

An investigation on the effects of Cawthorne Cooksey exercises on both vestibular and non-vestibular balance issues: A Systematic Review of Rehabilitative Services for the Elderly

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Abstract – The vestibular system plays an essential role in the preservation of balance. Any dysfunction in the vestibular system leads to an elevated risk (40%-50%) of elderly persons experiencing dizziness, vertigo, and peripheral vestibular disease. Functional deficit or physiological changes with aging can result in balance disturbance and an increase in the likelihood of falls in elders. Moreover, non-vestibular conditions such as sensory loss, psychiatric, visual impairment, and adverse drug effects have also disturbed the balance and can lead to falls in elders. The primary purpose of the proposed manuscript is to address whether the Cawthorne exercise intervention is effective for vestibular or non-vestibular balance impairments in the geriatric population and can contribute to the improvement of balance and to decrease the likelihood of falls. 40 studies from various databases (Pubmed, Medline, Cochrane, and other databases) were included in this systematic review. This systematic analysis is based on the PRISMA protocol guidelines. Only databases that investigated the impact of Cawthorne Cooksey exercises on both vestibular and non-vestibular balance disorders from 2011 to 2021 were included in this study. The results of these clinical trials indicate that Cawthorne and Cooksey's exercises are an effective means of treating elderly patients with vestibular or non-vestibular complaints. These exercises also enhance the quality of life and can be used in older peoples with balance disturbances as a prevention or treatment technique.

Keywords – Balance, fall, impairments, quality of life, vestibular system, vertigo

INTRODUCTION

Elderly "has been defined as the age of 65 or older, with those between 65 and 74 years old being called "early elders" and those beyond 75 years old being called "late elders".[1] Elderly individuals are described as "a group where different illnesses and anomalies are frequently present, and where disease might manifest as unpredictability, impaired mobility, falls, and reduced functional ability. Progressive physiological changes to the body's systems are what define ageing. Age-related major physiological changes include a 40% reduction in hair cells, a decline in the number of receptors and motor fibers, a decrease in electrical excitability, and a degeneration of core processing. These changes have functional implications as postural control deficits and symptoms of vertigo, lightheadedness, unsteadiness, and equilibrium dysfunction arise. Increased vestibular stimulation may cause the body to sway more. [2]

A decrease in vestibular functioning causes falls in elderly people. Degeneration and gradual depletion of neuronal cells in the central or peripheral vestibular system result in dizziness and lightheadedness. Vestibular

dysfunction is consistent with this physiological aging process. The incidence of vestibular dysfunction rises with age which can lead to falls, agitation, loneliness, fear of falling, and lack of confidence. Vestibular diseases have an incidence of 29 to 45 percent in people above 70 years of age. Vestibular rehabilitation strategies have been used to improve the quality of life of individuals suffering from vestibular conditions. Vestibular rehabilitation techniques such as Cawthorne Cooksey exercises have been used to enhance the quality of life of individuals suffering from vestibular disorders. Cawthorne Cooksey exercises are the therapeutic strategies that lead to vestibular compensation and are focused on core neuroplasticity mechanisms such as habituation, structural, and functional reorganization. [2]

Horak et al. defined balance as the nervous system's ability to sense any instability spontaneously or in advance and to evoke synchronized responses that will re-establish the supporting foundation of the body mass, avoiding falls. For a variety of central nervous system (CNS) and peripheral nervous system (PNS) systems, comprehensive balance management is recommended.[1] One of the major structures

for preserving balance is the vestibular system, as it is known as an absolute guideline relative to others, such as visual and somatosensory systems, which are also engaged in this process.[2] If the processing of auditory, labyrinthine, and proprioceptive input is not sufficiently incorporated into the CNS, there is a disturbance in the equilibrium state that can be manifested by body imbalance and can lead to falls.[3] In addition, unlike vestibular conditions (e.g. dizziness, vertigo, and peripheral vestibular disease) non-vestibular conditions such as sensory loss, psychiatric, visual impairment, and adverse drug effects have also disturbed the balance and may contribute to falls in elders. For these conditions, aging can be responsible. It can be difficult for the elderly to specifically monitor these sensations, which can be enhanced by specialized training programs. Considering that everyday tasks are present in various situations including sensory redundancy, it is important to provide expertise in analyzing and obtaining data to deter falls [4].

