pressure pain threshold in the neck and postural control in patients with dizziness or neck pain - a cross-sectional study. BMC Musculoskelet Disord. 2019;20(1):528-.
16. Knapstad MK, Glad Nordahl SH, Goplen FK. Clinical characteristics in patients with cervicogenic dizziness: A systematic review. 2019.
17. Magnusson M, Malmström EM. The conundrum of cervicogenic dizziness. Handb Clin Neurol. 2016;137:365-9.
18. Lim YH, Kang K, Lee HW, Kim JS, Kim SH. Gait in Benign Paroxysmal Positional Vertigo. Front Neurol. 2021;12:633393.
19. Paul SS, Dibble LE, Walther RG, Shelton C, Gurgel RK, Lester ME. Characterization of Head-Trunk Coordination Deficits After Unilateral Vestibular Hypofunction Using Wearable Sensors. JAMA Otolaryngol Head Neck Surg. 2017;143(10):1008-14.
20. Kavanagh J, Barrett R, Morrison S. The role of the neck and trunk in facilitating head stability during walking. Exp Brain Res. 2006;172(4):454-63.
21. Hall CD, Herdman SJ, Whitney SL, Cass SP, Clendaniel RA, Fife TD, et al. Vestibular Rehabilitation for Peripheral Vestibular Hypofunction: An Evidence-Based Clinical Practice Guideline: FROM THE AMERICAN PHYSICAL THERAPY ASSOCIATION NEUROLOGY SECTION. J Neurol Phys Ther. 2016;40(2):124-55.
22. Kavanagh JJ, Morrison S, Barrett RS. Coordination of head and trunk accelerations during walking. Eur J Appl Physiol. 2005;94(4):468-75.
23. Polit DF, Beck CT. Nursing research: Generating and assessing evidence for nursing practice. International edition; Eleventh edition; International edition; Eleventh

edition ed. Beck CT, editor. Philadelphia: Lippincott Williams & Wilkins; 2021 © 2021; [2020].
24. Thornquist E. Vitenskapsfilosofi og vitenskapsteori: For helsefag. 2. utg. ed. Bergen: Fagbokforlaget; 2018 2018. 288 p.
25. Cuesta-Vargas AI, Galán-Mercant A, Williams JM. The use of inertial sensors system for human motion analysis. Phys Ther Rev. 2010;15(6):462-73.
26. Zhang Y, Wang H, Yao Y, Liu J, Sun X, Gu D. Walking stability in patients with benign paroxysmal positional vertigo: an objective assessment using wearable accelerometers and machine learning. J Neuroeng Rehabil. 2021;18(1):56.
27. Henriksen M, Lund H, Moe-Nilssen R, Bliddal H, Danneskiod-Samsøe B. Test–retest reliability of trunk accelerometric gait analysis. Gait Posture. 2004;19(3):288-97.
28. Moe-Nilssen R. Test-retest reliability of trunk accelerometry during standing and walking. Arch Phys Med Rehabil. 1998;79(11):1377-85.
29. Paul SS, Walther RG, Beseris EA, Dibble LE, Lester ME. Feasibility and Validity of Discriminating Yaw Plane Head-on-Trunk Motion Using Inertial Wearable Sensors. IEEE Trans Neural Syst Rehabil Eng. 2017;25(12):2347-54.
30. Fletcher JP, Bandy WD. Intrarater reliability of CROM measurement of cervical spine active range of motion in persons with and without neck pain. J Orthop Sports Phys Ther. 2008;38(10):640-5.
31. Audette I, Dumas J-P, Côté JN, De Serres SJ. Validity and between-day reliability of the cervical range of motion (CROM) device. J Orthop Sports Phys Ther. 2010;40(5):318-23.
32. Tousignant M, de Bellefeuille L, O'Donoughue S, Grahovac S. Criterion validity of the cervical range of motion (CROM) goniometer for cervical flexion and extension. Spine (Phila Pa 1976). 2000;25(3):324-30.
33. Tousignant M, Duclos E, Laflèche S, Mayer A, Tousignant-Laflamme Y, Brosseau L, et al. Validity study for the cervical range of motion device used for lateral flexion in patients with neck pain. Spine (Phila Pa 1976). 2002;27(8):812-7.
34. Tousignant M, Smeesters C, Breton AM, Breton E, Corriveau H. Criterion validity study of the cervical range of motion (CROM) device for rotational range of motion on healthy adults. J Orthop Sports Phys Ther. 2006;36(4):242-8.

35. Park G, Kim CW, Park SB, Kim MJ, Jang SH. Reliability and usefulness of the pressure pain threshold measurement in patients with myofascial pain. Ann Rehabil Med. 2011;35(3):412-7.
36. Walton D, MacDermid J, Nielson W, Teasell R, Nailer T, Maheu P. A Descriptive Study of Pressure Pain Threshold at 2 Standardized Sites in People With Acute or Subacute Neck Pain. Journal of Orthopaedic & Sports Physical Therapy. 2011;41(9):651-7.
37. Knapstad MK, Nordahl SHG, Naterstad IF, Ask T, Skouen JS, Goplen FK. Measuring pressure pain threshold in the cervical region of dizzy patients—The reliability of a pressure algometer. Physiother Res Int. 2018;23(4):e1736-n/a.
38. Ko S-u, Stenholm S, Ferrucci L. Characteristic gait patterns in older adults with obesity—Results from the Baltimore Longitudinal Study of Aging. J Biomech. 2009;43(6):1104-10.
39. Wilhelmsen K, Strand LI, Nordahl SHG, Eide GE, Ljunggren AE. Psychometric properties of the Vertigo symptom scale - Short form. BMC Ear Nose Throat Disord. 2008;8(1):2-.
40. Tamber A-L, Wilhelmsen KT, Strand LI. Measurement properties of the Dizziness Handicap Inventory by cross-sectional and longitudinal designs. Health Qual Life Outcomes. 2009;7(1):101-.
41. Johansen JB, Andelic N, Bakke E, Holter EB, Mengshoel AM, Røe C. Measurement properties of the norwegian version of the neck disability index in chronic neck pain. Spine (Phila Pa 1976). 2013;38(10):851-6.
42. MacDermid JC, Walton DM, Avery S, Blanchard A, Etruw E, McAlpine C, et al. Measurement properties of the neck disability index: a systematic review. J Orthop Sports Phys Ther. 2009;39(5):400-C12.
43. Seffinger MA, Najm WI, Mishra SI, Adams A, Dickerson VM, Murphy LS, et al. Reliability of spinal palpation for diagnosis of back and neck pain: a systematic review of the literature. Spine (Phila Pa 1976). 2004;29(19):E413-25.
44. Pozzo T, Berthoz A, Vitte E, Lefort L. Head stabilization during locomotion. Perturbations induced by vestibular disorders. Acta Otolaryngol Suppl. 1991;481:322-7.

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Appendix 1 – Dizziness history form

HELSE BERGEN
Haukeland universitetssjukehus
Øre-nese-hals-avdelingen

Høgskulen på Vestlandet

Navn/ID og fødselsdato_____

Utdannelse

Kryss for høyeste nivå

☐ Grunnskole ☐ Videregående ☐ Høyere utdanning 3 år ☐ Høyere utdanning 5 år

☐ Høyere utdanning > 5 år

Fysisk aktivitet

Har du i løpet av de siste 6 mnd drevet med regelmessig trening/fysisk aktivitet hvor pulsen stiger og du blir litt svett? (idrett, spaserturer etc. i minimum 30 minutter).

☐ Nei

☐ Sjeldnere enn en gang i uken

☐ En gang i uken

☐ To ganger i uken

☐ Tre eller flere ganger i uken

De siste 4 ukene har jeg vært plaget med

☐ Svimmelhet ☐ Nakkesmerter

Når startet svimmelhetet (ca. dato): _____

Når startet nakkesmertene (ca. dato):_____

Svimmelhet

Hvordan begynte svimmelhetsplagene?

☐ Plutselig / akutt ☐ Gradvis / snikende

Utløsende årsak?

☐ Hodeskade ☐ Infeksjonssykdom ☐ Stress / påkjenning

☐ Hodebevegelse ☐ Annen sykdom ☐ Ingen åpenbar årsak

☐ Annet:

Forløp

☐ Kun ett anfall (eller en periode) ☐ Flere perioder

☐ Flere korte anfall (sekunder) ☐ Konstant svimmelhet

☐ Flere lengre anfall (> 20 minutter)

Type svimmelhet

☐ Karusell (alt går rundt) ☐ Båtdekk (alt gynger) ☐ Nærbesvimelse ☐ Ustø, dårlig balanse

☐ Annet (forklar)

Symptomer som ledsager svimmelheten

☐ Kvalme ☐ Hodepine ☐ Lysømfintlighet ☐ Lydømfintlighet

☐ Brekninger ☐ Besvimelse ☐ Synsforstyrrelse ☐ Fall

☐ Hørselstap ☐ Øresus ☐ Trykk/dott i øret ☐ Svartner for øynene

Hendelser / aktiviteter som utløser eller forverrer svimmelheten?

