Narrative review

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Physical activity to prevent older adult falls: an Aotearoa New Zealand approach

Atividade física para prevenir quedas em idosos: uma abordagem da Aotearoa Nova Zelândia

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ABSTRACT

Physical activity and exercise decreases falls by improving gait, balance, and strength. All types of exercise, particularly balance and functional exercises reduce the rate of falls by approximately 24%, although walking practice alone does not reduce falls rate. New Zealand has developed three effective, empowering and sustainable falls-prevention exercise classes for older adults. The world-renowned, home-based Otago Exercise Programme, the peer-led community-based Steady As You Go© and Aligned to Go, and Taurite Tū indigenous exercise program. The majority of the exercises are conducted while standing and progress to where the participant stands with feet close together, on one leg, minimises hands assisting with balance, and practice controlled movements of the body's centre of mass and body awareness. Peer-led classes such as Steady As You Go©, Aligned to Go and Taurite Tū have demonstrated their ability to attract participants to engage long term through strong social connections and culturally appropriate exercises that enable older adults to maintain their balance, strength and reduce their falls risk.

Keywords: Exercise; Falls prevention; Strength; Balance.

RESUMO

A atividade física e o exercício diminuem a incidência de quedas ao melhorar a marcha, o equilíbrio e a força. Todos os tipos de exercício, especialmente os exercícios funcionais e de equilíbrio, reduzem a taxa de quedas em aproximadamente 24%, a prática de caminhada isoladamente não reduz a incidência de quedas. A Nova Zelândia desenvolveu três programas de exercícios que têm se mostrado eficazes, estimuladores e sustentáveis para prevenção de quedas em pessoas idosas. O mundialmente renomado Programa de Exercícios Otago, realizado em casa, o Steady As You Go©, liderado por pares e baseado na comunidade, e o programa de exercícios indígenas Taurite Tū são exemplos desses programas. A maioria dos exercícios é realizada em pé e progride para que o participante fique com os pés juntos, em um pé só, minimizando o uso das mãos para ajudar no equilíbrio, e pratique movimentos controlados do centro de massa do corpo e da percepção corporal. As aulas lideradas por pares, como as dos programas Steady As You Go© e o Taurite Tū, demonstraram sua capacidade de atrair participantes para um envolvimento de longo prazo por meio de fortes conexões sociais e exercícios culturalmente apropriados, que permitem às pessoas idosas manter o equilíbrio, a força e reduzir o risco de quedas.

Palavras-chave: *Exercício; Prevenção de quedas; Força; Equilíbrio.*

Introductions

A fall has been defined as an event that occurs unintentionally that results in an individual falling onto the ground or towards a lower level[1]. Falls are a serious concern for older adults[1], with falls being one of the leading causes of accidental or unintentional injury or death for older adults[2]. Previous literature has shown that more than one third of individuals aged over 65 have experienced at least one fall in the past year[3]. Additionally, the risk of experiencing a fall can double or triple if there is a cognitive impairment or a prior history of having a fall[3].

Ageing is a natural process and occurs throughout the lifespan but rapidly increases from the age of 60 years[4]. Ageing-related physiological changes occur in all organ systems with harmless, inevitable and in certain situa-

tions, non-modifiable changes, such as decreased maximal heart rate, decline in cellular processes and a decline in respiratory strength[4]. However, there are modifiable factors that can be maintained or increased during the ageing process such as muscle mass, balance and agility[5]. There is substantial evidence that shows that training modifiable factors in older adults can reduce falls risk[6].

Physical activity and exercise decrease the incidence of falls in older adults by improving gait, coordination, balance, and strength[7,8]. A recent systematic review and meta-analysis by Sherrington et al.[8], reported that, compared to a control group, all types of exercise reduced the rate of falls by at least 23% (RaR = 0.77, 95% CI: 0.71 - 0.83; 14,306 participants, 64 studies, high-certainty evidence). The falls rate was reduced by 24% through balance and functional exercises (RaR = 0.76, 95% CI: 0.70 - 0.82; 7989 participants, 39 studies, high-certainty evidence), 23% through Tai Chi (RaR = 0.77, 95% CI: 0.61 - 0.97; 3169 participants, 9 studies, moderate-certainty evidence) and 28% through balance and functional exercises plus resistance exercises (RaR = 0.72, 95% CI: 0.56 - 0.93; 2283 participants, 15 studies; moderate-certainty evidence)[8]. However, uncertainty existed as to whether dance exercises and walking programmes alone had the ability to reduce the rate of falls[8]; Given that dance incorporates components of strength, balance an endurance, the uncertainty around dance exercises was an interesting finding. In the subgroup analysis by Sherrington et al.[8], there was no evidence of a difference in the effect on falls for participants with a higher baseline falls risk, being older (75 years or older versus 60–74 years), group exercise versus individual exercise, or interventions delivered by health professionals versus trained exercise leader[8].