Systems have physiological stores in our body that are differentiated in the nervous system by their reorganization ability, known as neuroplasticity.[5] Reserves are decreased but not exhausted with age, so a major improvement in activity can be assessed by the development of an ideal motor learning environment.[6] Pohl and Winstein reported that in the elderly, the practice also enhances neural processing abilities.[7] Vestibular exercises, such as those defined by Cooksey, serve as help for new peripheral sensory input arrangements, enabling new vestibular stimulus patterns required to become automatic for new experiences. This behavior of equilibrium will be able to stimulate a shift in the reactions of balance and, eventually, reduce drop.[8] These tasks are part of a vestibular rehabilitation regime that involves head, neck, and eye motions, balance control exercises in various poses (sitting, walking, in two-leg, one-leg positions), exercises with an eye open or closed, and soft surface use to minimize proprioceptive input.[9] The aim of the present study was to explore a specific therapeutic approach to the vestibular system by applying Cawthorne and Cooksey exercises, to see how they produced motor learning and contributed to improved balance and reducing the risk of elderly falls.

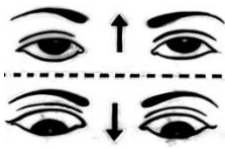


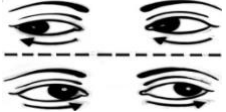

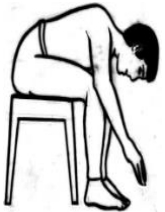

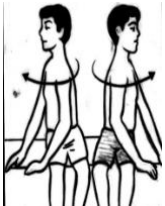
Many studies have been restricted to a systematic review of the effects of Cawthorne Cooksey exercises in a middle-aged and elderly population and have not focused specifically and exclusively on the elderly population. Previously conducted studies suggest that Cawthorne exercise is beneficial for vestibular disorders and impaired balance but did not define its efficacy for non-vestibular disorders (sensory loss, psychiatric, visual impairment, adverse drug effects, etc).[10] Therefore, the aim of this systematic review was to find out the effects of Cawthorne Cooksey exercise on vestibular and non-vestibular balance impairments in the geriatric population [11].

Cawthorne Cooksey exercises

The exercises of Cawthorne-Cooksey are based on the premise that repeated contact with provocative stimuli can lead to a decline in the pathological reaction of the intervention. In the 1940s, Cawthorne and Cooksey were the first to establish habituation based exercises. At the time, Cawthorne was treating patients with unilateral vestibular abnormalities and post-concussive effects. Cawthorne created a series of exercises in collaboration with Cooksey that deal with the symptoms of vertigo and poor balance of their patients. Cawthorne -Cooksey interventions include pursuit and saccadic eye motions, head movements, actions including eye contact with the head, general body movements, and balance tasks. Cawthorne and Cooksey suggested that these exercises can be conducted in various positions and at different speeds of acceleration. Moreover, patients were asked to perform these exercises with their eyes open and closed. Doing these exercises with the eyes closed, according to Cawthorne and Cooksey, reduced the patient's dependency on visual input and likely forced more efficient compensation by vestibular and somatosensory mechanisms. In addition, patients were often trained to do these exercises in loud and busy settings. Cawthorne and Cooksey also helped patients work together in weekly community tasks to promote constructive interaction.[12] The Cawthorne -Cooksey exercises are intended to calm the muscles of the neck and back, teach the eyes to work independently of the head, and practice coordination and head motions that induce dizziness.[11] These exercises consist of a sequence of eyes, head, and body movements aimed at causing symptoms with rising difficulty. The purpose of these exercises is to exhaust the vestibular reflex and induce the central nervous system to brace by habit for the stimulus.[13]



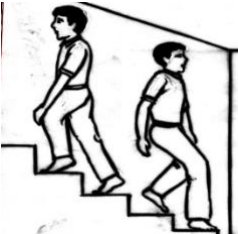




Cawthorne and Physiotherapist Cooksey also create exercise-based interventions to rehabilitate warriors with dizziness and brain injury. Studies have been published since the 1970s on the anatomy, physiology, functional testing, and compensatory mechanism of Vestibular rehabilitation, and since the 1980s therapeutic exercises have been given to patients with vestibular disorders.[14] These exercises involve eye and head movements and to reduce dizziness, imbalance, and improve quality of life. It is important to do these exercises persistently for at least 5 mins, 3 times a daily and for as long as vertigo lasts. If you experience dizziness while doing these exercises, immediately stop the exercises until the dizziness is settled and then repeat again. Cawthorne Cooksey exercises during the performance of eye, head, and body movement in bed or supine, sitting, standing, and walking positions are described below in Table1 and Table 2. [15]-[16].