☐ Svimmel når du legger deg ned eller snur deg i sengen

☐ Svimmelhet utløst av fysisk anstrengelse ☐ Svimmelhet ved trykk (nesepussing, toalettbesøk)

☐ Svimmelhet utløst av migrene ☐ Svimmelhet ved høye lyder

Hørselstap og øresus

☐ Dårlig hørsel ett øre ☐ Dårlig hørsel begge ører

☐ Øresus ett øre ☐ Øresus begge ører

Nakkesmerter (krysses om du har vært plaget med smerter de siste 4 ukene)

Hvordan begynte nakkesmertene?

☐ Plutselig / akutt ☐ Gradvis / snikende

Utløsende årsak?

☐ Hodeskade ☐ Stress / påkjenning ☐ Ingen åpenbar årsak

☐ Nakkeskade ☐ Arbeidsstilling

Forløp

☐ Flere perioder ☐ Konstante smerter

Symptomer som ledsager nakkesmertene?

☐ Hodepine ☐ Øresus ☐ Svimmelhet ☐ Lydømfintlighet

☐ Synsforstyrrelser ☐ Trykk/dott i øret ☐ Annet

Appendix 2 – History form (control group)

HELSE BERGEN
Haukeland universitetssjukehus
Øre-nese-hals-avdelingen

Høgskulen på Vestlandet

Navn/ID og fødselsdato_____

Har du de siste 3 mnd vært plaget med:

Nakkesmerter Nei☐ Ja☐

Svimmelhet Nei ☐ Ja☐

Utdannelse

Kryss for høyeste nivå

☐ Grunnskole ☐ Videregående ☐ Høyere utdanning 3 år ☐ Høyere utdanning 5 år

☐ Høyere utdanning > 5 år

Arbeid

Nåværende yrke _____

Er du yrkesaktiv (i inntekstgivene arbeid)?

Nei ☐ Ja☐

Om ja, i hvilken stillingsprosent jobber du: _____

Er du sykemeldt nå?

Nei ☐ Ja☐

Om ja, i hvilken grad (sykemeldingsprosent): _____

Er du uføretrygdet?

Nei ☐ Ja☐

Om ja, i hvilken grad (uføreprosent):_____

Er du arbeidsledig?

Nei ☐ Ja☐

Hvis du er sykemeldt/ufør, hva er hovedårsaken til dette? _____

Fysisk aktivitet

Har du i løpet av de siste 6 mnd drevet med regelmessig trening/fysisk aktivitet hvor pulsen stiger og du blir litt svett? (idrett, spaserturer etc. i minimum 30 minutter).

☐ Nei

☐ Sjeldnere enn en gang i uken

☐ En gang i uken

☐ To ganger i uken

☐ Tre eller flere ganger i uken

Appendix 3 – Consent form (dizzy)

HELSE BERGEN
Haukeland universitetssjukehus
Øre-nese-hals-avdelingen

01.08.2020

VIL DU DELTA I FORSKNINGSPROSJEKTET «DYNAMISK NAKKEFUNKSJON HOS PASIENTER MED SVIMMELHET»?

FORMÅLET MED PROSJEKTET OG HVORFOR DU BLIR SPURT

Dette er et spørsmål til deg om å delta i et forskningsprosjekt for å undersøke hvordan nakken beveger seg under gange hos personer med enten svimmelhet eller nakkesmerter. Du blir spurt om å delta på bakgrunn av at du er henvist for svimmelhet til Haukeland Universitetssykehus.

HVA INNEBÆRER PROSJEKTET FOR DEG?

Vi ønsker å undersøke hvordan nakken beveger seg når man går. Undersøkelsen vil foregå ved Høyskolen på Vestlandet. Du vil gjennomgå testing som innebærer at du må fylle ut spørreskjema som omhandler svimmelhet, nakkefunksjon og smerter. Det vil bli utført undersøkelse og måling av nakkebevegelser, kroppsmål, gange (der du har på deg to små sensorer), og gange på tredemølle. Undersøkelsen tar ca. 1 time. I prosjektet vil vi innhente og registrere opplysninger om deg fra spørreskjema og testresultatene. I tillegg til disse undersøkelsene samtykker du til at vi kan bruke journalopplysningene dine fra oppholdet her til vitenskapelige analyser og publikasjon.

MULIGE FORDELER OG ULEMPER

Din deltagelse vil ha betydning for å kunne nærmere undersøke sammenhengen mellom nakkesmerter og svimmelhet. Resultatet fra studien vil kunne øke forståelsen av nakkens betydning for svimmelhet, samt gi kunnskap som kan føre til bedre behandling av pasienter som har begge symptomer. Studien innebærer ingen ulemper utover din tidsbruk i forbindelse med undersøkelsene.

FRIVILLIG DELTAKELSE OG MULIGHET FOR Å TREKKE DITT SAMTYKKE

Det er frivillig å delta i prosjektet. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side.

Du kan når som helst og uten å oppgi noen grunn trekke deg fra prosjektet og/eller trekke tilbake ditt samtykke til at prosjektet kan bruke dine helseopplysninger til forskning. Det vil ikke ha noen negative

konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke ditt samtykke til forskning. Dersom du trekker tilbake samtykket, vil det ikke forskes videre på dine helseopplysninger. Du kan også kreve at dine helseopplysninger i prosjektet slettes eller utleveres innen 30 dager. Adgangen til å kreve destruksjon, sletting eller utlevering gjelder ikke dersom materialet eller opplysningene er anonymisert. Denne adgangen kan også begrenses dersom opplysningene er inngått i utførte analyser eller brukt i vitenskapelige publikasjoner.

Dersom du senere ønsker å trekke tilbake ditt samtykke eller har spørsmål til prosjektet, kan du kontakte prosjektkoordinator (se kontaktinformasjon på siste side).

HVA SKJER MED OPPLYSNINGENE OM DEG?

Opplysningene som registreres om deg skal kun brukes slik som beskrevet under formålet med prosjektet, og planlegges brukt til 2024. Eventuelle utvidelser i bruk og oppbevaringstid kan kun skje etter godkjenning fra REK og andre relevante myndigheter. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene. Du kan klage på behandlingen av dine opplysninger til Datatilsynet og institusjonen sitt personvernombud.

Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger (=kodede opplysninger). En kode knytter deg til dine opplysninger gjennom en navneliste. Det er kun Frederik Goplen og Mari Kalland Knapstad som har tilgang til denne listen.

Dine persondata vil bli oppbevart i fem år etter prosjektslutt av kontrollhensyn. Etter dette vil data bli anonymisert, slik at de ikke lenger kan kobles til deg som enkeltperson.

FORSIKRING

Pasientskadelovens regler gjelder for skade som oppstår under medisinske forsøk, jf. helseforskningsloven § 50.

GODKJENNINGER

Regional komité for medisinsk og helsefaglig forskningsetikk har gjort en forskningsetisk vurdering og godkjent prosjektet. [Saksnummer 169388]. Helse Bergen og prosjektleder Frederik Goplen er ansvarlig for personvernet i prosjektet. Vi behandler opplysningene basert på ditt samtykke.

KONTAKTOPPLYSNINGER

Dersom du har spørsmål til prosjektet eller ønsker å trekke deg fra deltakelse, kan du kontakte Mari Kalland Knapstad, tlf. 55972739, mail: mari.kalland.knapstad@helse-bergen.no

Dersom du har spørsmål om personvernet i prosjektet, kan du kontakte personvernombudet ved Helse Bergen HF: christer.kleppe@helse-bergen.no.

Datatilsynets e-postadresse er postkasse@datatilsynet.no.

JEG SAMTYKKER TIL Å DELTA I PROSJEKTET OG TIL AT MINE PERSONOPPLYSNINGER BRUKES SLIK DET ER BESKREVET

Sted og dato	Deltakers signatur
	Deltakers navn med trykte bokstaver
Sted og dato	Signatur
	Prosjektkoordinator

Appendix 4 – Consent form healthy controls

HELSE BERGEN
Haukeland universitetssjukehus
Øre-nese-hals-avdelingen

01.08.2020

VIL DU DELTA I FORSKNINGSPROSJEKTET «DYNAMISK NAKKEFUNKSJON HOS PASIENTER MED SVIMMELHET»?

FORMÅLET MED PROSJEKTET OG HVORFOR DU BLIR SPURT

Dette er et spørsmål til deg om å delta i et forskningsprosjekt for å undersøke hvordan nakken beveger seg under gange hos personer med svimmelhet. Du blir spurt om å delta i prosjektet som frisk kontroll.

HVA INNEBÆRER PROSJEKTET FOR DEG?

