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The effect of balance training on the self-efficacy of a healthy elderly population

A systematized literature review

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Abstract

Balance training is a common intervention in geriatric physiotherapy, which primarily aims to maintain or improve the functional ability of elderly clients. Balance training is speculated to be able to improve confidence relating to activities of daily living. Activity specific confidence can be referred to as self-efficacy, which has a meaningful effect on behavioral change and the adoption of health-related lifestyle habits.

The objective of this thesis was to conduct a systematized literature review and explore the effect of isolated balance training on the self-efficacy of a healthy elderly population. The thesis process began with familiarizing with the research topic. Once the author had a moderate understanding of the topic, the theory portion was written. The theory was written primarily between May and December 2020. However, adjustments were made until September 2021.

The thesis was implemented as a systematized literature review. The process of the literature review was conducted between May and June 2021. Interpretation and expression of the literature review's results were continued until September 2021. The databases of PubMed and PEDro were used for the search. Five randomized control trials were selected. The selected studies were of at least moderate quality using the PEDro scale criteria.

According to the literature review, balance training had a significant effect on self-efficacy compared to passive control groups. Compared to alternative interventions, balance training's effect on self-efficacy was mixed. The studies used in the systematized literature review differed greatly on their implementation. Conclusions cannot be made based on the results of this thesis. Further research is needed using different balance training modalities and comparing them to other interventions.

Key words
Self-efficacy, balance, geriatrics, physiotherapy

CONTENTS

1 INTRODUCTION

The biological systems of human functioning generally decline during the aging process (Van Beek et al., 2016). Muscle mass begins to slowly decrease within a sedentary population at the age of 30. An 80-year-old has an estimated 40 percent of the muscle mass that they had at 20 years of age (Wilkinson et al., 2018). Additionally, cognitive decline occurs. Studies based on magnetic resonance imaging (MRI) have shown a decrease in neural connections between cerebral lobes and atrophy of certain brain components, such as the hippocampus, which is responsible for the formation of long-term memories and executive function (Samson & Barnes, 2013).

The development of medicine and living standards have increased life expectancy throughout the developed world. This combined with a decreased birth rate is increasing the proportion of the elderly population. As of 2018, the proportion of those over 65-years old in Finland is 21.5%. This percentile is growing, with an expected number of over 25% by 2030 (Website of Terveyskylä). With an aging population, the importance of maintaining and improving the functional ability and independence of the senior population grows tremendously. The first reason is an ethical one. It should be an ethical priority to support the possibility to an enjoyable and high quality of life during the final years of life. The second reason is economic. An aging population means an increase in costs regarding social welfare. The more elderly in poor condition there are, the higher this cost on society is. Having as many functionally independent seniors is much more cost-efficient as opposed to care home institution or hospitalization (Goetzel et al., 2007). Most seniors wish to live within their own home for as long as possible, which is a positive sign for developing cooperative motivation with seniors (Ahlqvist, 2016).

Balance interventions are commonly used in geriatric physiotherapy to improve functional ability. Functional ability is primarily measured using objective measurements such as the Short Physical Performance Battery (SPPB) or Berg

Balance Scale (BBS). These objective measures are examples of several effective methods of assessing functional ability. In addition to the value given by objective outcomes, the value and insight of subjective measures have become increasingly understood. Self-efficacy is a subjective outcome, which has been shown to be an important factor in the successful aging process (McAuley et al., 2011).

Self-efficacy functions as a driving force of motivation and the foundation of the behaviors one takes. Self-efficacy can be defined as the judgment of one's ability to successfully carry out a task and deal with challenges they might face regarding the task. Self-efficacy is not based just on objective ability, but the subjective view of what can be achieved with the skills they possess (Bandura, 1997, pp. 36-37). A physiotherapist has the ability to influence the self-efficacy of a client. The words that a physiotherapist says and the interventional approach they choose provides the clients with efficacy information and thus compliance to the intervention. By being aware of self-efficacy as a concept, a physiotherapist can improve their ability to motivate their clients and get them to commit to behavioral change (McAuley et al., 2011). This is relevant in geriatric physiotherapy since seniors with positive self-efficacy display more effort in physical and intellectual activity, which in return positively affect the quality of life (Pino et al., 2013; Garrido & Videra, 2013).

This bachelor-level thesis sets to conduct a systematized literature review on balance training's impact on the self-efficacy of a healthy elderly population. No literature reviews or meta-analyses were found on this subject. Therefore, the impact that balance training specifically has on self-efficacy is not clear. A limited amount of randomized control trials have been published on the subject and are the sources for the systematized literature review.

2 AIM AND OBJECTIVE

The aim of this thesis is to outline the current state of research regarding balance training and the self-efficacy of elderly. The objective is to conduct a systematized literature review and answer the research question: "What is the effect of isolated balance training on the self-efficacy of a healthy elderly population ?"

3 SELF-EFFICACY

3.1 The concept of self-efficacy

Self-efficacy is a term that describes one's view on their condition and ability to execute a required task and deal with potential setbacks that might occur from the task. The term self-efficacy was conceptualized by social-cognitive psychologist Albert Bandura as a key part of the development of the social cognitive theory (SCT) published in 1977 (Lopez-Garrido, 2020). The concept of self-efficacy implies that if someone believes in their ability to carry out a task, they are more likely to perform the task. Self-efficacy provides an understanding of the decision-making process and gives insight into human behaviors in a variety of disciplines (Bandura, 1997, pp. 2-4). Thus, its sphere of influence quickly spread outside of the field of psychology into other fields, such as healthcare (Williams & Rhodes, 2014).

Self-efficacy is a multi-dimensional outcome, which is at the core of Bandura's social cognitive theory. The SCT outlines behavior as being the combined result of personal, behavioral, and environmental processes (Bandura, 1997, p. 6). These are each a categorization of several multidimensional variables (See figure 1). Personal, behavioral, and environmental processes all influence each other bidirectionally. This differs from behaviorist theories, in which Bandura claims overemphasize the influence of external stimuli while downplaying the role of the inner processes. Likewise, Bandura does not overemphasize the role of biological and personal factors

either. He claims they all have a meaningful impact on each other, and none should be overlooked (Pajares, 2002). The level of each processes' effect differs based on event and circumstance. (Bandura, 1997, pp. 6-8).

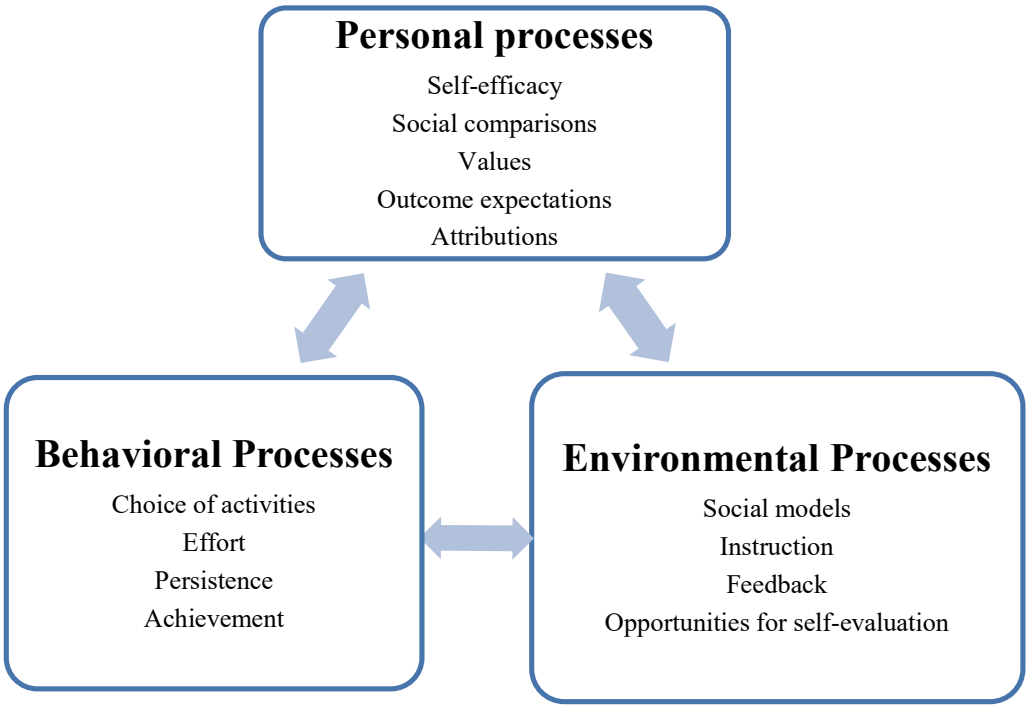


Figure 1. The social cognitive theory's triadic reciprocal model of behavior (adapted from Bandura, 1997, 6).