Paradoxically, most falls occur when walking or being physically active due to more time spent in an upright position, subsequent imbalances in weight shifting, and increased exposure to extrinsic fall risk factors[9-11]. Therefore, falls risk exhibits a U-shaped association with a greater fall risk among inactive older adults and highly active older adults[12,13]. Despite an increased risk of falls with higher physical activity, the latest international consensus on exercise for older adults still recommends implementing a multicomponent exercise programme that targets two or more components of progressively increasing balance, strength, or endurance, with improving balance an gait as key factors to reducing falls risk older adults[14]. Equally important is an exercise programme that is convenient, available, low cost and can be sustained over a longer-term with large-scale implementation potential[15].

One programme that is convenient, available and sustainable, is the Otago Exercise Programme (OEP). The OEP programme was developed in the University of Otago in New Zealand in the late 1990s, by A John Campbell and Clare Robertson, and is one of the most widespread multicomponent falls prevention exercise programmes for older people in the world[16-18]. It was originally designed as a home-based physiotherapy-led programme comprising 17 exercises (5 strength and 12 balance) that require minimal equipment (e.g. chair, and ankle weights)[19,20]. It is recommended as an exercise programme for community-dwelling older adults 80+ years of age who can exercise safely at home, on their own. There have been multiple adaptations to the OEP over the years[21] (see here: https://www.livestronger.org.nz/assets/Uploads/acc1162-otago-exercise-manual.pdf). The frequency and duration of the OEP has been tested and reported, using different modified versions of the OEP. Although the initial efficacy trials utilized 4 or 5 home visits per week[18], other systematic reviews show effectiveness of modified versions ranging from 2 to 5 times per week, depending on the desired outcome variable[21-23]. Furthermore, over the past two decades, the New Zealand approach to falls prevention has steadily moved away from a deficit model to an empowering approach, which has led to the development of Steady As You Go© and Aligned to Go, both community-based peer-led falls-prevention models, as well as Taurite Tū, a Kaupapa Māori indigenous falls-prevention approach. The history and description of these models are described below (Figure 1).

Steady As You Go©

In 2002, the New Zealand Ministry of Health agreed to fund the delivery of a ten-week programme including strength and balance classes. All exercise classes are on a compact disk, which was created by Age Concern Otago and distributed to all groups. The initial ten weeks are supervised classes and exercise instructors were employed to instruct the classes with the programme managed by the Executive Officer of Age Concern Otago. With funding from both the Ministry of Health and ACC, a permanent Steady As You Go© coordinator was employed and additional class instructors were hired. The coordinator was responsible for the collection and collation of physical test data (Timed Up and Go[24], Functional Reach[25], Sit to Stand[26]) that was