Table 1: Cawthorne Cooksey exercises in bed and sitting position

IN BED/ SUPINE POSITION		SITTING POSITION
(Eye movement)	(Head movement)	(Eye & Head movements)
Head immobile, at first move slowly and then quickly	First, move slowly and then quickly, later on move with eyes opened and eye closed	Same as described in the previous section(i.e. in bed or supine position) except <ul style="list-style-type: none"> • Turn the head side to side initially while doing 2 slow turns followed by 1 fast turn, then after a few seconds of delay, do 3 fast turns. • Repeat above with eye closed.
		
Looking up and then down	Bending alternately forward & backward	Shrugging and rotating shoulders
		
Looking alternately left and right	Turning alternately to the left then right	Bending forward and picking up objects from the floor
		
Convergence Exercises		Turning head and trunk alternately to the left and then right
(Supine Position)		Throw and catch the ball from side to side while sitting
<ul style="list-style-type: none"> • Roll head and body side to side. • Sit up, and from the side. 		

[12, 13, 24]

Table 2: Cawthorne Cooksey exercises in standing and walking position

STANDING POSITION	WALKING POSITION
<p><u>Eye & head movements</u></p> <p>Same as described in the previous section (i.e. in bed or supine position)</p> <p><u>Arm & body movements</u></p> <p>Same as described in the previous section (i.e. in sitting position).</p>	 <p>Throwing and catching the ball while walking</p> <p>(Circle and straight line)</p>
 <p>Switching from sitting to standing, first with eyes open and then closed</p>	 <p>Walking up and down a flight of stairs first with an eye open then closed</p>
 <p>Throwing the ball in an arc from hand to hand and following with the eyes</p>	 <p>Walking in a circle with head turned left and right, eyes open and closed</p>
 <p>Throwing a small ball from hand to hand under the knee</p>	 <p>Playing any game involving bending, stretching and aiming with the ball such as basketball and bowling</p>
<p>Changing from sitting to standing and turning around in between</p>	<ul style="list-style-type: none"> • Walking in a circle with head turned left and right, eyes open and closed. • Walking across the room with eyes open and closed, backward-forward, sideways, turning head. • Walking up and down slopes first with the eye open then closed.

[4, 12, 13]

Cawthorne and Cooksey's protocol has already proved to be effective in vestibular disorders. [10] These exercises stimulate the vestibular system by developing a central compensatory mechanism that is beneficial in the treatment of post labyrinthectomy, chronic Meniere diseases, recurrent vestibulopathy, and chronic vestibular diseases.[17] These exercises further enhance visual-vestibular connections, postural stability, and reduce dizziness and anxiety symptoms as well. Brandt-Daroff exercises were performed by patients with posterior semicircular canal BPPV, while Cawthorne-Cooksey exercises were performed by patients with the horizontal semicircular canal. [18, 19]

The most successful therapeutic methods identified by literature reviews were Brandt-Daroff exercises, Epley's maneuver, and habituation strategies, while clinical trials for managing body imbalance in older individuals reveal that Cawthorne exercises were found successful in managing body imbalance, body unsteadiness, vertigo, dizziness in 19.3 percent of the studies, whereas the Tusa and Herdman protocol was shown to be effective in 87.5 percent of cases. [20] These exercises have beneficial outcomes but they have not provided evidence on the effectiveness of Cawthorne exercises on proprioception management, the base of support, and visual information that can be corrected by coordination, flexibility, and strengthening exercises.[21] According to a recent Cochrane review, there is moderate to strong evidence, that vestibular rehabilitation is an effective and safe treatment for peripheral vestibular disorders and APTA has published clinical guidelines for vestibular rehabilitation of peripheral vestibular disorder.[22] Vestibular system disorders are responsible for 40% to 50% chance of dizziness, vertigo, and peripheral vestibular diseases in older adults similarly these symptoms also occur in non-vestibular disorders due to sensory loss, psychiatric, CVS disorders, anxiety, visual impairment, and adverse drug effects.[13], [23]

OBJECTIVES OF THE STUDY

The primary purpose of the proposed manuscript is to address whether the Cawthorne exercise intervention is effective for vestibular or non-vestibular balance impairments in the geriatric population and can contribute to the improvement of balance and to decrease the likelihood of falls.