Vi ønsker å undersøke hvordan nakken beveger seg når man går. Undersøkelsen vil foregå ved Høyskolen på Vestlandet. Du vil gjennomgå testing som innebærer at du må fylle ut spørreskjema som omhandler svimmelhet, nakkefunksjon og smerter. Det vil bli utført undersøkelse og måling av nakkebevegelser, kroppsmål, gange (der du har på deg to små sensorer), og gange på tredemølle. Undersøkelsen tar ca. 1 time. I prosjektet vil vi innhente og registrere opplysninger om deg fra spørreskjema og testresultatene. I tillegg til disse undersøkelsene samtykker du til at vi kan bruke opplysningene og resultatene dine til vitenskapelige analyser og publikasjon.

MULIGE FORDELER OG ULEMPER

Din deltagelse vil ha betydning for å kunne nærmere undersøke sammenhengen mellom nakkesmerter og svimmelhet. Resultatet fra studien vil kunne øke forståelsen av nakkens betydning for svimmelhet, samt gi kunnskap som kan føre til bedre behandling av pasienter som har begge symptomer. Studien innebærer ingen ulemper utover din tidsbruk i forbindelse med undersøkelsene.

FRIVILLIG DELTAKELSE OG MULIGHET FOR Å TREKKE DITT SAMTYKKE

Det er frivillig å delta i prosjektet. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side.

Du kan når som helst og uten å oppgi noen grunn trekke deg fra prosjektet og/eller trekke tilbake ditt samtykke til at prosjektet kan bruke dine helseopplysninger til forskning. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke ditt samtykke til forskning. Dersom du trekker tilbake samtykket, vil det ikke forskes videre på dine helseopplysninger. Du kan også kreve at dine helseopplysninger i prosjektet slettes eller utleveres innen 30 dager. Adgangen til å kreve destruksjon, sletting eller utlevering gjelder ikke

dersom materialet eller opplysningene er anonymisert. Denne adgangen kan også begrenses dersom opplysningene er inngått i utførte analyser eller brukt i vitenskapelige publikasjoner.

Dersom du senere ønsker å trekke tilbake ditt samtykke eller har spørsmål til prosjektet, kan du kontakte prosjektkoordinator (se kontaktinformasjon på siste side).

HVA SKJER MED OPPLYSNINGENE OM DEG?

Opplysningene som registreres om deg skal kun brukes slik som beskrevet under formålet med prosjektet, og planlegges brukt til 2024. Eventuelle utvidelser i bruk og oppbevaringstid kan kun skje etter godkjenning fra REK og andre relevante myndigheter. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene. Du kan klage på behandlingen av dine opplysninger til Datatilsynet og institusjonen sitt personvernombud.

Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger (=kodede opplysninger). En kode knytter deg til dine opplysninger gjennom en navneliste. Det er kun Frederik Goplen og Mari Kalland Knapstad som har tilgang til denne listen.

Dine persondata vil bli oppbevart i fem år etter prosjektslutt av kontrollhensyn. Etter dette vil data bli anonymisert, slik at de ikke lenger kan kobles til deg som enkeltperson.

FORSIKRING

Pasientskadelovens regler gjelder for skade som oppstår under medisinske forsøk, jf. helseforskningsloven § 50.

GODKJENNINGER

Regional komité for medisinsk og helsefaglig forskningsetikk har gjort en forskningsetisk vurdering og godkjent prosjektet. [Saksnummer 169388]. Helse Bergen og prosjektleder Frederik Goplen er ansvarlig for personvernet i prosjektet. Vi behandler opplysningene basert på ditt samtykke.

KONTAKTOPPLYSNINGER

Dersom du har spørsmål til prosjektet eller ønsker å trekke deg fra deltakelse, kan du kontakte Mari Kalland Knapstad, tlf. 55972739, mail: mari.kalland.knapstad@helse-bergen.no

Dersom du har spørsmål om personvernet i prosjektet, kan du kontakte personvernombudet ved Helse Bergen HF: christer.kleppe@helse-bergen.no.

Datatilsynets e-postadresse er postkasse@datatilsynet.no.

JEG SAMTYKKER TIL Å DELTA I PROSJEKTET OG TIL AT MINE PERSONOPPLYSNINGER BRUKES SLIK DET ER BESKREVET

Sted og dato

Deltakers signatur

.....

Deltakers navn med trykte bokstaver

Sted og dato

Signatur

.....

Prosjektkoordinator

Appendix 5

Testprotokoll:

Samtykke:

Informere kort om hva prosjektet går ut på og tar skriftlig samtykke.

Gange med sensorer

Deltakerne går noen runder uten analyse (ca 3 x frem og tilbake) for å «gå seg litt varm», med utstyret på. Det brukes flying start og stop og det måles totalt opptak på 6 meter.

De går:

4 runder i foretrukket tempo

Instruksjon: Når jeg sier klar, ferdig gå, går du i ditt foretrukne tempo

2 runder med raskt tempo

Instruksjon: Når jeg sier klar ferdig gå, går du så fort som du kan, uten å løpe og uten å miste balansen.

2 runder med å dual-task (50 – 3), prioritere gange

Instruksjon: Når jeg sier klar ferdig gå, skal du gå mens du trekke 3 i fra 50 og 3 i fra der igjen. Forsøk så godt som mulig å ikke stoppe opp.

Utfylling av skjema:

De fyller så ut skjema (både friske og svimle)

Andre målinger

Nakke ROM:

Utgangsstilling pasient: sittende på stol uten ryggstøtte, med anatomisk/nøytral utgangsstilling i rygg og nakke og føttene hvilende på bakken.

Pasient fjerner eventuelle briller, hodeplagg og smykker. Tester viser først en gang hva som skal gjøres deretter får pasienten en prøverunde uten CROM. Pasienten gjennomfører to sett tester av alle nakkens bevegelser. For hvert sett blir hver retning målt en gang. For hver måling blir hodet korrigert til anatomisk utgangsstilling.

Instruksjon:

Fleksjon: Trekk inn haken og bøy hodet fremover så langt du kommer.

Ekstensjon: Løft opp haken, beveg deretter hodet så langt bak som du kommer

Lateralfleksjon: Se rett frem og bøy hodet til høyre/venstre side ved å bevege øret ned mot skulderen så langt som du kommer.
Rotasjon: Snu hodet dit så langt som du kommer, se for deg en horisontal linje som du skal følge med synet.

Trykkalgomenter:

Prosedyre

Utgangsstilling pasient: mageliggende

Punkter:

- Øvre nakke: Suboccipitalt, to fingerbreddet lateralt fra C2 inferiort for skallebasis
- Nedre nakke: Fasettledd området C6-C5, anteriort for øvre kant av trapezius.

Utgangsstilling tester ved øvre nakke: Tester står caudalt for pasienten på samme siden som punktet som testes og gir et gradvis trykk i midtre del av suboccipital muskulatur.

Utgangsstilling tester nedre nakke: Tester står på samme siden som punktet som testes og gir et gradvis trykk med retning mot fasettledd.

Instruksjon: Jeg skal nå gi deg et gradvis trykk. Du sier «ja» når trykket går over fra å kun være trykk til den minste fornemmelse av smerte

Trykk: et gradvis trykk som tilsvarer 5N/s – 25N per 5 sek. Trykket stanses umiddelbart når pasienten sier «ja».

Tester gjennomfører tre sett av trykk på alle fire punktene. For hvert sett blir alle fire punktene testet. Mellom hvert sett får pasienten 30 sek pause.

Høyde:

Uten sko

Vekt:

Uten sko

Appendix 6: Evaluation of the pilot study (summarized)

For feasibility in further research, the procedures in the study were evaluated and summarized.

Study design

We found the study design to function as intended for its purpose. Future studies could consider examination of specific sub-groups or diagnoses with regards to dizziness, for instance participants without dizziness but with neck pain or with dizziness and without neck pain.

Recruitment

We were able to recruit 6/14 eligible participants (43 percent). This is relatively low, and if a similar inclusion rate was to be found in the main study, the generalizability of the results could be limited. Also, inclusion could take a long time. The participants were recruited from only one source, and if we had more sources for participants, it is likely that we would be able to recruit more patients.

Infrastructure and equipment

The maximal continuous walking length is 10 meters (including two meters at each end for acceleration and deceleration). This may be short, and the participants walked four times for each condition. The lab is equipped with several treadmills, which would allow for longer continuous walking. However, treadmill walking has an effect on gait as the walker does not propel forward, but instead resists being pulled backwards. Also, participants may be unfamiliar with treadmill walking, which would then require time to learn and adapt to the treadmill. As it was, on average, 7,7 steps were captured for each participant, which we suggest is sufficient for analyses.

As to sensor placement, future studies should discuss the possibility of adding a sensor to the upper trunk or cervicothoracic junction, if one seeks specific data on neck function during gait and not just the difference between the head and lower trunk.

The technical equipment worked reasonably well. Few, but some instances occurred where data was insufficient for processing, demanding repeat measurements of gait one or more gait trials. We were, however, able to obtain appropriate walking data for all participants. One participant tended to stop for calculation during the dual task condition,

and several walks were necessary before we had four trials with continuous walking. Instructions about prioritization is necessary, but this is a trade-off, as participants may perform suboptimal in the cognitive task. However, for future study we propose instructing participants to focus their gaze on a fixed item during walking, as this may elicit different responses between those that have decrease head stability/gaze stability and those who do not. Lastly, further studies using the same setup should consider examining other modes of walking (i.e., on foam mats, with head movements or other tasks that mimic some daily activities).