3.2 Self-efficacy and behavior

Self-efficacy functions as a part of personal processes of behavior in the SCT (see figure 1). It is important to remember that self-efficacy is not the sole determinant of behavioral outcomes. Self-efficacy nevertheless is the SCT's driving force and guides motivation and personal achievement (McAuley et al., 2011; Bandura, 1997, pp. 122-126). If someone lacks confidence in an action, there is little excitement to execute the action. Thus, even if one's self-efficacy is high but objective ability is poor given a certain task, this individual is still likely to perform and display effort. Through this focus and effort, they would theoretically achieve a favorable outcome as opposed to someone with low self-efficacy (Bandura, 1997, pp. 54-61). A meta-analysis of 14

studies by Cherian & Jacob (2013) shows a significant association of self-efficacy in work performance. Additionally, a meta-analysis of 26 studies by Szczuka et al. (2021) presented that lower self-efficacy is a predictor of sedentary behaviors.

Bandura states that peoples' motivation and behaviors are more supported by what the individual believes, rather than the objective truth (Bandura, 1997, p. 14). If two individuals were hypothetically in the same environment, their interpretation and reaction to an event will be different based on their introspective observation of the event. One's introspective observation is adaptable and can be shaped through an individual's thoughts and actions (Bandura, 1997, pp. 131-132). Self-efficacy is activity specific. One may have high self-efficacy in the ability to start a new exercise program, but low self-efficacy in starting and maintaining a diet (McAuley et al., 2011).

Thoughts and actions influence the neurochemistry of the brain. The brain can remodel in a process called neuroplasticity. This is not exclusive to younger populations and occurs in over 80-populations as well (Guglielman, 2012). The neurophysiological mechanisms affecting self-efficacy are vast and complex. An example of a physiological mechanism on self-efficacy is when a certain action is repeatedly interpreted as being successful, neural networks of the brain responsible for this action strengthen and even new neural networks can be formed. Receptors of neurotransmitters in the synapses of neurons responsible for this behavior also increase. Thus, decreasing the conscious effort and mental energy required for initiating and committing to the task (Berkman, 2018).

3.2.1 Sources of efficacy information

Efficacy information are the sources of self-efficacy. Efficacy information is split into four categories (see figure 2). The categories of efficacy information are mastery experiences, vicarious experiences, social persuasion, and physiological and emotional states (Lopez-Garrido, 2020).

Mastery experiences are the perception of past performances. Mastery experiences provide the most significant efficacy information to the individual. Success builds confidence in one's actions, while failure weakens confidence. Success acquired effortlessly, however, is not effective at developing self-efficacy. The expectation of easy results following easy success sets up discouragement from failure. Strong efficacy is acquired from overcoming challenges with determined effort. This allows the individual to endure through the setbacks that commonly occur with challenges (Bandura, 1994).

Vicarious experiences or social models are the second most powerful source of efficacy information. Observing other people succeed who are similar to themselves, provides the observer with confidence that they also have the abilities to accomplish similar outcomes. At the same time, seeing others display determined effort and still fail would decrease self-efficacy (Bandura, 1994). Perceived similarity to the observer strongly impacts the extent that vicarious experiences affect the observer's efficacy. Generally, positive social role models provide positive efficacy information (Lopez-Garrido, 2020).

Social persuasion is the third major source of efficacy information. Receiving positive feedback of ability or accomplishment often encourages the continuation of the action. Improving self-efficacy with social persuasion purely is unlikely. Unrealistic efficacy encouragements are quickly proven false with failed outcomes. Effective social persuasion is connected with successful performances. Conversely, if someone has been persuaded of their ineptitude, they will focus on their self-doubts and more likely avoid action (Bandura, 1994).

The final major source of efficacy information is physiological and emotional states. One's physical and psychological well-being shape the view of their capabilities regarding a task. A positive disposition naturally sets up positive efficacy interpretation (Bandura, 1994). On the reverse side, depressive or anxious symptoms impact an individual's view of themselves, thus negatively affecting efficacy beliefs. Interpretation of the same stressor can vary greatly from person to person (Lopez-Garrido, 2020).

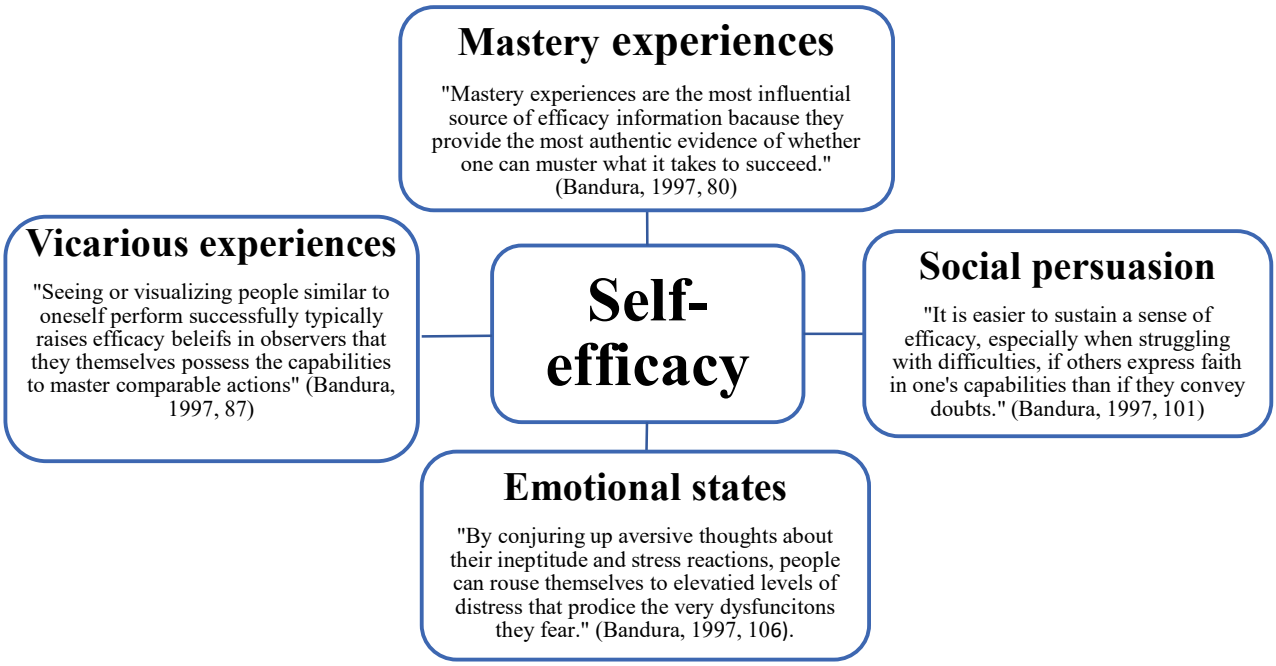


Figure 2. The four determining sources of efficacy information (adapted from Bandura, 1997, 80-106).

3.2.2 Measuring self-efficacy

Self-efficacy is a subjective outcome and is measured through questionnaires. Self-efficacy is considered a form of activity-specific confidence thus, the scale must accurately represent the realm of what is being measured. A successful businessman may have high organizational efficacy, but low efficacy relating to managing family life. Self-efficacy scales cover a vast number of topics, such as the self-efficacy of academic success, maintaining relationships, ability to function with activities of daily living, etc. Despite not being accurate to specific situations, general self-efficacy can also be measured, although not recommended by Bandura (Bandura, 2006).