MATERIALS AND METHODS

This systematic analysis is based on the PRISMA protocol guidelines.

- **Eligibility criteria:** Studies eligible for inclusion were RCTs evaluating the effectiveness of Cawthorne exercises in minimizing age-related vestibular or non-vestibular and balancing problems in the geriatric population.
- **Identification of studies and Methodological quality assessment:** A version of the physiotherapy evidence database [PEDro] scale was used to determine the methodological quality of the included studies. A list of 11 criteria for the validity and interpretation of controlled trial data makes up the PEDro scale.
- A direct search of the following keywords was employed: "Vestibular System" and "Vestibular rehabilitation", "Non-Vestibular System" and "Cawthorne exercises" and "older people" and "vestibular Rehabilitation in geriatrics" and "Aging & Cawthorne exercises".
- Potentially relevant studies were identified by the following search strategy: ("older population" or "vestibular disorders") and ("elderly" or "vestibular rehab") and ("aged" or "non-vestibular dysfunctions") and ("Cawthorne training" or "balance disorders) and ("balance preservation" or "fall"). The search was restricted by publication date and language (English) (from 2011 to 2021).
- Two independent reviewers evaluated the titles and abstracts of the records that were retrieved from the search method for eligibility using the following inclusion criteria:
 - (1) Sample with a 60+ year old;
 - (2) Participants with vestibular or non-vestibular dysfunction
 - (3) Random sampling
 - (4) Cawthorne Cooksey exercises were used in the experimental group, while the control group received no treatment, a placebo, or any other form of active intervention.
 - (5) Through vestibular neuroplasticity, experimental intervention is described as stimulation exercises for the restoration of vestibular and bodily balance function.

Following the review of study titles and abstracts, the full texts of studies that might be eligible were examined. Those that met the criteria for inclusion had the pertinent data extracted using a standardized form that contained the following information: sample characteristics, primary and secondary outcomes, trial design, characteristics of the interventions, and interventions' effects.

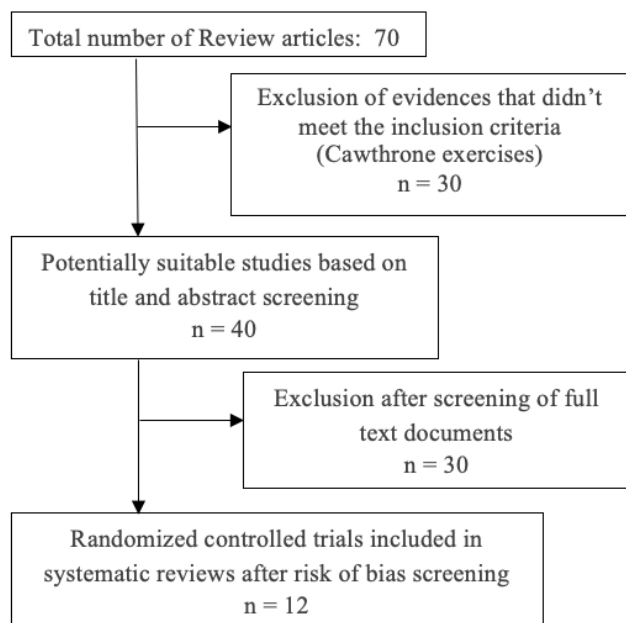


Figure 1: Data extraction and analysis of methodological quality

Source of data

Medline, Google Scholar, Pubmed, Cochrane.

Study design

Systematic review

Study Population

Geriatric population

Inclusion criteria

- A search for relevant publications was conducted in Medline, Google Scholar, Pubmed, Cochrane, and other databases.
- Clinical trials and studies that were written and published in the English language were selected. The accuracy of the empirical studies was evaluated by using the PEDRO scale.
- Clinical evidence databases from 2011 to 2022 were searched.