We also propose that if PPT measurements are to be performed, that they are measured with the patients in the prone position. We also experienced problems with the algometers and poor battery capacity (perhaps due to equipment age). CROM measurements appeared to function well, and we propose no changes to this mode of assessing neck mobility except using a chair that supports the thoracic spine in order to reduce possible compensatory movements of the trunk.

Data analysis:

This study only examined accelerations and attenuation of accelerations between the two sensors used. Future studies should consider examining other variables such as harmonic ratio to gain understanding on gait variability or frequency of oscillations in the sensors and how the trunk and neck attenuates these. Our study did not explore the ratio of attenuation that occurred between sensors in the two groups. Thus, this may also be considered in future studies. Correlation analyses should look for associations within the dizzy group.

Summary:

We encountered difficulties in identifying and recruiting dizzy patients. We found the general methods in the study to function appropriately with some smaller exceptions. Future studies should consider some modifications to study design and eligibility criteria, as well as some smaller modifications regarding methods of measurements.

Appendix 7 - Correlation analyses

		Lat_flex	flex	Rot	PPT UN	PPT LN
Lat_flex	Pearson Correlation	1,00	,615*	0,54	0,53	0,49
	Sig. (2-tailed)		0,03	0,07	0,10	0,12
flex	Pearson Correlation	,615*	1,00	,590*	0,16	0,53
	Sig. (2-tailed)	0,03		0,04	0,64	0,09
Rot	Pearson Correlation	0,54	,590*	1,00	-0,01	0,11
	Sig. (2-tailed)	0,07	0,04		0,97	0,75
PPT UN	Pearson Correlation	0,53	0,16	-0,01	1,00	,717*
	Sig. (2-tailed)	0,10	0,64	0,97		0,01
PPT LN	Pearson Correlation	0,49	0,53	0,11	,717*	1,00
	Sig. (2-tailed)	0,12	0,09	0,75	0,01	
AP back pref	Pearson Correlation	,587*	0,31	,697*	0,10	0,04
	Sig. (2-tailed)	0,05	0,32	0,01	0,78	0,91
ML back pref	Pearson Correlation	-0,24	-0,10	0,40	-0,50	-0,48
	Sig. (2-tailed)	0,46	0,77	0,20	0,12	0,13
V back pref	Pearson Correlation	0,20	0,08	,677*	-0,12	-0,13
	Sig. (2-tailed)	0,54	0,81	0,02	0,73	0,71
AP head pref	Pearson Correlation	-0,45	-0,39	-0,19	-0,35	-0,57
	Sig. (2-tailed)	0,15	0,21	0,56	0,30	0,07
ML head pref	Pearson Correlation	-0,14	0,05	0,57	-0,48	-0,45
	Sig. (2-tailed)	0,67	0,87	0,05	0,14	0,17
V head pref	Pearson Correlation	0,16	0,13	,689*	-0,16	-0,17
	Sig. (2-tailed)	0,61	0,69	0,01	0,65	0,62
AP ATT pref	Pearson Correlation	,630*	0,39	,617*	0,21	0,25
	Sig. (2-tailed)	0,03	0,21	0,03	0,54	0,46
ML ATT pref	Pearson Correlation	-0,14	-0,16	-0,08	-0,16	-0,17
	Sig. (2-tailed)	0,67	0,63	0,80	0,64	0,62
V ATT pref	Pearson Correlation	0,11	-0,24	-0,20	0,20	0,23
	Sig. (2-tailed)	0,74	0,45	0,54	0,56	0,50
AP back DT	Pearson Correlation	0,57	0,50	,725**	0,09	0,37
	Sig. (2-tailed)	0,05	0,10	0,01	0,80	0,27
ML back DT	Pearson Correlation	-0,53	-0,22	-0,02	-0,44	-0,10
	Sig. (2-tailed)	0,08	0,49	0,95	0,18	0,78
V back DT	Pearson Correlation	0,09	0,26	0,28	0,01	0,23
	Sig. (2-tailed)	0,78	0,42	0,37	0,97	0,51
AP head DT	Pearson Correlation	-0,08	-0,15	-0,03	-0,17	-0,28
	Sig. (2-tailed)	0,81	0,63	0,94	0,63	0,41
ML head DT	Pearson Correlation	0,14	0,06	0,44	-0,34	-0,23
	Sig. (2-tailed)	0,68	0,86	0,16	0,31	0,49
V head DT	Pearson Correlation	0,06	0,34	0,35	-0,05	0,24
	Sig. (2-tailed)	0,86	0,28	0,27	0,88	0,48
AP ATT DT	Pearson Correlation	0,43	0,45	0,48	0,18	0,44
	Sig. (2-tailed)	0,17	0,14	0,11	0,59	0,18
ML ATT DT	Pearson Correlation	-,648*	-0,27	-0,48	-0,06	0,14
	Sig. (2-tailed)	0,02	0,39	0,12	0,86	0,69
V ATT DT	Pearson Correlation	0,08	-0,43	-0,38	0,26	-0,15
	Sig. (2-tailed)	0,81	0,16	0,23	0,44	0,66

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 7 - Correlation analyses

		AP back pref	ML back pref	V back pref	AP head pref
Lat_flex	Pearson Correlation	,587*	-0,24	0,20	-0,45
	Sig. (2-tailed)	0,05	0,46	0,54	0,15
flex	Pearson Correlation	0,31	-0,10	0,08	-0,39
	Sig. (2-tailed)	0,32	0,77	0,81	0,21
Rot	Pearson Correlation	,697*	0,40	,677*	-0,19
	Sig. (2-tailed)	0,01	0,20	0,02	0,56
PPT UN	Pearson Correlation	0,10	-0,50	-0,12	-0,35
	Sig. (2-tailed)	0,78	0,12	0,73	0,30
PPT LN	Pearson Correlation	0,04	-0,48	-0,13	-0,57
	Sig. (2-tailed)	0,91	0,13	0,71	0,07
AP back pref	Pearson Correlation	1,00	0,50	,745**	-0,40
	Sig. (2-tailed)		0,10	0,01	0,20
ML back pref	Pearson Correlation	0,50	1,00	0,48	0,15
	Sig. (2-tailed)	0,10		0,12	0,64
V back pref	Pearson Correlation	,745**	0,48	1,00	0,05
	Sig. (2-tailed)	0,01	0,12		0,88
AP head pref	Pearson Correlation	-0,40	0,15	0,05	1,00
	Sig. (2-tailed)	0,20	0,64	0,88	
ML head pref	Pearson Correlation	0,26	0,53	,606*	0,48
	Sig. (2-tailed)	0,42	0,08	0,04	0,11
V head pref	Pearson Correlation	,689*	0,49	,972**	0,14
	Sig. (2-tailed)	0,01	0,11	0,00	0,67
AP ATT pref	Pearson Correlation	,935**	0,33	0,56	-,699*
	Sig. (2-tailed)	0,00	0,29	0,06	0,01
ML ATT pref	Pearson Correlation	0,33	,631*	-0,02	-0,27
	Sig. (2-tailed)	0,30	0,03	0,95	0,39
V ATT pref	Pearson Correlation	0,08	-0,14	-0,10	-0,40
	Sig. (2-tailed)	0,81	0,66	0,75	0,20
AP back DT	Pearson Correlation	,582*	0,16	,627*	-0,11
	Sig. (2-tailed)	0,05	0,62	0,03	0,74
ML back DT	Pearson Correlation	-0,44	0,10	0,05	0,43
	Sig. (2-tailed)	0,16	0,75	0,87	0,17
V back DT	Pearson Correlation	-0,19	-0,34	0,27	0,37
	Sig. (2-tailed)	0,55	0,28	0,39	0,23
AP head DT	Pearson Correlation	-0,39	0,01	-0,15	,793**
	Sig. (2-tailed)	0,21	0,97	0,63	0,00
ML head DT	Pearson Correlation	0,09	0,17	0,42	0,55
	Sig. (2-tailed)	0,78	0,61	0,17	0,06
V head DT	Pearson Correlation	-0,16	-0,21	0,29	0,38
	Sig. (2-tailed)	0,61	0,51	0,37	0,22
AP ATT DT	Pearson Correlation	,708**	0,09	0,53	-,759**
	Sig. (2-tailed)	0,01	0,79	0,08	0,00
ML ATT DT	Pearson Correlation	-0,51	-0,08	-0,40	-0,18
	Sig. (2-tailed)	0,09	0,82	0,20	0,58
V ATT DT	Pearson Correlation	-0,02	-0,31	-0,17	-0,21
	Sig. (2-tailed)	0,95	0,33	0,59	0,52