3.3 Self-efficacy of elderly

When discussing the self-efficacy of the elderly, the emphasis is usually on physical functioning. Being able to perform the requirements of daily living is the most relevant concern for seniors. As opposed to younger adults, who might be more concerned with learning a new skill or performance at work (Bandura, 2006). Self-efficacy has been progressively become more understood as a crucial element of functional ability and well-being during the later years in life (Stretton et al., 2006). It influences one's actions directly through decision-making and indirectly by influencing goals, motivation, the level of optimism, and general outlook on life (Avvenuti et al., 2016; Bandura, 2006). Unfortunately, with the decline in cognition and functional ability that comes with aging, elderly also have a declined self-efficacy (Miller & West, 2010). This is an important issue because a declined self-efficacy means the lack of one's self-perceived ability to control the events that negatively impact their life (Bandura, 1997, p. 3). This results in a decreased likelihood of healthy lifestyle choices and thus, predisposes to chronic diseases and declined cognitive and physical states (Peters et al., 2019; Laugero et al., 2010).

3.3.1 Physical functional ability

The self-efficacy of an elderly client is heavily influenced by their worldview and the environment around them. However, one factor has risen to be the most influential yet modifiable variable of senior's self-efficacy. This variable is the senior's functional ability (McAuley et al., 2011). Functional ability can be defined as the multifactorial ability to perform the required activities of daily living (ADLs). Understanding this is vital for physiotherapists working with a geriatric population since geriatric physiotherapy often focuses on improving physical functioning, which is an essential part of functional ability (Ongaro et al., 2001). Several studies support the claim of self-efficacy's and physical activity's bidirectional influence, which often leads to improved functional ability of elderly (McAuley et al., 1997; McAuley et al., 1999; Hammer et al., 2016; Picha & Howell, 2017). By influencing self-efficacy, we can increase one's confidence or sense of empowerment regarding carrying out physical

activities. This in return leads to more activity and improved objective and health outcomes (Stretton et al., 2006; McAuley et al., 2011).

Subjective measures such as self-efficacy have been shown to be a powerful variable impacting the prognosis of given interventions and quality of life. This is strongly apparent in the geriatric population, where the subjective view of physical functioning is correlated with objective measures (McAuley et al., 2011; Innerd et al., 2015; Tovel et al., 2017). It might seem obvious that those in a better objective condition also subjectively consider themselves as being in better condition. The association however is not entirely causational, the correlation is only considered moderate (McAuley et al., 2011).

When observing cross-sectional population comparisons, it is apparent that increased physical activity is associated with increased self-perceived health and self-efficacy. (Pino et al., 2013, Garrido & Videra, 2013). Increased exercise frequency has shown to be associated with higher self-efficacy of elderly. Those who exercised 3-4 times per week showing the highest self-efficacy (Garrido & Videra, 2013). The type of exercise does not appear to show a significant difference. This implies that to improve self-efficacy getting moving is more important than what specific form of exercise is being done (Garrido & Videra, 2013; McAuley et al., 1999).

Bandura's self-efficacy theory outlines the complexity of several personal, behavioral and environmental variables; thus, population comparisons of fit and unfit seniors do not allow us to draw causational conclusions that one factor leads to another (Bandura, 1997, pp. 39-41). Meta-analyses are not available on the effect of exercise on self-efficacy, but several clinical trials are published. The physical activity groups score noticeably better on both objective and subjective outcomes compared to passive controls (McAuley et al., 1997; Pahor et al., 2014; Wada et al., 2019; Shin et al., 2009; Ory et al., 2018). However, the results are not unanimous**.** Amesberger et al.'s (2019) trial found inconsistent results regarding self-efficacy and objective outcomes. Exercise groups may provide efficacy information through mastery experiences and vicarious experiences. This prompts the likelihood of long-term physical activity maintenance, which could allow a lasting effect on functional ability (Resnick 2004; Wahlich et al., 2017).

Objective measures have a moderate association with self-efficacy outcomes, therefore, give insight into how an intervention might affect self-efficacy (Nielsen et al., 2016; McAuley et al., 2011). Studies tracking the results of the same participants in exercise groups show a clear positive impact on objective measures. This topic has been studied thoroughly. A meta-analysis of 33 studies by Mayer et al. (2011), shows significant improvement regarding balance and strength through group exercises with elderly. The ability to develop strength does halt completely in aging and has been shown to improve even in a population of over 90-year-olds (Cadore et al., 2017). Increased strength often means improved functional ability, which affects ADLs, such as getting up, transfers, cooking, and walking. However, the failure of making a lifestyle change causes functional ability to decline following the intervention (McAuley et al., 2011).

McAuley et al. (2003) have made the claim of self-efficacy being an indicator of long-lasting physical activity habits. The study followed up their 6-month trial two and five years later. This randomized control trial (RCT) of elderly (n=174) showed that those with higher self-efficacy at the end of the intervention had noticeably increased activity levels. The 5-year follow-up showed similar results (McAuley et al., 2003). This could indicate that self-efficacy improvements from exercise interventions can have a long-term effect and not just be active during the intervention. Those who do not continue exercising display decreased self-efficacy and performance outcomes (McAuley et al., 1999) This supports Bandura's belief of lasting behavior maintenance is strongly influenced by self-efficacy (Bandura, 1997, p. 279).

3.3.2 Social systems

Self-efficacy is influenced by social systems (Bandura, 1997, p. 6). This implies that given an empowering and supportive social environment, one's self-efficacy could be boosted. The social circles often decline during the later years of life, which often has a negative effect on one's self-efficacy (Tripathi & Asthana, 2015). In geriatric physiotherapy, social influence on efficacy information can be applied in a couple of ways. The first is if the client is being provided with a social circle of those in a similar

situation, such as in an exercise group. Other participants' presence and success would positively function as social models for vicarious experiences (McAuley et al., 2000; Bandura, 1994). Additionally, the physiotherapist can provide efficacy information through social persuasion with support and encouragement. The physiotherapist can also effectively build efficacy by providing clients with mastery experiences by setting up challenges of appropriate difficulty where the client succeeds without excessive failures (Ashford et al., 2010). A socially guided technique is a powerful tool to improve and maintain self-efficacy (Bandura, 1997, p. 261)

"people's level of motivation, affective states, and actions are based more on what they believe than on what is objectively true" – Albert Bandura

4 BALANCE

4.1 The concept of balance

Balance is an umbrella term with varying definitions based on context and author. Balance in this thesis is observed as a function, which is the entirety of the individual's multifactorial operations aimed at postural control (Ragnarsdottir, 1996). In the field of physiotherapy, postural control is often used interchangeably with balance and often the focus of intervention. The body's objective with balance, or postural control, is to uphold gravitational equilibrium by maintaining or bringing the center of gravity above the base of support. To maintain postural control the human body is dependent on many physiological functions and its ability to adjust to the surrounding environment while performing the required task (Website of Physiopedia).