RESULTS

- In this study out of 70 articles 12 articles are selected and their results show that Cawthorne Cooksey exercise is used to reduce age-related vestibular or non-vestibular complications like dizziness, vertigo, falls, and imbalance in the elder population.
- **Methodological excellence:** Quality evaluation ratings varied from 5 to 8 out of a possible 10.

Outcome measure:

Different outcome measures for the examination of vestibular function reported in 5 studies were Dizziness Handicap Inventory (DHI), Disability Index (DI), Dynamic Gait Index (DGI), Berg Balance Scale (BBS), Gait variables, were mostly used.

Table 3: Modified PEDro Scale for Studies Reviewed

Author's	1	2	3	4	5	6	7	8	9	10	11	Total
Ricci et al., (2016)	yes	yes	yes	yes	no	no	no	yes	yes	yes	yes	8 / 10
Júnior et al., (2014)	yes	yes	no	no	no	no	no	yes	yes	yes	yes	5 / 10
Khanna et al., (2014)	yes	yes	no	yes	no	no	no	yes	yes	yes	yes	6 / 10
Bayat et al., (2012)	yes	yes	no	no	no	no	no	yes	yes	yes	yes	5 / 10
Meldrum et al., (2015)	yes	yes	yes	yes	no	no	yes	yes	yes	yes	yes	8 / 10
Marioni et al., (2013)	yes	yes	yes	yes	no	no	no	yes	yes	yes	yes	7 / 10
Patatas et al., (2015)	yes	no	no	yes	no	no	no	yes	yes	yes	yes	5 / 10
Simoceli et al., (2016)	yes	yes	no	yes	yes	no	no	yes	yes	yes	yes	7 / 10
Zanardini et al., (2017)	yes	yes	no	no	no	no	no	yes	yes	yes	yes	5 / 10
Morettin et al., (2018)	yes	Yes	no	yes	no	no	no	yes	yes	yes	yes	6 / 10
McGibbon et al., (2017)	yes	Yes	no	yes	no	no	no	yes	yes	yes	yes	6 / 10
Andersson et al., (2018)	yes	Yes	yes	yes	no	no	no	yes	yes	yes	yes	7 / 10

Table 4: Evidence for Cawthorne Cooksey Exercises

Author's	Total Participa nts	Outcome measures	Treatments	Conclusions
Ricci et al., (2016)	n = 82	Time-to-go test, balancing test, and multidirectional functional reach test (e.g., sit to stand and static Romberg test), DGI (Dynamic Gait Index), a handgrip-strengthening gadget, and fall history.	Cawthorne Cooksey exercises (Conventional versus multimodal)	The multimodal Cawthorne Cooksey exercise is more effective at reducing vertigo.[25]
Júnior et al., (2014)	n = 9	POMA (Performance Oriented Mobility Assessment) and Fukuda stepping or Unterberger test	Cawthorne Cooksey exercises	In older people with vertigo, Cawthorne Cooksey exercises improve balance and anterior displacement. [26]
Khanna et al., (2014)	n = 30	BBS (Berg Balance Test), DGI (Dynamic Gait Index), and ABC scale (Activities Specific balance confidence)	Gaze stability exercises (adaptation and substitution) and balance exercise	Elderly individuals benefit from balancing training. [27]
Bayat et al., (2012)	n = 33	Vedionystagmography and the DHI (Dizziness Handicap Inventory)	Cawthorne Cooksey exercises performed two workouts per week for two months.	Vestibular rehabilitation treatment can help older persons with persistent vestibular issues. [28]
Meldrum et al., (2015)	n = 71	Dynamic posturography, the ABC scale (activities specific balance confidence), the dynamic visual acuity test, the dynamic gait index Scale, and the hospital anxiety and depression scale	vestibular rehabilitation with traditional or virtual reality (NWFP)	Older people's balance and dizziness are greatly improved when NWFP and conventional VR are combined. [29]
Marioni et al., (2013)	n = 14	Computerized posturography and the DHI (Dizziness Handicap Inventory)	Group A VR with posturography assistance and a home-based training regimen 3 times each day for six weeks. Group B Only home-based training	Vestibular rehabilitation and posturography work better together than just a home exercise routine does. [30]
Patatas et al., (2015)	n = 22	The DHI (Dizziness Handicap Inventory)	Cawthorne Cooksey, and the gaze stability exercises	Following customized vestibular therapy, each patient's quality of life significantly improved. [31]
Simoceli et al., (2016)	n = 39	VAS (Visual Analogue Scale), the Disability Index, and computerized posturography	Group A For two months, Cawthorne Cooksey worked out twice daily. Group B Tusa and Herdman procedure	Both the Tusa & Herdman technique and the Cawthorne Cooksey exercise are equally beneficial in the elderly. [32]
Zanardini et al., (2017)	n = 8	Vectonystagmography and the DHI (Dizziness Handicap Inventory)	Cawthorne Cooksey work outs	Following vestibular therapy, there was a noticeable improvement in the physiological, functional, and mental components. [33]
Morettin et al., (2018)	n = 30	DHI (Dizziness Handicap Inventory)	Simont manoeuvre, Cawthorne Cooksey exercise, and the Brandt Daroff exercise	Patients gain advantages from vestibular rehabilitation.[34]
McGibbon et al., (2017)	n = 36	Gait pace, stance period, step average length, and step breadth	Vestibular rehabilitation, and Tai Chi exercise	Tai chi may be used in conjunction with vestibular rehabilitation. [35]
Andersson et al., (2018)	n = 29	Computerized posturography, the Visual Analogue Scale, and the Dizziness Handicap Inventory	Cawthorne Cooksey work out versus Cognitive Behavioral treatment	Dizziness can be effectively treated with Cawthorne Cooksey work out and cognitive behavioural treatment.[36]