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 7 - Correlation analyses

		ML head pref	V head pref	AP ATT pref	ML ATT pref
Lat_flex	Pearson Correlation	-0,14	0,16	,630*	-0,14
	Sig. (2-tailed)	0,67	0,61	0,03	0,67
flex	Pearson Correlation	0,05	0,13	0,39	-0,16
	Sig. (2-tailed)	0,87	0,69	0,21	0,63
Rot	Pearson Correlation	0,57	,689*	,617*	-0,08
	Sig. (2-tailed)	0,05	0,01	0,03	0,80
PPT UN	Pearson Correlation	-0,48	-0,16	0,21	-0,16
	Sig. (2-tailed)	0,14	0,65	0,54	0,64
PPT LN	Pearson Correlation	-0,45	-0,17	0,25	-0,17
	Sig. (2-tailed)	0,17	0,62	0,46	0,62
AP back pref	Pearson Correlation	0,26	,689*	,935**	0,33
	Sig. (2-tailed)	0,42	0,01	0,00	0,30
ML back pref	Pearson Correlation	0,53	0,49	0,33	,631*
	Sig. (2-tailed)	0,08	0,11	0,29	0,03
V back pref	Pearson Correlation	,606*	,972**	0,56	-0,02
	Sig. (2-tailed)	0,04	0,00	0,06	0,95
AP head pref	Pearson Correlation	0,48	0,14	-,699*	-0,27
	Sig. (2-tailed)	0,11	0,67	0,01	0,39
ML head pref	Pearson Correlation	1,00	,628*	0,01	-0,32
	Sig. (2-tailed)		0,03	0,97	0,31
V head pref	Pearson Correlation	,628*	1,00	0,48	-0,03
	Sig. (2-tailed)	0,03		0,11	0,92
AP ATT pref	Pearson Correlation	0,01	0,48	1,00	0,36
	Sig. (2-tailed)	0,97	0,11		0,25
ML ATT pref	Pearson Correlation	-0,32	-0,03	0,36	1,00
	Sig. (2-tailed)	0,31	0,92	0,25	
V ATT pref	Pearson Correlation	-0,23	-0,33	0,21	0,05
	Sig. (2-tailed)	0,48	0,29	0,51	0,88
AP back DT	Pearson Correlation	0,55	0,57	0,50	-0,32
	Sig. (2-tailed)	0,07	0,06	0,10	0,30
ML back DT	Pearson Correlation	0,47	0,11	-0,50	-0,31
	Sig. (2-tailed)	0,13	0,73	0,10	0,32
V back DT	Pearson Correlation	0,47	0,28	-0,30	-,810**
	Sig. (2-tailed)	0,13	0,38	0,35	0,00
AP head DT	Pearson Correlation	0,41	-0,10	-,612*	-0,36
	Sig. (2-tailed)	0,18	0,77	0,03	0,25
ML head DT	Pearson Correlation	,782**	0,42	-0,15	-0,53
	Sig. (2-tailed)	0,00	0,17	0,65	0,08
V head DT	Pearson Correlation	,586*	0,31	-0,27	-,772**
	Sig. (2-tailed)	0,05	0,33	0,39	0,00
AP ATT DT	Pearson Correlation	-0,01	0,44	,846**	0,11
	Sig. (2-tailed)	0,97	0,15	0,00	0,73
ML ATT DT	Pearson Correlation	-0,38	-0,34	-0,33	0,26
	Sig. (2-tailed)	0,22	0,28	0,30	0,41
V ATT DT	Pearson Correlation	-,651*	-0,25	0,07	0,25
	Sig. (2-tailed)	0,02	0,44	0,84	0,43

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 7 - Correlation analyses

		V ATT pref	AP back DT	ML back DT	V back DT
Lat_flex	Pearson Correlation	0,11	0,57	-0,53	0,09
	Sig. (2-tailed)	0,74	0,05	0,08	0,78
flex	Pearson Correlation	-0,24	0,50	-0,22	0,26
	Sig. (2-tailed)	0,45	0,10	0,49	0,42
Rot	Pearson Correlation	-0,20	,725**	-0,02	0,28
	Sig. (2-tailed)	0,54	0,01	0,95	0,37
PPT UN	Pearson Correlation	0,20	0,09	-0,44	0,01
	Sig. (2-tailed)	0,56	0,80	0,18	0,97
PPT LN	Pearson Correlation	0,23	0,37	-0,10	0,23
	Sig. (2-tailed)	0,50	0,27	0,78	0,51
AP back pref	Pearson Correlation	0,08	,582*	-0,44	-0,19
	Sig. (2-tailed)	0,81	0,05	0,16	0,55
ML back pref	Pearson Correlation	-0,14	0,16	0,10	-0,34
	Sig. (2-tailed)	0,66	0,62	0,75	0,28
V back pref	Pearson Correlation	-0,10	,627*	0,05	0,27
	Sig. (2-tailed)	0,75	0,03	0,87	0,39
AP head pref	Pearson Correlation	-0,40	-0,11	0,43	0,37
	Sig. (2-tailed)	0,20	0,74	0,17	0,23
ML head pref	Pearson Correlation	-0,23	0,55	0,47	0,47
	Sig. (2-tailed)	0,48	0,07	0,13	0,13
V head pref	Pearson Correlation	-0,33	0,57	0,11	0,28
	Sig. (2-tailed)	0,29	0,06	0,73	0,38
AP ATT pref	Pearson Correlation	0,21	0,50	-0,50	-0,30
	Sig. (2-tailed)	0,51	0,10	0,10	0,35
ML ATT pref	Pearson Correlation	0,05	-0,32	-0,31	-,810**
	Sig. (2-tailed)	0,88	0,30	0,32	0,00
V ATT pref	Pearson Correlation	1,00	0,12	-0,27	-0,08
	Sig. (2-tailed)		0,71	0,41	0,81
AP back DT	Pearson Correlation	0,12	1,00	0,15	0,57
	Sig. (2-tailed)	0,71		0,65	0,05
ML back DT	Pearson Correlation	-0,27	0,15	1,00	0,46
	Sig. (2-tailed)	0,41	0,65		0,13
V back DT	Pearson Correlation	-0,08	0,57	0,46	1,00
	Sig. (2-tailed)	0,81	0,05	0,13	
AP head DT	Pearson Correlation	-0,21	0,14	0,46	0,43
	Sig. (2-tailed)	0,51	0,66	0,13	0,17
ML head DT	Pearson Correlation	-0,09	,672*	0,51	,676*
	Sig. (2-tailed)	0,79	0,02	0,09	0,02
V head DT	Pearson Correlation	-0,17	,631*	0,56	,966**
	Sig. (2-tailed)	0,60	0,03	0,06	0,00
AP ATT DT	Pearson Correlation	0,26	0,51	-0,31	-0,01
	Sig. (2-tailed)	0,41	0,09	0,33	0,98
ML ATT DT	Pearson Correlation	-0,16	-0,57	0,42	-0,27
	Sig. (2-tailed)	0,61	0,05	0,18	0,39
V ATT DT	Pearson Correlation	0,36	-0,50	-0,57	-0,36
	Sig. (2-tailed)	0,26	0,10	0,05	0,25

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 7 - Correlation analyses

		AP head DT	ML head DT	V head DT	AP ATT DT
Lat_flex	Pearson Correlation	-0,08	0,14	0,06	0,43
	Sig. (2-tailed)	0,81	0,68	0,86	0,17
flex	Pearson Correlation	-0,15	0,06	0,34	0,45
	Sig. (2-tailed)	0,63	0,86	0,28	0,14
Rot	Pearson Correlation	-0,03	0,44	0,35	0,48
	Sig. (2-tailed)	0,94	0,16	0,27	0,11
PPT UN	Pearson Correlation	-0,17	-0,34	-0,05	0,18
	Sig. (2-tailed)	0,63	0,31	0,88	0,59
PPT LN	Pearson Correlation	-0,28	-0,23	0,24	0,44
	Sig. (2-tailed)	0,41	0,49	0,48	0,18
AP back pref	Pearson Correlation	-0,39	0,09	-0,16	,708**
	Sig. (2-tailed)	0,21	0,78	0,61	0,01
ML back pref	Pearson Correlation	0,01	0,17	-0,21	0,09
	Sig. (2-tailed)	0,97	0,61	0,51	0,79
V back pref	Pearson Correlation	-0,15	0,42	0,29	0,53
	Sig. (2-tailed)	0,63	0,17	0,37	0,08
AP head pref	Pearson Correlation	,793**	0,55	0,38	-,759**
	Sig. (2-tailed)	0,00	0,06	0,22	0,00
ML head pref	Pearson Correlation	0,41	,782**	,586*	-0,01
	Sig. (2-tailed)	0,18	0,00	0,05	0,97
V head pref	Pearson Correlation	-0,10	0,42	0,31	0,44
	Sig. (2-tailed)	0,77	0,17	0,33	0,15
AP ATT pref	Pearson Correlation	-,612*	-0,15	-0,27	,846**
	Sig. (2-tailed)	0,03	0,65	0,39	0,00
ML ATT pref	Pearson Correlation	-0,36	-0,53	-,772**	0,11
	Sig. (2-tailed)	0,25	0,08	0,00	0,73
V ATT pref	Pearson Correlation	-0,21	-0,09	-0,17	0,26
	Sig. (2-tailed)	0,51	0,79	0,60	0,41
AP back DT	Pearson Correlation	0,14	,672*	,631*	0,51
	Sig. (2-tailed)	0,66	0,02	0,03	0,09
ML back DT	Pearson Correlation	0,46	0,51	0,56	-0,31
	Sig. (2-tailed)	0,13	0,09	0,06	0,33
V back DT	Pearson Correlation	0,43	,676*	,966**	-0,01
	Sig. (2-tailed)	0,17	0,02	0,00	0,98
AP head DT	Pearson Correlation	1,00	,726**	0,46	-,781**
	Sig. (2-tailed)		0,01	0,13	0,00
ML head DT	Pearson Correlation	,726**	1,00	,728**	-0,21
	Sig. (2-tailed)	0,01		0,01	0,52
V head DT	Pearson Correlation	0,46	,728**	1,00	0,00
	Sig. (2-tailed)	0,13	0,01		0,99
AP ATT DT	Pearson Correlation	-,781**	-0,21	0,00	1,00
	Sig. (2-tailed)	0,00	0,52	0,99	
ML ATT DT	Pearson Correlation	-0,33	-0,57	-0,24	-0,07
	Sig. (2-tailed)	0,30	0,05	0,46	0,82
V ATT DT	Pearson Correlation	-0,34	-0,52	-,589*	-0,02
	Sig. (2-tailed)	0,29	0,09	0,04	0,95