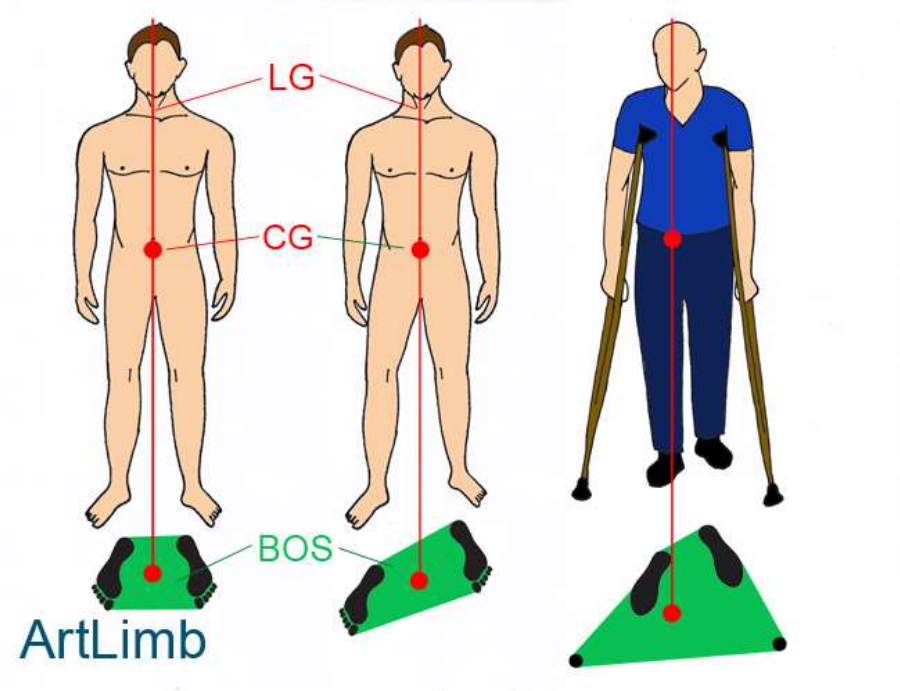
Balance is commonly split into static and dynamic. In static balance, one attempts to maintain postural control while keeping their center of gravity within a stationary base of support. This commonly would be maintaining a standing or sitting position. Dynamic balance requires maintaining the center of gravity with a shift in weight and the base of support, which means that it is required when moving (Karimi, 2011). Both

static and dynamic balance play important roles in maintaining upright positioning that one requires to independently live their life (Sandström & Ahonen, 2011, p. 166).

4.1.1 Biomechanics of balance

Keeping the center of gravity above the base of support is required to maintain upright balance. The center of gravity (CG) is a hypothetical location where the combined mass of an object operates (Website of Physiopedia). During neutral standing position, the CG is located along the centerline a few centimeters anterior of the sacrum's endplate. The CG changes as humans move into different positions and perform tasks. Additional loads such as carrying a shopping bag or backpack shift the CG (Sandström & Ahonen, 2011, pp.166-168).

The base of support is the area between the points of contact with the ground. The positioning of the lower limbs and feet play a considerable role in maintaining balance since they form the base of support's boundaries (See picture 1). Generally, a larger base of support gives more stability. When standing on two feet, the base of support is larger with a wider stance and smaller with feet together. The line of gravity is the imaginary vertical line directly below the CG that must still fall within the base of support to maintain balance (Website of Physiopedia). With a typical gait there are moments when the base of support is limited to the heels during heel-strike and metatarsals during push-off (Sandström & Ahonen, 2011 p.167).



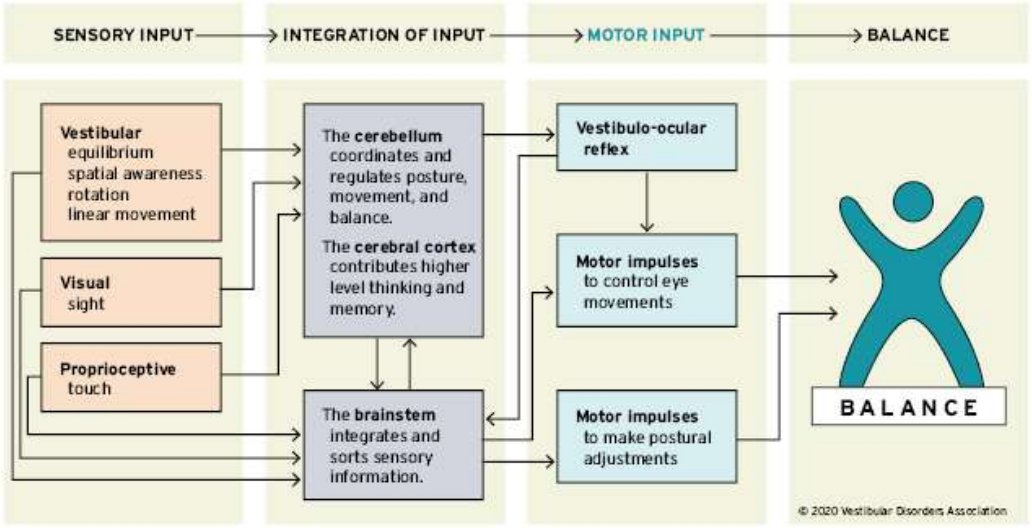
Picture 1. Illustration of the base of support=BOS, line of gravity=LG, and center of gravity=CG (Website of ArtLimb).

Humans have three general strategies for maintaining balance. Each strategy has a role in postural control. The ankle strategy is the most distal of the strategies. The ankle strategy refers to the corrective actions of the talocrural joint, subtalar joint, and through weight shifts. The better the functioning of this most distal strategy, the fewer large movements are required to maintain balance. The hip strategy is when balance is adjusted by hip movement. The hip strategy is used when the postural sway is too large to be controlled by the ankle strategy. If the postural sway exceeds the hip strategy's abilities, the step strategy is utilized, in which a step is taken to increase the base of support and prevent falling (Sandström & Ahonen, 2011, p. 169).

4.1.2 Physiology of balance

Balance is regulated by the cooperation of several physiological systems. Essential factors in regulating and maintaining balance are the central and peripheral nervous systems, the musculoskeletal system, and several sensory systems. The body is constantly receiving sensory (afferent) information, which is signaled to and interpreted by the central nervous system (CNS). Based on the interpretation of external and internal circumstances, the brain triggers the appropriate motor (efferent) response. Balance however is more than a reaction to external stimuli. Balance is also regulated proactively in which the CNS prepares for a challenge of postural control. Through these processes, the body can adjust with appropriate motor responses to maintain balance (Website of Physiopedia; Ivanenko & Gurfinkel, 2018). By regulating motor responses, the CNS controls the function of skeletal muscles, which are a foundation of postural control. Involuntary muscle tone upholds the body against gravitational forces and is present in keeping the body upright. Phasic voluntary muscle activity is primarily for movements and adjustments to the outside world. (Ivanenko & Gurfinkel, 2018).

The relevant sensory systems are the visual, tactile, vestibular, and proprioceptive systems (see picture 2). Vision provides the central nervous system with visual feedback of the environment and body positioning, which allows the body to react and adjust to its situation (Jeon et al., 2013). The vestibular system is located in the ear and senses the positioning of the head in relation to the body. It plays a vital role in spatial awareness and positioning. A disturbance in the vestibular system may disturb the ability to perform basic functional tasks or cause vertigo (Gillian, 2013). Proprioception is the sensory input acquired from within the muscles and joints. These proprioceptors provide the central nervous system with information regarding limbs' positioning, movement, and speed (Tortora, 2010 p. 549).



Picture 2. Interactions of sensory and motor systems, which control balance. (Website of Vestibular Disorders Association).

4.2 Balance of elderly

As the aging process progresses and senior's physical functioning gets worse, balance becomes a concern for many seniors. A general association is that balance does decrease with aging. Using self-report questionnaires, 13% of 65-69-year-olds are concerned about their balance, but this value jumps to 46% for those of 85-years and up (Osoba et al., 2019). This loss of balance negatively affects one's ability to safely carry out ADLs. Since losing independence is of ethical and financial concern, the aspect of balance is worth intervening in. Suitable rehabilitation focused on balance can reduce injuries and improve functional ability (Sherrington et al., 2011).

The effectiveness of the sensory systems and input processing decreases during later years. The combination of sensory systems' functional decline and task complexity is an increased likelihood of balance loss or falls of elderly. Increased task complexity places higher demands on the coordination of the several sensory systems responsible for balance equilibrium (Osoba et al., 2019). Proprioceptive awareness of the foot and ankle gets worse as the amount and sensitivity of receptors decrease. It is theorized that mechanoreceptive sensitivity decreases partially through a lack of tactile sensation. Tactile sensation gets less stimulation because of decreased physical activity and constant shoe wearing. This lack of sensing the foot's positioning, or

proprioception, may place the lower extremity in vulnerable positions for falls, which can lead to disability, additional costs, and in the worst-case premature mortality (Henry & Baudry, 2019). Added fall risk is of societal concern since 30-40% of Finnish seniors fall at least once per year (Website of Terveyskirjasto).