DISCUSSION

Following an assessment of the studies using the PEDro scale, only two studies demonstrated good scientific evidence. This can reduce the strength of the evidence in the study because of several issues, such as the lack of hidden randomization, masking the subject, assessors and therapists, and limiting outcome measures. The central vestibular receptor, proprioceptive, cerebellar, and visual pathways are just a few of the brain systems that age-related degeneration of affects.

BPPV is one of the oto-neurological diseases in the geriatric population that has the greatest prevalence and can cause changes in body balance that directly impact the quality of life of the persons involved. The Dizziness Handicap Inventory (DHI) was the most often utilized tool to assess how dizziness affected a patient with vestibular dysfunction's quality of life out of all the items studied.

The literature confirmed that the most widely used VR Protocol is that of Cawthorne and Cooksey, which was employed in eight of the selected studies. Its use is widespread because it is appropriate for use with older patients and contains simple exercises that improve the patient's motivation and interest—two essential components of high-quality care. Results of these clinical trials showed that VR is beneficial for older adults in terms of gait, body balance control, and activities of daily living. It is estimated that in 20% of the elderly patients the vestibular dysfunction is due to vascular problems. The main circulatory disorders that can cause impairment of the peripheral or central auditory and vestibular systems are hyper- or hypotension, heart failure, myocardial infarction, arrhythmia, hypersensitivity of the carotid sinus reflex, aortic stenosis, and atherosclerosis [37].

This systematic review summarizes the evidence on the effects of VR for balance disorders and on the assessment tools that can contribute to support the clinical actions of health professionals working in this area. The studies presented here support the use of simple and costless protocols for the management of vestibular disorders in the geriatric population. However, further high-quality studies are still needed to clarify some doubts regarding the effects of VR for certain diseases, the optimal treatment duration necessary to avoid recurrence of symptoms, and the comparison with protocols of multi-components of postural control.

CONCLUSION AND RECOMMENDATION

Vestibular rehabilitation (Cawthorne Cooksey exercises) has shown efficacy in the treatment of geriatric patients who suffer from vestibular and non-vestibular disorders. According to the findings of this comprehensive study, conventional and inexpensive forms of therapy can help geriatric patients live better lives, be more functional, and experience fewer falls. However highly Pedro scored RCTs are needed to support the effectiveness of VR in the geriatric population. Nevertheless, pre-intervention assessment of the patients by medical examination is recommended for future studies in order to achieve more accurate results. However, as the focus of this study was on the influence of exercises on balance, there was no possibility of assessing fatigue, which may affect balance. Fatigue measurements could draw firm conclusions at this point.

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