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 7 - Correlation analyses

		ML ATT DT	V ATT DT
Lat_flex	Pearson Correlation	-,648*	0,08
	Sig. (2-tailed)	0,02	0,81
flex	Pearson Correlation	-0,27	-0,43
	Sig. (2-tailed)	0,39	0,16
Rot	Pearson Correlation	-0,48	-0,38
	Sig. (2-tailed)	0,12	0,23
PPT UN	Pearson Correlation	-0,06	0,26
	Sig. (2-tailed)	0,86	0,44
PPT LN	Pearson Correlation	0,14	-0,15
	Sig. (2-tailed)	0,69	0,66
AP back pref	Pearson Correlation	-0,51	-0,02
	Sig. (2-tailed)	0,09	0,95
ML back pref	Pearson Correlation	-0,08	-0,31
	Sig. (2-tailed)	0,82	0,33
V back pref	Pearson Correlation	-0,40	-0,17
	Sig. (2-tailed)	0,20	0,59
AP head pref	Pearson Correlation	-0,18	-0,21
	Sig. (2-tailed)	0,58	0,52
ML head pref	Pearson Correlation	-0,38	-,651*
	Sig. (2-tailed)	0,22	0,02
V head pref	Pearson Correlation	-0,34	-0,25
	Sig. (2-tailed)	0,28	0,44
AP ATT pref	Pearson Correlation	-0,33	0,07
	Sig. (2-tailed)	0,30	0,84
ML ATT pref	Pearson Correlation	0,26	0,25
	Sig. (2-tailed)	0,41	0,43
V ATT pref	Pearson Correlation	-0,16	0,36
	Sig. (2-tailed)	0,61	0,26
AP back DT	Pearson Correlation	-0,57	-0,50
	Sig. (2-tailed)	0,05	0,10
ML back DT	Pearson Correlation	0,42	-0,57
	Sig. (2-tailed)	0,18	0,05
V back DT	Pearson Correlation	-0,27	-0,36
	Sig. (2-tailed)	0,39	0,25
AP head DT	Pearson Correlation	-0,33	-0,34
	Sig. (2-tailed)	0,30	0,29
ML head DT	Pearson Correlation	-0,57	-0,52
	Sig. (2-tailed)	0,05	0,09
V head DT	Pearson Correlation	-0,24	-,589*
	Sig. (2-tailed)	0,46	0,04
AP ATT DT	Pearson Correlation	-0,07	-0,02
	Sig. (2-tailed)	0,82	0,95
ML ATT DT	Pearson Correlation	1,00	0,00
	Sig. (2-tailed)		0,99
V ATT DT	Pearson Correlation	0,00	1,00
	Sig. (2-tailed)	0,99	

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 7 - Correlation analyses

Correlations

		Lat_flex	flex	Rot	UN	LN	
Lat_flex	Pearson Correlation	1,00	,615*		0,54	0,53	0,49
	Sig. (2-tailed)		0,03		0,07	0,10	0,12
flex	Pearson Correlation	,615*	1,00	,590*		0,16	0,53
	Sig. (2-tailed)	0,03		0,04		0,64	0,09
Rot	Pearson Correlation	0,54	,590*	1,00		-0,01	0,11
	Sig. (2-tailed)	0,07	0,04			0,97	0,75
UN	Pearson Correlation	0,53	0,16	-0,01	1,00	,717*	
	Sig. (2-tailed)	0,10	0,64	0,97			0,01
LN	Pearson Correlation	0,49	0,53	0,11	,717*		1,00
	Sig. (2-tailed)	0,12	0,09	0,75	0,01		
Velocity back fast	Pearson Correlation	0,30	0,13	0,31	0,23	0,18	
	Sig. (2-tailed)	0,35	0,69	0,33	0,49	0,60	
Cadence back fast	Pearson Correlation	-0,01	-0,02	0,44	0,04	0,03	
	Sig. (2-tailed)	0,99	0,95	0,15	0,90	0,94	
Steplength back fast	Pearson Correlation	0,46	0,23	-0,05	0,29	0,25	
	Sig. (2-tailed)	0,13	0,47	0,88	0,39	0,47	
AP back fast	Pearson Correlation	0,37	0,08	0,46	0,08	0,01	
	Sig. (2-tailed)	0,24	0,80	0,13	0,81	0,98	
ML back fast	Pearson Correlation	0,01	-0,03	0,31	0,14	0,04	
	Sig. (2-tailed)	0,97	0,93	0,33	0,67	0,90	
V back fast	Pearson Correlation	0,23	0,17	0,57	-0,26	-0,20	
	Sig. (2-tailed)	0,48	0,59	0,05	0,44	0,55	
AP head fast	Pearson Correlation	-0,14	-0,19	0,27	-0,08	-0,31	
	Sig. (2-tailed)	0,67	0,56	0,39	0,82	0,35	
ML head fast	Pearson Correlation	-0,12	0,04	0,48	-0,40	-0,46	
	Sig. (2-tailed)	0,72	0,91	0,11	0,23	0,16	
V head fast	Pearson Correlation	0,20	0,42	,599*	-0,45	-0,21	
	Sig. (2-tailed)	0,53	0,17	0,04	0,16	0,54	
AP attenuation fast	Pearson Correlation	0,42	0,15	0,36	0,11	0,12	
	Sig. (2-tailed)	0,18	0,64	0,24	0,75	0,73	
ML attenuation fast	Pearson Correlation	0,06	-0,05	0,18	0,30	0,20	
	Sig. (2-tailed)	0,86	0,89	0,58	0,38	0,56	
V attenuation fast	Pearson Correlation	-0,02	-,611*	-0,27	0,49	0,09	
	Sig. (2-tailed)	0,94	0,04	0,40	0,12	0,80	

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 7 - Correlation analyses

Correlations

		Vel back fast	Cad back fast	SL back fast	AP back fast
Lat_flex	Pearson Correlation	0,30	-0,01	0,46	0,37
	Sig. (2-tailed)	0,35	0,99	0,13	0,24
flex	Pearson Correlation	0,13	-0,02	0,23	0,08
	Sig. (2-tailed)	0,69	0,95	0,47	0,80
Rot	Pearson Correlation	0,31	0,44	-0,05	0,46
	Sig. (2-tailed)	0,33	0,15	0,88	0,13
UN	Pearson Correlation	0,23	0,04	0,29	0,08
	Sig. (2-tailed)	0,49	0,90	0,39	0,81
LN	Pearson Correlation	0,18	0,03	0,25	0,01
	Sig. (2-tailed)	0,60	0,94	0,47	0,98
Velocity back fast	Pearson Correlation	1,00	,749**	,624*	,711**
	Sig. (2-tailed)		0,01	0,03	0,01
Cadence back fast	Pearson Correlation	,749**	1,00	-0,05	,719**
	Sig. (2-tailed)	0,01		0,88	0,01
Steplength back fast	Pearson Correlation	,624*	-0,05	1,00	0,22
	Sig. (2-tailed)	0,03	0,88		0,50
AP back fast	Pearson Correlation	,711**	,719**	0,22	1,00
	Sig. (2-tailed)	0,01	0,01	0,50	
ML back fast	Pearson Correlation	,781**	,933**	0,07	,804**
	Sig. (2-tailed)	0,00	0,00	0,84	0,00
V back fast	Pearson Correlation	,731**	0,56	0,44	,727**
	Sig. (2-tailed)	0,01	0,06	0,15	0,01
AP head fast	Pearson Correlation	-0,11	-0,01	-0,19	0,19
	Sig. (2-tailed)	0,74	0,99	0,56	0,56
ML head fast	Pearson Correlation	0,53	0,53	0,16	0,54
	Sig. (2-tailed)	0,08	0,08	0,62	0,07
V head fast	Pearson Correlation	0,45	0,30	0,33	0,52
	Sig. (2-tailed)	0,15	0,35	0,30	0,08
AP attenuation fast	Pearson Correlation	,751**	,723**	0,29	,934**
	Sig. (2-tailed)	0,01	0,01	0,37	0,00
ML attenuation fast	Pearson Correlation	,705*	,880**	0,02	,728**
	Sig. (2-tailed)	0,01	0,00	0,96	0,01
V attenuation fast	Pearson Correlation	0,36	0,37	0,09	0,19
	Sig. (2-tailed)	0,25	0,23	0,78	0,55