The vestibular system's capacity decreases noticeably after 65. A decrease in its function is apparent in demanding activities by the decrease in performance quality and vertigo. Vertigo, or dizziness caused by vestibular system disturbance is likely benign paroxysmal positional vertigo (BPPV) or peripheral vestibular impairment (PVI). Vertigo is prevalent in over 30% of over 65-year-olds with BPPV or PVI having high occurrence (Ahearn & Umapathy, 2015). It is unclear how effective exercises are for preventing or rehabilitating vestibular problems. Certain researchers such as (Fu et al., 2020) speculate physical activity's positive effect on preventing vertigo dysfunction. Whether or not physical activity can improve vestibular dysfunction, decrease in vestibular dysfunction commonly occurs with aging and can lead to balance problems (Ahearn & Umapathy, 2015).

There are structural changes of the eye, which often decrease visual function during aging. Visual function decrease is apparent in visual acuity, depth perception, peripheral vision, and visual input transmission to the CNS. The common consensus is that seniors generally over-rely on visual feedback to maintain balance. This is a symptom of decreased vestibular and proprioceptive function (Yeh et al., 2014). Studies have isolated sensory functions, such as vision to explore the effect the specific sensory system plays. Blocking vision of older subjects affects postural control more opposed to more youthful subjects (Yeh et al., 2014; Lee, 2017; Penzer et al., 2015). This supports the general theory that seniors rely heavily on visual input. This is of moderate concern because reliance on one sensory system implies that other systems are not being fully utilized. This could lead to a physiological adaptation of down-regulating other sensory systems assisting in balance or postural control (Lee, 2017).

Muscle mass, strength, and function generally decrease in aging and affect one's balance. This age-related loss of muscle mass and function is referred to as sarcopenia. Sarcopenia begins slowly from the age of 40 onwards but by the age of 80, most have lost 30-50% of muscle mass and function. Generally, the less the individual has loaded

their muscles, the faster sarcopenia occurs (McCormick & Vasilaki, 2018). A systematic review by Ishigaki et al., (2014) reveals that muscle strength has a strong association with balance performance.

Seniors often have suboptimal muscle activation regarding balance. Antagonistic muscle activation when maintaining balance is usually higher compared to more youthful populations. Additionally, elderly have shown different balancing strategies compared to their younger counterparts. Muscle activation is found to be more proximal to distal rather than distal to proximal. This means that elderly more easily rely on hip and step strategies than younger populations (Osoba et al., 2019).

4.3 Balance training

Practically in all movement, we must control our center of gravity, which challenges the several biological systems that regulate balance. This includes aerobic training, strength training, and ADLs. Balance training itself prioritizes challenging the sensorimotor and neuromuscular systems to adapt these systems to improve postural control. Balance training often consists of both static and dynamic exercises. Equipment such including unstable surfaces, balance boards, etc, are often included to add additional challenges and stimuli (Website of Physiopedia). Dual-task training may be used. This could include counting, reading a text and carrying a tray with items. During dual-task training one's attention is split between cognitive and motors tasks. (Halvarsson et al., 2015).

Meta-analyses have outlined the importance of balance training regarding fall prevention and balance ability (Sherrington et al., 2011; Chodzko-Zaiko et al., 2009). Evidence-based recommendations exist for resistance and aerobic exercise, but not balance training. This is the reasoning behind balance training approaches varying greatly (Lesinski et al., 2015).

A meta-analysis of 23 clinical trials conducted by Lesinski et al. (2015) sought to evaluate the effectiveness of frequency, method, period, volume, and intensity on the improvement of objective measures of balance training. Balance training's effect on

objectively measured static balance is small to medium. However, balance training had a large effect on balance test batteries and reactive balance. The most effective dosage is 3 times per week, 31-40 minutes per session, and 36-40 total training sessions. Less than 11-weeks was shown to have weaker effects in improving balance. These results are similar in younger participants (Lesinski et al., 2015).

The physiological adaptation that results from training is usually specific to the training done. This general rule of exercise physiology known as Specific Adaptations to Imposed Demands (SAID principle) can be applied to balance training (Halvarsson et al., 2015). Because daily living requires both static and dynamic balance, it would be wise to implement a variety of different kinds of balance exercises. Dynamic and static balance performance only have moderate correlations between participants (Mayson et al., 2008; Dunsky et al., 2017). This is due to the differing demands on the systems regulating balance (Dunsky et al., 2017). To improve functional balance performance, balance training should replicate situations of daily living where subjects may feel uncertain. Therefore, the individualization of programs would provide considerable benefits (Halvarsson et al., 2015).

Perturbation balance is also referred to as reactive balance control. Perturbation training exposes the trainee to unpredictable external perturbations, which require quick reactions and adjustments to stay upright. An example of a perturbation exercise is while the participant maintains an upright position, the professional gives slight pushes to the participant from various directions in an unpredictable manner (Website of Physiopedia). Perturbation training is considered more task-specific to fall-risk situations, such as tripping and an unexpected loss of balance (Gerards et al., 2021). This method of balance training is an emerging approach with elderly. Meta-analysis of 8 RCTs supports the use of perturbation training alongside traditional balance training (Mansfield et al., 2015).

5 RESEARCH METHODS AND PROCESS

5.1 Systematized literature review

The thesis was conducted as a systematized literature review. A systematized literature review attempts to find research, evaluate, and express the results regarding a specific research question. This form of secondary research is based on findings of primary sources. Generally, randomized control trials (RCT) are preferred for the review, but not a requirement. A systematized review differs from a systematic review, as it does not have the same rigorous standards as a systematic review, such as attempting to find all relevant research or requiring two researchers. Thus, its levels of reliability and validity are not equal. However, a correctly executed systematized review still presents the research methods in a clear and replicable manner. Systematized reviews are suitable as individual work or a post-graduate student's assignment. A systematized review demonstrates that a post-graduate student understands the research process. (Grant & Booth, 2009).

5.2 Research question

The research question for the literature review was created using the PICO model. The PICO framework is a mnemonic that with slight variations stands for population, intervention, control, and outcome. The PICO framework is commonplace in evidence-based practice (Website of University of Illinois, 2021; Eriksen & Frandsen, 2018).

The research question of this thesis is "What is the effect of isolated balance training on the self-efficacy of a healthy elderly population?"

Population: ≥65-year-olds without serious diseases or pathologies
Intervention: Training purely focused on improving balance
Control: Alternative intervention or passive control
Outcome: Self-efficacy

5.3 Construction of the search

The online databases of PubMed and PEDro were used. In PubMed search terms were “self-efficacy” and its equivalents of “balance confidence”, “fall-efficacy”, and “efficacy”. For the PubMed searches both “balance training” and “balance program” were used (see table 1). PubMed has mesh terms, which cover related terms. The mesh term for elderly is in PubMed is “aged”. Boolean operators (AND & OR) were used in the search. Boolean operators are effective for separating, combining, and excluding certain terms. Filters applied in PubMed were: RCT, aged 65+ and English. In PubMed, duplicates were found by saving the search results through the Zotero Google Chrome extension and uploading it to the Zotero software. The two PubMed searches were conducted and evaluated during April 2021.

In PEDro the searches used “self-efficacy” and its equivalent of “fall-efficacy”. Additionally, “balance training” was used. Nothing relating to elderly was used in the search because the filter of gerontology excluded studies with younger subjects (see table 1). The filters applied were clinical trial and gerontology. PEDro does not use Boolean operators or mesh terms. Search results were exported from PEDro and uploaded to Zotero software to identify duplicates. The PEDro searches took place during April-May 2021.

Table 1. Database search

Database	**Search**	**Search results**	**Results after filters**
PubMed	Self-Efficacy OR "Balance confidence" AND "Aged"[Mesh] AND "balance training" OR “balance program”	159	51
PubMed	Efficacy OR "fall-Efficacy" AND "Aged"[Mesh] AND "balance training" OR "balance program"	177	66
PEDro	Self-efficacy balance training	-	29
PEDro	Fall-efficacy balance training	-	48

5.4 Inclusion criteria

The studies from the search were selected based on specific inclusion and exclusion criteria (see table 2). This is to ensure that the results of the studies used represent the research question as well as possible.