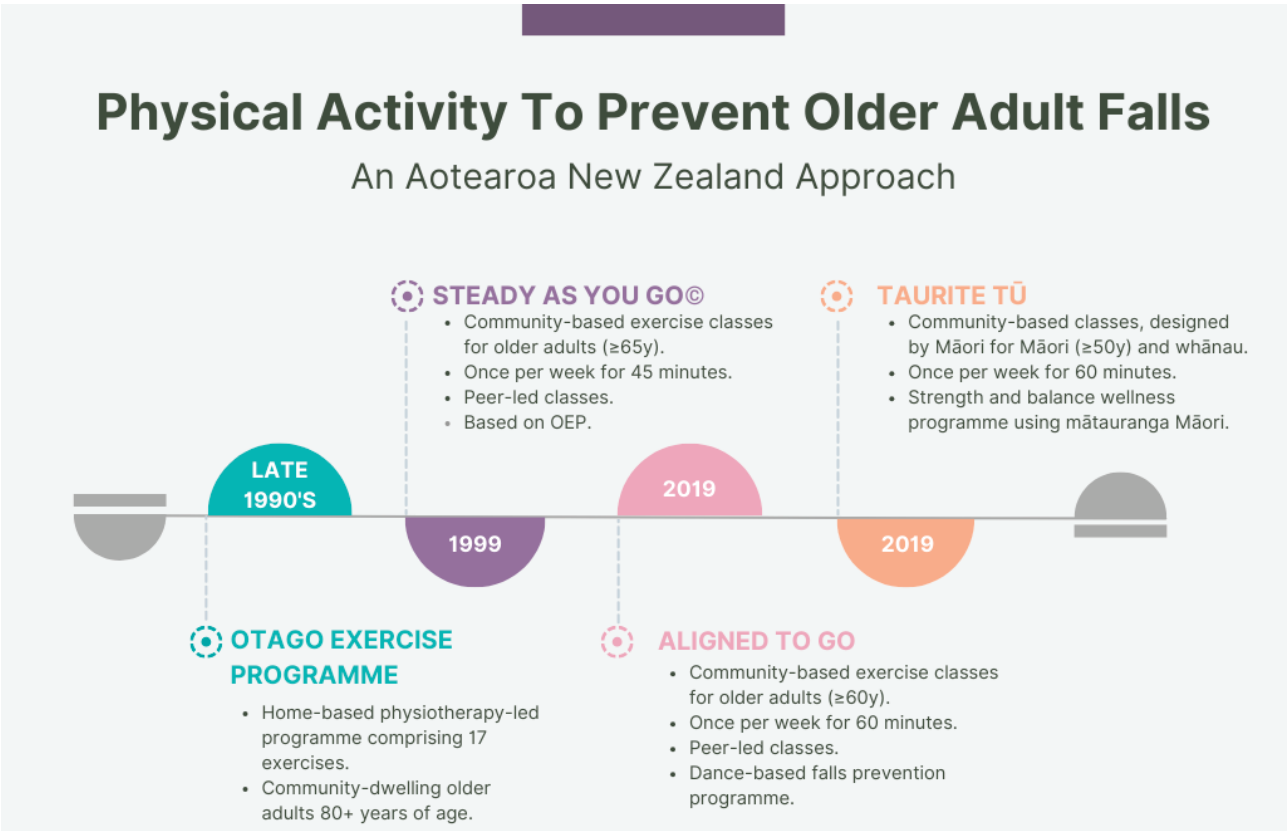

Figure 1 – Timeline of falls prevention programmes in Aotearoa New Zealand

reported to the funders. Over the years, unpublished data showed improved functionality and increases in strength and balance for most participants, but this was not independently researched or evaluated until 2009[27].

The Steady As You Go© classes include 45 minutes of exercise, in keeping with evidence reported in a systematic review that a session with a duration of over 30 minutes, was superior to a shorter session (1–30 minutes per session) to improve balance ($p = 0.002$ vs. $p = 0.13$, respectively), muscle strength ($p = 0.003$ vs. $p = 0.56$, respectively) and mobility ($p<0.001$ vs. $p = 0.28$, respectively)[28]. This evidence agrees with previous reports that 31–45 minutes per exercise session is the most effective in improving overall balance performance[29,30]. The Steady As You Go© has a duration of ten weeks; a duration found by Waters et al's evaluation of the programme to significantly improve leg strength. Following 10 weeks, leg strength was reported to plateau and be maintained for over the subsequent 12 months of the intervention[27]. A systematic review by Wu also reported that 4–12 weeks was more effective than 13–26 weeks for improving lower muscle strength[28]. Longer duration programmes, however have been found to improve balance and mobility. Wu's systematic review reported that a programme length of 13–26 weeks led to significant improvement in both balance and mobility[30] and a meta-analysis of home-based training over 16 weeks significantly improved balance[31]. Wurzer et al.[32,33] also reported better strength and balance and lower falls incidence in those Steady As You Go© participants who attended class for 3 or more years with 70% attendance.

After the initial ten weeks supervisor-led Steady As You Go© classes, the classes transition to peer-led classes. This is a unique, and possibly the most successful; aspect of the Steady As You Go© programme. In 2003, ACC began funding a "Train the Trainer" course at the University of Otago's School of Physiotherapy to train both paid instructors and volunteers from within individual existing classes. Training allowed participants that had completed the 10-week professionally led class, to become "Peer Leaders" for their own groups. The Peer Leaders use the compact disk to lead the exercise classes to ensure fidelity of the programme. The Age Concern Otago study coordinator visits the groups on a regular basis throughout the year, and a "refresher" workshop is held for all Peer Leaders once per year. Peer leadership proved to be very suc-

cessful, with currently over 320 Steady As You Go© groups and over 4500 people participating weekly in the classes across New Zealand. Empowering groups to run their own Steady As You Go© classes has resulted in some classes running continuously for over 20 years. In 2009, ACC funded an evaluation that demonstrated significant increases in strength and balance, reduced falls incidence, as well as the strong social connection between class members and Peer Leaders[27,34,35]. More information can be found here: https://www.ageconcern.org.nz/Public/Public/Age_Well/Exercise.aspx.