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 7 - Correlation analyses

Correlations

		ML back fast	V back fast	AP head fast	ML head fast
Lat_flex	Pearson Correlation	0,01	0,23	-0,14	-0,12
	Sig. (2-tailed)	0,97	0,48	0,67	0,72
flex	Pearson Correlation	-0,03	0,17	-0,19	0,04
	Sig. (2-tailed)	0,93	0,59	0,56	0,91
Rot	Pearson Correlation	0,31	0,57	0,27	0,48
	Sig. (2-tailed)	0,33	0,05	0,39	0,11
UN	Pearson Correlation	0,14	-0,26	-0,08	-0,40
	Sig. (2-tailed)	0,67	0,44	0,82	0,23
LN	Pearson Correlation	0,04	-0,20	-0,31	-0,46
	Sig. (2-tailed)	0,90	0,55	0,35	0,16
Velocity back fast	Pearson Correlation	,781**	,731**	-0,11	0,53
	Sig. (2-tailed)	0,00	0,01	0,74	0,08
Cadence back fast	Pearson Correlation	,933**	0,56	-0,01	0,53
	Sig. (2-tailed)	0,00	0,06	0,99	0,08
Steplength back fast	Pearson Correlation	0,07	0,44	-0,19	0,16
	Sig. (2-tailed)	0,84	0,15	0,56	0,62
AP back fast	Pearson Correlation	,804**	,727**	0,19	0,54
	Sig. (2-tailed)	0,00	0,01	0,56	0,07
ML back fast	Pearson Correlation	1,00	0,54	0,07	0,54
	Sig. (2-tailed)		0,07	0,84	0,07
V back fast	Pearson Correlation	0,54	1,00	0,23	,779**
	Sig. (2-tailed)	0,07		0,47	0,00
AP head fast	Pearson Correlation	0,07	0,23	1,00	0,49
	Sig. (2-tailed)	0,84	0,47		0,10
ML head fast	Pearson Correlation	0,54	,779**	0,49	1,00
	Sig. (2-tailed)	0,07	0,00	0,10	
V head fast	Pearson Correlation	0,28	,890**	0,20	,726**
	Sig. (2-tailed)	0,38	0,00	0,54	0,01
AP attenuation fast	Pearson Correlation	,781**	,645*	-0,18	0,36
	Sig. (2-tailed)	0,00	0,02	0,59	0,26
ML attenuation fast	Pearson Correlation	,951**	0,33	-0,11	0,26
	Sig. (2-tailed)	0,00	0,29	0,74	0,42
V attenuation fast	Pearson Correlation	0,38	-0,12	-0,01	-0,16
	Sig. (2-tailed)	0,23	0,71	0,99	0,61

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 7 - Correlation analyses

Correlations

		V head fast	AP ATT fast	ML ATT fast	V ATT fast
Lat_flex	Pearson Correlation	0,20	0,42	0,06	-0,02
	Sig. (2-tailed)	0,53	0,18	0,86	0,94
flex	Pearson Correlation	0,42	0,15	-0,05	-,611*
	Sig. (2-tailed)	0,17	0,64	0,89	0,04
Rot	Pearson Correlation	,599*	0,36	0,18	-0,27
	Sig. (2-tailed)	0,04	0,24	0,58	0,40
UN	Pearson Correlation	-0,45	0,11	0,30	0,49
	Sig. (2-tailed)	0,16	0,75	0,38	0,12
LN	Pearson Correlation	-0,21	0,12	0,20	0,09
	Sig. (2-tailed)	0,54	0,73	0,56	0,80
Velocity back fast	Pearson Correlation	0,45	,751**	,705*	0,36
	Sig. (2-tailed)	0,15	0,01	0,01	0,25
Cadence back fast	Pearson Correlation	0,30	,723**	,880**	0,37
	Sig. (2-tailed)	0,35	0,01	0,00	0,23
Steplength back fast	Pearson Correlation	0,33	0,29	0,02	0,09
	Sig. (2-tailed)	0,30	0,37	0,96	0,78
AP back fast	Pearson Correlation	0,52	,934**	,728**	0,19
	Sig. (2-tailed)	0,08	0,00	0,01	0,55
ML back fast	Pearson Correlation	0,28	,781**	,951**	0,38
	Sig. (2-tailed)	0,38	0,00	0,00	0,23
V back fast	Pearson Correlation	,890**	,645*	0,33	-0,12
	Sig. (2-tailed)	0,00	0,02	0,29	0,71
AP head fast	Pearson Correlation	0,20	-0,18	-0,11	-0,01
	Sig. (2-tailed)	0,54	0,59	0,74	0,99
ML head fast	Pearson Correlation	,726**	0,36	0,26	-0,16
	Sig. (2-tailed)	0,01	0,26	0,42	0,61
V head fast	Pearson Correlation	1,00	0,45	0,05	-0,56
	Sig. (2-tailed)		0,14	0,87	0,06
AP attenuation fast	Pearson Correlation	0,45	1,00	,768**	0,19
	Sig. (2-tailed)	0,14		0,00	0,55
ML attenuation fast	Pearson Correlation	0,05	,768**	1,00	0,49
	Sig. (2-tailed)	0,87	0,00		0,10
V attenuation fast	Pearson Correlation	-0,56	0,19	0,49	1,00
	Sig. (2-tailed)	0,06	0,55	0,10	

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Vanskeligheter på grunn av svimmelhet (DHI)

Vi ber deg om å lese instruksjonene nøye: Hensikten med dette skjemaet er å identifisere vanskeligheter du kan oppleve **på grunn av din svimmelhet eller ustøhet de siste 4 ukene**. Vennligst besvar hvert av spørsmålene med «ja», «nei», «noen ganger». Besvar hvert spørsmål sett ut fra at det bare er forbundet med ditt svimmelhets – eller ustøhetsproblem.

Jeg føler meg ikke svimmel eller ustø ☐ gå til side 7

Nr	Spørsmål	Ja	Nei	Noen ganger
1	Øker problemet ditt når du ser opp?			
2	Føler du deg frustrert på grunn av problemet ditt?			
3	Begrenser du reising i jobb eller fritid på grunn av problemet ditt?			
4	Øker problemet ditt når du går mellom reolene i et supermarked?			
5	Har du vansker med å komme inn eller ut av sengen på grunn av problemet ditt?			
6	Hemmer ditt problem deg i betydelig grad fra å delta i sosiale aktiviteter som å gå ut på middag, kino, dans eller selskap?			
7	Har du vansker med å lese på grunn av problemet ditt?			
8	Øker problemet ditt når du utfører mer ambisiøse aktiviteter som sport, dans og husarbeid som å feie gulv eller sette oppvasken på plass?			
9	Er du redd for å gå hjemmefra uten å ha noen til å følge deg på grunn av problemet ditt?			
10	Har du vært forlegen/flau foran andre på grunn av problemet ditt?			
11	Øker problemet ditt når du snur fort på hodet?			
12	Unngår du høyder på grunn av problemet ditt?			
13	Øker problemet ditt når du snur deg i sengen?			
14	Er det vanskelig for deg å utføre anstrengende husarbeid eller hagearbeid på grunn av problemet ditt?			
15	På grunn av problemet ditt, er du redd for at folk kan tro du er (be)ruset?			
16	Er det vanskelig for deg å gå på en tur alene på grunn av problemet ditt?			
17	Øker problemet ditt når du går langs et fortau?			
18	Er det vanskelig for deg å konsentrere deg på grunn av problemet ditt?			
19	Er det vanskelig for deg å gå rundt i huset ditt i mørket på grunn av problemet ditt?			
20	Er du redd for å være alene hjemme på grunn av problemet ditt?			
21	Føler du deg handikappet på grunn av problemet ditt?			
22	Har problemet ditt vært belastende på ditt forhold til familiemedlemmer eller venner?			
23	Er du deprimert på grunn av problemet ditt?			
24	Forstyrrer problemet ditt deg i å ivareta dine forpliktelser i jobb eller hjemme?			
25	Øker problemet ditt når du bøyer deg forover?			