Table 2. Inclusion and exclusion criteria

Inclusion criteria	**Exclusion criteria**
Mean age of participants 65 or over	Mean age of participants under 65
Balance training as the only additional intervention compared to the control group	The intervention included additional training not focused on balance compared to control group. e.g. strength or aerobic training
A self-efficacy scale was used as an outcome measure	A self-efficacy scale was not used as an outcome measure
The study focused on elderly of general good health, including frail elderly without diseases	The study focused on a specific group of elderly. Such as Parkinson's, diabetes, osteoporosis, stroke, or post hip-fracture
The methodology of a randomized control trial was used	A randomized control trial was not used
PEDro score ≥4	A PEDro score below 4
Intervention guided by a professional	Self-administered intervention
The study is in English	The study is in another language

5.5 Study selection

The 2009 version of the Prisma flow diagram was used to display the study selection process (see figure 3). The Prisma flow chart presents the phases of the literature review. It shows the number of records identified in each stage and the reasons for exclusion. There are several templates suitable for different types of reviews (Website of Prisma-statement). The summaries of the selected studies can be found in table 4. It includes the relevant information from each study included in the literature review.

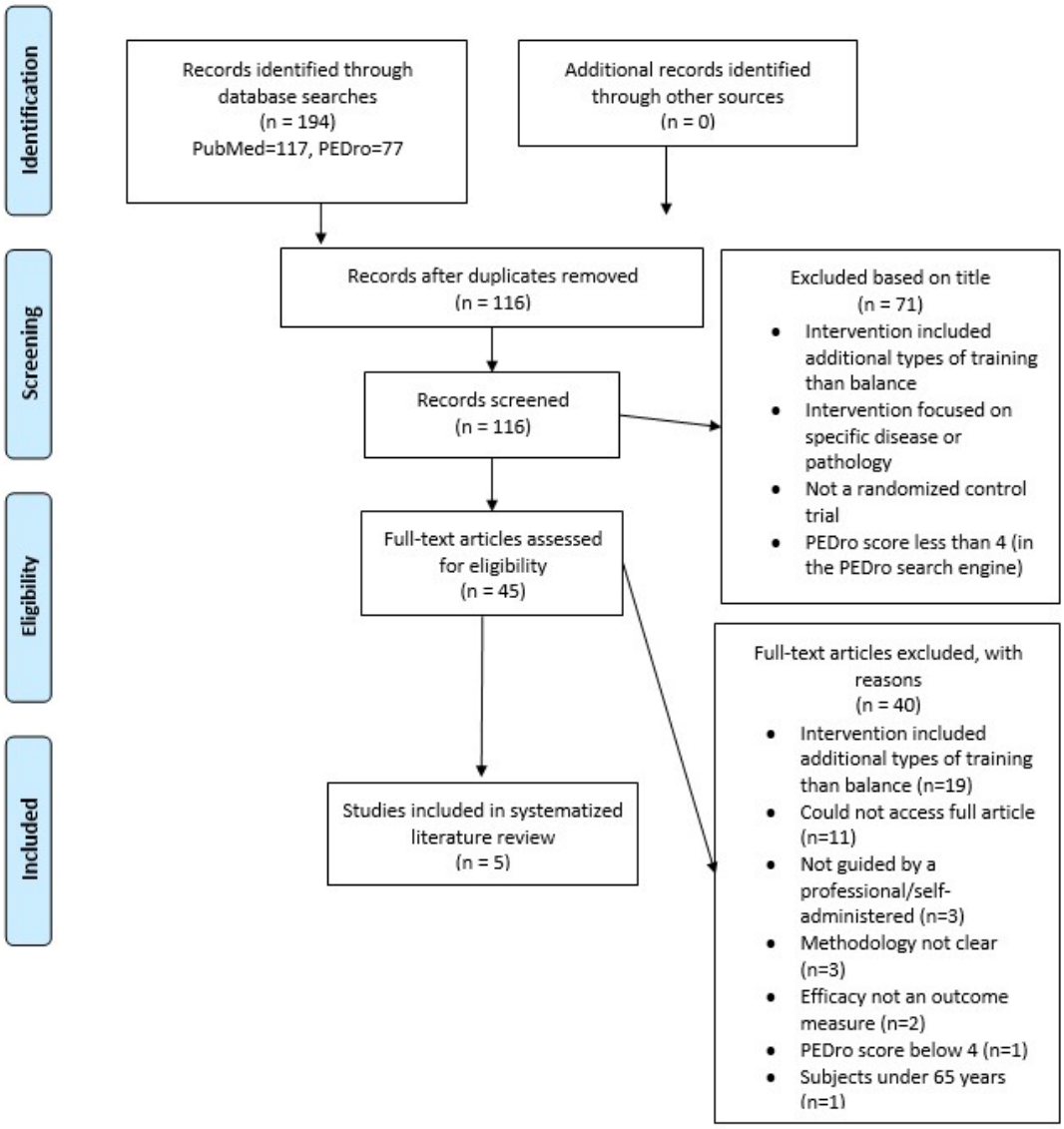


Figure 3. Study selection flow diagram. Modeled from the Prisma flow diagram. Layout altered by author (Website of Prisma-statement).

Table 4. Summaries of the studies selected for the systematized literature review.

Study	Subjects	Intervention	Control	Measure	Results
Gusi et al., 2012	N=40 Elderly who lived in a nursing home with a fear of falling. Mean age: 76	N=20 Biodex Balance System, which focuses on balancing/rebalancing and weight shifts. Additionally, regular multidisciplinary care received in the nursing home. 2x/week. 12-weeks.	N=20 Regular multidisciplinary care received in the nursing home.	Falls-efficacy scale international (FES-I)	Improvement in FES-I score in intervention group (32→26) compared to control. (33→34) (p= < .001) Statistically significant.
Kurz et al., 2016	N=53 Community-dwelling elderly. Mean age: 80	N=27 Perturbation training. Unexpected anterior-posterior and medial-lateral translations during single belt, treadmill walking. Safety harness used. 2x/week. 12-weeks.	N=26 Walking on a treadmill without unexpected perturbations. 2x/week. 12-weeks	Falls-efficacy scale (FES)	No significant difference between groups regarding self-efficacy. Researchers did not give numerical data regarding self-efficacy
Halvarsson et al., 2011	N=59. Community-dwelling elderly. Fear of falling or experienced fall.	N=38 Individually adjusted, progressive, and specific balance group training. 3x/week.	N=21. Lived their regular daily life.	Falls-efficacy scale (FES)	Improvement in FES compared to control (p=0.008)

	Mean age: 79	12-weeks			Statistically significant
Kim et al., 2015	N=30. Community-dwelling elderly women without past falls. Mean age: 73	N=15 Standing bent over stretches forward, down, to sides. 3 second holds. 3x/week for 8-weeks	N=15 Same exercises but seated in a chair.	Falls-efficacy scale (FES)	Improvement of FES in standing group 27.8 ± 13.4 → 21.9 ± 6.5 compared to seated control 24.1 ± 10.9 → 21.2 ± 5.9 (p=.05) Statistically significant
Steadman et al., 2003	N=199 Over 60-year-olds with a berg balance score of less than 45. Mean age: 82	N=96 All components of conventional therapy plus balance exercises, with an emphasis on progression. 2x/week for 6 weeks	N=102 "Conventional therapy", which included assistive aid assessment, stair practice, and sit to stand. Control had no exercises that focused on balance or progression of exercises 2x/week for 4 weeks plus 2 weeks of	A custom questionnaire designed for the study	Subjective confidence in balance improved in the enhanced balance group when walking indoors 36% vs 28% p=.04) and outdoors (27% vs 18% (p=.02) Statistically significant

			telephone follow-up.		