The importance of the peer-led system in creating the strong social connection outlined above, was also shown in semi-structured phone interviews with 20 Steady As You Go© participants and managers following the first COVID-19 lockdown in New Zealand[36]. The consequences of the COVID-19 pandemic and large-scale lockdowns for older adults are well known and include disproportionately negative impacts on the morbidity and mortality of older adults, as well as increased loneliness and social isolation[36]. International data has showed that specifically older adults have suffered poorer quality of life and reduced physical activity because of COVID-19[36]. Three themes were constructed from the analysis of the qualitative interviews, which included *Personal Function and Well-Being, Class Functioning and Logistics, and Future Strategies for Classes During Prospective Lockdowns*[36]. The interviews highlighted that participants used a range of strategies to stay connected with each other, including phone calls and continue to exercise at home[36]. Although most participants and Peer-Leaders reported that they maintained physical function during lockdown, some did say they had feelings of psychological distress and social isolation[36]. Most importantly, classes resumed post-lockdown with only minor modifications and slightly decreased attendance[36].

Aligned to Go

Although middle age is not typically associated with geriatric syndromes, the processes occurring during midlife and early older age, are antecedents to successful ageing. The two strongest predictors of a future fall are a past fall, and abnormality of gait and balance[37]. The onset of decline in balance and physical functioning are typically observed between ages 40 and 60 years[38]. Therefore, falls-prevention classes targeting younger older adults (60-75 years of age) could positively influence successful ageing and reducing falls. Since the highly successful Steady As You Go© programme was launched, a second programme was developed in late 2019 by Matthew Onarheim-Smith, the 2018 University of Otago Caroline Plummer Fellow in Community Dance, and Margaret Dando QSM, Age Concern Otago Falls Prevention Coordinator. Aligned to Go is a dance-based falls prevention programme that follows the same successful peer-led community setting as Steady As You Go©. However, Aligned to Go is quite different from the original Steady As You Go© as it is not based on the OEP, but was designed by a contemporary dancer. It is much faster paced than Steady As You Go©, and longer in duration. It requires participants to do some barefoot walking and parts of it are dance moves. Aligned to Go therefore possibly targets a different participant population, including younger older adults and less-frail older adults. Currently, there are over 10 classes around Aotearoa New Zealand, with roughly 100 participants.

An initial pilot comparative study examined the difference in participant characteristics between Steady As You Go© and Aligned to Go, and investigated the improvements in physical function between the two groups over a ten week timeframe (non-peer-led). One newly formed Steady As You Go© group (n = 12) and one newly formed Aligned to Go group (n = 11) were followed over a time period of 10 weeks. As hypothesised, baseline results showed that participants in the Aligned to Go group were younger, less frail and faster in usual gait speed, compared to the Steady As You Go© group. Aligned to Go classes therefore cater to a different population, with an opportunity to start falls-prevention classes earlier and with younger-older adults. Furthermore, similar to the highly successful Steady As You Go© programme[27], the Aligned to Go group showed statistically significant improvements in the five times sit to stand test, as well as both usual gait speed and maximum gait speed, over the initial 10-week time period ($p<0.05$). These initial results, and different style and pace of movements (dance), show that successful falls-prevention classes can target different populations, providing interesting and helpful strategies to start preventing falls earlier in the lifespan.

Taurite Tū

A more recent targeted development has been that of a Kaupapa Māori indigenous falls-prevention approach for ageing Māori, Taurite Tū, led by Katrina Pōtiki Bryant, (Waitaha, Kāti Mamoe, Kāi Tahu)[39]. Whilst falls are

a leading cause of injury for all older New Zealanders, the consequences of sustaining fall -related injuries have more major consequences for ageing Māori (indigenous people of Aotearoa New Zealand)[39]. Evidence also points to inequities of effective injury prevention and rehabilitative services being provided to older Māori. For example, the reach, accessibility and thus participation in falls prevention programmes such as Steady As You Go© has been minimal. To achieve equitable injury prevention outcomes for ageing Māori, evidence from falls prevention exercise programmes was used to design a programme embedded in te Ao Māori (Māori worldview) and focussed on uplifting overall well-being.