Har du hatt plagene de siste 4 ukene? ☐ Ja ☐ Nei

SKJEMA OM HEMMENDE NAKKEPLAGER (Norwegian version of the NDI)

☐ **(1) IKKE UTFYLT**

VEILEDNING: **Dette spørreskjemaet er laget for å gi legen informasjon om hvorledes dine smerter i nakken har påvirket din evne til å klare deg i dagliglivet. Vennligst svar på hver del og kryss av bare den ENE ruta i hver del som passer for deg. Vi er klar over at du kan synes at to av utsagnene i en og samme del kan passe for deg, men vennligst bare kryss av i den ruta som kommer nærmest til å beskrive ditt problem.**

Del 1 - Smerteintensitet

- ☐ Jeg har ingen smerter akkurat nå.
- ☐ Smertene er svært svake akkurat nå.
- ☐ Smertene er moderate akkurat nå.
- ☐ Smertene er nokså sterke akkurat nå.
- ☐ Smertene er meget sterke akkurat nå.
- ☐ Smertene er de verst tenkelige akkurat nå.

Del 2 - Personlig stell (vaske seg, kle på seg, osv.)

- ☐ Jeg kan stelle meg selv som normalt, uten at det gir ekstra smerter.
- ☐ Jeg kan stelle meg selv som normalt, men det gir ekstra smerter.
- ☐ Det er smertefullt å stelle seg, og jeg er langsom og forsiktig.
- ☐ Jeg trenger noe hjelp, men klarer mesteparten av mitt personlige stell.
- ☐ Jeg trenger hjelp hver dag med mesteparten av mitt personlige stell.
- ☐ Jeg klarer ikke å kle på meg, har vansker med å vaske meg og holder meg i senga.

Del 3 - Løfting

- ☐ Jeg kan løfte noe tungt uten at det gir ekstra smerter.
- ☐ Jeg kan løfte noe tungt, men det gir ekstra smerter.
- ☐ Smerter hindrer meg i å løfte noe tungt opp fra gulvet, men jeg kan klare det hvis det er gunstig plassert, for eksempel på et bord.
- ☐ Smerter hindrer meg i å løfte noe tungt, men jeg kan klare noe lett eller middels tungt hvis det er gunstig plassert.
- ☐ Jeg kan bare løfte noe meget lett.
- ☐ Jeg kan ikke løfte eller bære noe i det hele tatt.

Del 4 - Lesing

- ☐ Jeg kan lese så mye som jeg ønsker, uten at det gir smerter i nakken.
- ☐ Jeg kan lese så mye som jeg ønsker, men med svake smerter i nakken.
- ☐ Jeg kan lese så mye som jeg ønsker, men med moderate smerter i nakken.
- ☐ Jeg kan ikke lese så mye som jeg ønsker, på grunn av nokså sterke smerter i nakken.
- ☐ Jeg kan omtrent ikke lese i det hele tatt, på grunn av meget sterke smerter i nakken.
- ☐ Jeg kan ikke lese i det hele tatt, på grunn av smerter i nakken.

Del 5 - Hodepine

- ☐ Jeg har ikke hodepine i det hele tatt.
- ☐ Jeg har svak hodepine som kommer nå og da.
- ☐ Jeg har moderat hodepine som kommer nå og da.
- ☐ Jeg har moderat hodepine som kommer jevnlig.
- ☐ Jeg har sterk hodepine som kommer jevnlig.
- ☐ Jeg har hodepine nesten hele tiden.

Vernon,H., & Mior,S.(1991). The Neck Disability Index: A Study of Reliability and Validity. J. Manipulative and Physiological Therapeutics,14(7),409-415.

SKJEMA OM HEMMENDE NAKKEPLAGER - forts.

Del 6 - Konsentrasjon

- ☐ Jeg kan konsentrere meg uten vansker.
- ☐ Jeg kan konsentrere meg med små vansker.
- ☐ Jeg har nokså store vansker med å konsentrere meg.
- ☐ Jeg har store vansker med å konsentrere meg.
- ☐ Jeg har svært store vansker med å konsentrere meg.
- ☐ Jeg kan ikke konsentrere meg i det hele tatt.

Del 7 - Arbeid (eller daglige gjøremål)

- ☐ Jeg kan gjøre så mye arbeid som jeg ønsker.
- ☐ Jeg kan gjøre mitt vanlige arbeid, men ikke mer.
- ☐ Jeg kan gjøre mesteparten av mitt vanlige arbeid, men ikke mer.
- ☐ Jeg kan ikke gjøre mitt vanlige arbeid.
- ☐ Jeg kan omtrent ikke gjøre noe arbeid i det hele tatt.
- ☐ Jeg kan ikke gjøre noe arbeid i det hele tatt.

Del 8 - Bilkjøring

- ☐ Jeg kan kjøre en bil uten at det gir smerter i nakken.
- ☐ Jeg kan kjøre en bil så lenge som jeg ønsker, men med svake smerter i nakken.
- ☐ Jeg kan kjøre en bil så lenge som jeg ønsker, men med moderate smerter i nakken.
- ☐ Jeg kan ikke kjøre en bil så lenge som jeg ønsker, på grunn av nokså sterke smerter i nakken.
- ☐ Jeg kan omtrent ikke kjøre en bil i det hele tatt, på grunn av meget sterke smerter i nakken.
- ☐ Jeg kan ikke kjøre en bil i det hele tatt, på grunn av smerter i nakken.

Del 9 - Søvn

- ☐ Jeg har ikke problemer med å sove.
- ☐ Søvnen min er litt forstyrret (mindre enn 1 times søvnløshet).
- ☐ Søvnen min er noe forstyrret (1-2 timers søvnløshet).
- ☐ Søvnen min er moderat forstyrret (2-3 timers søvnløshet).
- ☐ Søvnen min er sterkt forstyrret (3-5 timers søvnløshet).
- ☐ Søvnen min er fullstendig forstyrret (5-7 timers søvnløshet).

Del 10 - Fritid

- ☐ Jeg er i stand til å drive med alle mine fritidsaktiviteter uten at det gir smerter i nakken overhodet.
- ☐ Jeg er i stand til å drive med alle mine fritidsaktiviteter, men med noe smerter i nakken.
- ☐ Jeg er i stand til å drive med de fleste av, men ikke alle, mine vanlige fritidsaktiviteter på grunn av smerter i nakken.
- ☐ Jeg er bare i stand til å drive med noen få av mine vanlige fritidsaktiviteter, på grunn av smerter i nakken.
- ☐ Jeg kan omtrent ikke drive med noen fritidsaktiviteter, på grunn av smerter i nakken.
- ☐ Jeg kan ikke drive med fritidsaktiviteter i det hele tatt.

Vernon,H., & Mior,S.(1991). The Neck Disability Index: A Study of Reliability and Validity. J. Manipulative and Physiological Therapeutics,14(7),409-415.

Vertigo Symptom Skala Spørreskjema

Vi ønsker å vite hva slags svimmelhetssymptomer du har hatt i det siste. Hvert spørsmål besvares ved å sette en ring rundt det tallet som passer best med dine opplevelser den siste måneden.

	Hvor ofte har du i løpet av den siste måneden hatt følgende symptomer:	**Aldri**	**Noen ganger**	**Flere ganger**	**Ganske ofte**	**Veldig ofte**
1	En følelse av at du selv eller ting rundt deg roterer eller beveger seg, som varer mindre enn 20 minutter	0	1	2	3	4
2	Varme eller kulde anfall	0	1	2	3	4
3	Kvalme, kastet opp	0	1	2	3	4
4	En følelse av at enten du selv eller ting rundt deg roterer eller beveger seg, som varer mer enn 20 minutter	0	1	2	3	4
5	Hjertebank eller flaksing	0	1	2	3	4
6	En følelse av å være svimmel eller desorientert, som varer hele dagen	0	1	2	3	4
7	Hodepine eller følelse av trykk i hodet	0	1	2	3	4
8	Ute av stand til å stå eller gå skikkelig uten støtte, skjener eller trekker mot en side	0	1	2	3	4
9	Pustevansker, kortpustet	0	1	2	3	4
10	Følt deg ustø, nær ved å miste balansen, som varer mer enn 20 minutter	0	1	2	3	4
11	Overdreven svetting	0	1	2	3	4
12	Følt deg svak, nær ved å besvime	0	1	2	3	4
13	Følt deg utsø, nør ved å miste balansen, som varer mindre enn 20 minutter	0	1	2	3	4
14	Smerter i hjerte eller brystregion	0	1	2	3	4
15	En følelse av å være svimmel eller desorientert, som varer mindre enn 20 minutter	0	1	2	3	4
SUM:						

Referanse: Wilhelmsen K, Strand LI, Nordahl SHG, Eide GE, Ljunggren AE. Psychometric properties of the Vertigo symptom scale - Short form. BMC Ear Nose Throat Disord. 2008 Mar 27;8:2. doi: 10.1186/1472-6815-8-2. PMCID: PMC2329601. PMID: 18371190