5.6 Evaluation of collected studies

Evaluating the quality of the studies used in the literature review ensures that the reader understands the quality of the literature review. The Physiotherapy Evidence Database (PEDro) scale was used for evaluating the quality of the RCTs used for the systematized literature review. The PEDro scale consists of 11 yes-no questions, of which questions 2-11 are used as the final score. A yes=1 and no=0. A higher score indicates a higher quality clinical trial with a lower likelihood of researcher bias. Using the PEDro score, 0-3 is of poor quality, 4-5 is moderate, 6-8 is good-quality, while 9-10 is excellent. When it is unclear whether the study fulfilled the criteria, it is marked no. (Website of PEDro). How each study used in the literature review scored on the PEDro scale questions can be seen in table 5.

Table 5**.** Methodological quality assessment of studies using the PEDro scale

Study	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Pedro score**
Halvarsson et al., 2011.	x	x	x	x			x	x		x	x	**7/10** (Graded by PEDro)
Kim et al., 2015	x	x	x	x				x	x	x	x	**7/10** (Graded by author)
Gusi et al., 2012	x	x	x	x			x	x	x	x	x	**8/10** (Graded by PEDro)
Steadman et al., 2003	x	x		x	x				x	x	x	**5/10** (Graded by PEDro)
Kurz et al., 2016	x	x		x			x		x	x	x	**6/10** (Graded by PEDro)

5.7 Data analysis

An inductive data analysis was the method chosen for the results of this systematized literature review. In an inductive data analysis, the researcher takes a broad perspective of the study results. Based on these results a theory or explanation is proposed. An inductive evaluation is not used to validate theories, but to bring clarity to uncertain topics (Thomas, 2006). P-values are utilized as a part of the data analysis. A p-value of ≤.05 indicates a statistically significant result (Neo, 2020). P-values show the likelihood that a result came by pure chance and are commonplace in randomized control trials. They are used by all the studies in this literature review, excluding the trial by Kurz et al. (2016).

6 RESULTS

Five trials were selected for the literature review with a total of 382 subjects. The sample sizes varied from 30-199 and the mean age ranged from 73-82. Intervention groups performed balance training 2-3 times/week for 6-12 weeks (See table 3).

Implementing balance training on a population of healthy elderly has a promising, yet uncertain impact on self-efficacy. In 4/5 studies, the intervention group had statistically significant improvement of self-efficacy scores compared to the control group (Halvarsson et al., 2011; Kim et al., 2015; Gusi et al., 2012; Steadman et al., 2003). Kurz et al.'s trial (2016) did not show improvement in the intervention group compared to the control group.

Balance training appears to be especially effective in improving self-efficacy compared to a passive control group. Two of the selected studies had a passive control group, which did not perform an additional intervention to their daily lives (Gusi et al., 2012; Halvarsson et al., 2011). The intervention groups had significantly reduced their FES score; p=<.001 & p=.008. This improvement is greater than the other studies

where the control group was given an alternative treatment (Steadman et al., 2003; Kim et al., 2015; Kurz et al., 2016).

Progressive balance exercises appear to be effective at improving self-efficacy compared to non-progressive balance training. All three trials with progressive balance training (Gusi et al., 2012; Halvarsson et al., 2011; Steadman et al., 2003) all improved their self-efficacy scores compared to controls (p=<.001, p=.008 & p=.04). These improvements are of statistical significance.

Studies where the participants selected had either poor balance or a fear of falling benefited the most from the balance interventions (Halvarsson et al., 2011; Steadman et al., 2003; Gusi et al., 2012). These participants' improvement of self-efficacy improvement (p=.008, p= 0.04 & p=<.001) was superior to studies with participants of general or community dwelling elderly (p=0.05) that may consist of well-functioning seniors (Kim et al., 2015; Kurz et al., 2016). Kurz et al.'s (2016) trial of community dwelling did not achieve an improvement in self-efficacy, nor did they publish quantifiable values of self-efficacy.

Adding balance training to conventional therapy has a promising effect on self-efficacy of elderly with a Berg Balance Score less than 45. The results of Steadman et al. (2003) suggest that adding progressively challenging balance exercises to conventional therapy has an impact on self-efficacy. The conventional therapy group (n=102) included guidance on transfers and therapeutic exercise including assisted walking using parallel bars, stair training, and sit to stand. The conventional therapy group also showed improvements in self-efficacy. Of those in the balance group (n=96) more subjects reported their walking confidence outside improved 27 % compared to the conventional therapy control 18% (p=.02) and indoors 36% vs 28% (p=.04). Both results of which are statistically significant.

Perturbation training did not improve self-efficacy compared to an alternative intervention (Kurz et al., 2016). The intervention group (n=27) walked on a treadmill with random perturbations, while the control (n=26) just walked on a treadmill. The authors did not release quantifiable values for self-efficacy in their report.

Reaching postural control exercises performed in a standing position appears to be superior to the same exercises performed in a seated position in improving self-efficacy. Kim et al. (2015) had healthy elderly women perform reaching exercises in different directions with 3-second holds. The intervention (n=15) performed them standing, while the control (n=15) performed them sitting. FES improved on the standing group: 27.9→21.9 and also improved in the sitting group: 24.1→21.2 (p=.05).

Adding balance training to the care received in an elderly home had a significant improvement in self-efficacy (Gusi et al., 2012). This study (n=40) had institutionalized seniors use the biodex balance system. The biodex balance system is machine that participants stand on and gives participants balance challenges of various difficulties. The intervention group's FES-I score improved 32→26 compared to control 33→34 (p= < .001).

7 CONCLUSION

The results of this systematized literature review consisting of five trials suggest that balance training could be moderately effective in improving the self-efficacy of healthy elderly. Balance training's improvement of self-efficacy is more apparent compared to a passive control, of which 2/2 trials had a statistically significant result. The significance of balance training's effect on self-efficacy compared to an alternative intervention is promising. Compared to an alternative intervention, the balance groups achieved a statistically significant improvement in 2/3 trials. A notable observation was that the improvements were greater in the three studies where the interventions' participants were of either lower objective or perceived balance ability. The results of the literature review are limited and therefore, not conclusive.

8 DISCUSSION

The aim of the thesis was to outline the current state of research regarding balance training and the self-efficacy of elderly. Self-efficacy is a belief in one's ability to execute a given task. With the elderly, self-efficacy is primarily focused on safely performing activities of daily living and usually decreases as the aging process progresses. A major attribution to this decrease is believed to be the loss of balance, as increased fear of injury negatively influences belief in one's ability to perform required daily tasks. This literature review found that pure balance interventions do generally improve the self-efficacy of elderly. The purpose of this thesis was not to promote isolated balance training as a lifestyle intervention. However, to accurately observe specifically balance training's effect, isolating balance training as the intervention was deemed the most accurate approach.

The idea for the thesis topic arose when reading about physical activity's positive influence on brain function in Anders Hansen's book, *The real happy pill.* Through this, the author of this thesis had a desire to come up with a topic that further develops an understanding of the biopsychosocial totality of human functioning. Another goal for the thesis topic was to research a topic relevant to physiotherapy, yet minimally researched. This led to the final topic of balance training and the self-efficacy of elderly. The thesis topic was decided in May 2020. It was planned that the theory portion was to be written by December 2020, while the practical implementation and results would be done in spring and summer 2021. The methodology was originally planned to be an intervention group with a before and after questionnaire. This was to be done in cooperation with the municipality of Pori, Finland, and their balance groups. Due to the COVID-19 pandemic, the balance groups were not organized. As a result, the methodology was switched to a literature review. Because the theory was the same, the author was able to adjust and stay on schedule regarding the writing process. Due to the specific nature of the topic, the extent of existing literature that would fit the inclusion criteria was uncertain. Five studies that fit the criteria were found, which was deemed enough to execute the systematized literature review. The thesis was presented on 8.10.2021.

The importance of this topic arises from the commonplace of balance groups and interventions for the elderly being organized by municipalities, hospitals, and private sector providers. Due to strength training's thoroughly researched impact on functional ability, these interventions mostly have strength training as a main component as well. Additionally, clinical trials with balance training and self-efficacy of elderly also mostly include strength training. As discussed in section 3.2.1, exercise in general appears to have a positive effect on the self-efficacy of the elderly, but how balance training specifically fairs was in question. Literature reviews or meta-analyses on this topic were not found by the author. The lack of research left it unclear of the specific role of balance training on self-efficacy in these interventions. This gap in the literature is what provided a topic, which inspired the author to conduct the review.

With the state of current literature regarding balance training and self-efficacy of elderly, an inductive data analysis was an appropriate method. Trials in this review use different scales, methods, dosages, etc. Thus, taking this broad perspective and viewing the various potential influences on self-efficacy was deemed appropriate. The heterogeneity of the trials serves both as a strength and a weakness of this review. A strength is the broad implementations of the trials allows a general understanding of where this narrow field of research stands. This is the reasoning for using the method of an inductive data analysis, which leaves room for interpretation of the results.

The validity of a study refers to a study's trustworthiness. The author prioritized neutrality and all relevant research that matched the exclusion/inclusion criteria was used. However, unconscious bias cannot be accounted for. Only having one researcher does suscept to bias regarding interpretation and expression of results. For higher validity, the included studies had to be at least of moderate quality according to the PEDro scale and only randomized control trials were included. Self-efficacy is difficult to sell and therefore commercial interest of researchers in the field is low, which decreases financial incentives of original studies. The variability of the intervention, control, and overall implementation between the selected studies is a limitation of the review. The weakness is further increased by the small subject numbers of most of the trials. Four out of five of the studies showed subject counts below 60, which increases the risk of results shifting in either direction purely on chance. A study's external validity is its generalizability to other populations. This review may have some

generalizability to other elderly populations, or those who have balance as a major concern. Such as those recovering from a hip fracture or stroke. External validity to other populations is poor.

The reliability of research refers to its replicability. This thesis was implemented with the intention of being replicable. The literature review process was outlined in detail in section 5. This section outlined the literature review methodology, research question's PICO model, the database search, inclusion criteria, study selection flowchart, and the evaluation of collected studies. The guideline used by the author for the validity and reliability of a literature review was from the website of UKessays (2018).

Self-efficacy as a term covers a broad field of topics. However, in the context of this thesis, it was viewed from the narrow perspective relating to the ability to physically perform activities of daily living (ADLs). This is the same perspective that is generally used in research regarding self-efficacy and elderly unless mentioned separately. In research, the term self-efficacy is usually implied based on the target population. For example, "self-efficacy of new parents", would imply the self-efficacy regarding raising a child. Terminology within the thesis' research topic varies. For this thesis, terms considered equivalent to self-efficacy and used in the literature review were fall-efficacy and balance confidence. There are several similar concepts but were not considered synonymous with self-efficacy. These terms include self-perceived functioning, self-reported disability, self-perceived health, and subjective health. These terms were excluded from the literature review.

Several of the studies used self-efficacy as a secondary outcome. Meaning that it was not the priority of the research. This is an efficient method of collecting additional data for research. Self-efficacy being a specific field of research may not be the absolute priority due to the limited resources of many researchers. However, since having participants fill out a questionnaire does not require a lot of additional resources, it could easily be added as a secondary outcome to future studies on balance interventions. Because self-efficacy is often used as a secondary outcome, this makes it more difficult to find during the literature review. The author believes that self-

efficacy as a secondary outcome may not be used in the keywords of studies. Therefore, relevant studies may have gone unnoticed during the search process.

The definition of balance training imposed by the author is that balance training is training where the main emphasis is on challenging the postural control of the participants. Training is excluded where balance is challenged, but other components such as strength may be the limiting factor. For example, lunges require balance and coordination but would not be considered balance training for the purpose of this thesis. Additionally, the emphasis must be on challenging postural control. Tai-chi has been shown to have significant results in improving balance (Hackney & Wolf, 2014). It even has a promising effect on self-efficacy (Birimoglu & Bilgili, 2017). Tai-chi as a concept was not included in the study since, the focus is not purely on improving balance, but additionally on meditation, stress reduction, breathwork, etc.

Prior to the research process, the author had hypothesized that balance training would improve the self-efficacy of elderly. As expected, the results were considerable compared to a passive control group. When the control group was an alternative intervention, the significance of balance training decreased. This could imply that suboptimal interventions may also improve self-efficacy to a lesser extent. Alternative interventions likely provide positive efficacy information. Interpretations of success might have occurred to provide mastery experiences. The vicarious experiences and social persuasion from fellow group members and professionals might be enough to provide subjects with a sense of self-efficacy. However, the balance groups did still manage to outperform the alternative intervention in the trials by Steadman et al. (2003), Kim et al. (2015), but not in Kurz et al's (2016) trial where there was no meaningful difference. This might suggest that the situation-specific nature of balance training to fall situations may still support the development of self-efficacy opposed to general interventions.

One of the major takeaways of the results is that balance training's effect on self-efficacy is greatest with seniors of either poor objective or subjective balance ability. The three studies (Halvarsson et al., 2011; Steadman et al., 2003; Gusi et al., 2012) using the previously mentioned participant group scored higher in self-efficacy improvements. This finding aligns with the theory of self-efficacy. If confidence is

lower relating to a specific activity, in this case balance, there is more opportunity for providing efficacy information that challenges that belief. If one were to have high confidence relating to balance, it is not a concern for them and there is less room for growth. The author's interpretation of this is that balance training as an intervention is naturally more suited for and benefitted by seniors with poor balance outcomes. Although, it still would be useful in maintaining self-efficacy in those with better balance outcomes. This highlights the importance of individualized programming for clients based on their needs.

Coincidentally the previously mentioned three studies were the three studies, which had progressively difficult balance exercises. The extent of how much the exercise progression or balance ability of the participants group affected the results is unclear. Steadman et al. (2003), Gusi et al. (2012) and Halvarsson et al. (2011) state that the balance exercises were progressively difficult. Kim et al. (2015), and Kurz et al. (2016) had no progression. This is of important consideration since training of moderate difficulty is theoretically the most effective regarding providing mastery experiences and improving self-efficacy. By participants realizing that they can achieve these demanding tasks, their sense of empowerment increases. The overcoming of difficult tasks is a factor in influencing efficacy. Too difficult training would not provide a sense of accomplishment and possibly lower self-efficacy (McAuley et al., 2011).

The author's hypothesized interaction based on the theoretical portion of this thesis, is that by increasing self-efficacy, we can increase a senior's confidence in activity. This in return would theoretically lead to increased activity quantity, which would hopefully result in an improvement in objective outcomes such as muscle strength, balance, and aerobic capacity (see figure 4).

Figure 4. The author's hypothesized objective-subjective outcome interaction (Created by author).

The literature review may be considered by researchers wishing to expand on the topic. The clearest development to gain an understanding of balance training's effect on self-efficacy of elderly would be additional RCTs. To give full insight there should be RCTs on passive controls and alternative interventions. In an optimal situation, trials of longer periods and follow-ups would be done. Efficacy beliefs are the outcome of years of thoughts and experiences. This may give insight into how long it takes for efficacy beliefs to change and if they may be maintained following the end of the intervention.

Another suggestion for future clinical trials would be to be conducted by researchers thoroughly familiar with the social cognitive theory and self-efficacy theory. This would allow planning an intervention to contain supportive sources of efficacy information. The author speculates that the multifactorial complexity of self-efficacy implies that a multidimensional approach is needed for optimal improvement of self-efficacy. The extent of efficacy information from mastery experiences, vicarious experiences, social persuasion, and physiological states is however difficult to accurately express in research.

In conclusion, this thesis provides insight into self-efficacy from a physiotherapeutic perspective and the results of the thesis topic are promising. The improvement of self-efficacy is most promising in interventions with progressive balance training, with participants of either poor subjective or objective balance ability, and compared to passive controls. The number of trials in this literature review are limited and therefore, the results should not lead to conclusions. The reader should take that limitation into consideration when interpreting the results of this systematized literature review. However, the theoretical base of the thesis can provide practicing physiotherapists with an understanding of self-efficacy and how it can be applied to their clinical practice. By understanding what makes up efficacy information, physiotherapists can utilize methods that promote the self-efficacy of clients.

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