Ms Bryant, with the support of kaumātua (older adults) Māori, Māori physiotherapists, and Māori movement experts in mau rākau (Māori martial arts), tī rākau (Māori stick games), poi, tākaro (games) and te whare tapere (Māori performing arts), designed Taurite Tū, a strength and balance wellness programme. The programme uses mātauranga Māori (Māori knowledge based) techniques to strengthen muscle, build balance and confidence and prevent the risk of falling by focusing on posture, breathing, strengthening, stretching, coordination, body awareness and pelvic floor muscles. In developing Taurite Tū, expertise was drawn on from Māori community members in areas such as tikanga (incorporating practices and values from Māori knowledge), delivery of engaging Māori health initiatives and Māori movement practices. Meaningful approaches were developed with regards to posture, proprioception and sensory motor training, and importantly strength and balance, all impacting on reduction of falls. Additionally, Taurite Tū breathing exercises, coordination and pelvic floor exercises were also developed in an engaging way for Māori. This was thus a programme designed by Māori for Māori aged 50 plus and their whānau (family).

The Taurite Tū programme comprises weekly one hour group exercise classes, followed by one-hour shared kai (food), whakawhanaungatanga (making and maintaining relationships) and health based kōrero (conversation). Resources are provided to support the exercise programmes include equipment such as tū rākau (a standing stick), ankle weights and poi (a light ball on a string of varying length which is swung or twirled rhythmically), an accompanying descriptive soundtrack, website with videos and community engagement platforms such as weekly zoom class, community notice board and leaderboard. Each rohe (group) has a physiotherapist attached to the programme to support the individualised needs of the attending kaumātua.

A 2019 trial of Taurite Tū demonstrated statistically significant reductions in falls risks for Māori living in the Ōtākou takiwā and subsequent delivery of Taurite Tū has continued for kaumātua living in this area. Quantitative data analysis also demonstrated statistically significant improvements in leg strength, balance, and walking speed. Furthermore, and more importantly, analysis of the post-trial qualitative data collected via in-depth interviews and focus group hui (meeting) demonstrated positive participant feedback on Oranga Tinana (physical wellbeing). This included increased strength and balance, improved ability to walk and other physical gains contributing to improved active lives styles. Lastly, qualitative interviews showed that Taurite Tū provided safe cultural and physical spaces, included cultural wellbeing, provided opportunities to make connections, have fun, supported mental wellbeing and provided further insights on hauora (Māori philosophy of holistic health and wellbeing).

Taurite Tū Ltd was established as a charitable company, under the umbrella of Te Rūnanga o Ōtākou (TRŌ), to pursue the implementation of the research results widely. In March 2023, ACC and TRŌ Taurite Tū Ltd supported Taurite Tū programme to be delivered into 15 new rohe (areas) across Aotearoa to 450+ kaumātua. Furthermore, ACC and Primary Health Organisations are currently funding the delivery of Taurite Tū within a further 12 new areas throughout Aotearoa. Importantly, these programmes are delivered out of Māori organisations that have connections and relationships with the Māori communities they serve. Taurite Tū Ltd have trained 100+ kaimahi (facilitators) to support the effective delivery of Taurite Tū, helping to additionally support the capacity within these communities for activity-based solutions to ageing well. Resources, including video, slide presentations and written material, have been created to support further training of kaimahi in more areas around Aotearoa to enable wider delivery within Māori communities.

Summary and conclusion

In summary, exercise programmes to reduce falls should include progressively challenging balance training and lower body strengthening, and walking practice is also advised. Programmes such as Steady As You Go©, Aligned to Go and Taurite Tū, have the majority of the exercises conducted while standing and progress to where the participant stands with their feet closer

together or on one leg and minimise the use of their hands to assist balance. They also practice controlled movements of the body's centre of mass and body awareness by walking around and between a circle of chairs and for instance using a rakau in Taurite Tū. Although, there are reportedly larger effects of exercise on falls rate from programmes that include a higher dose of exercise[40], we have reported that the 45 minute Steady As You Go© classes once a week, but over a long duration, results in significantly improved balance and strength and reduced falls incidence[27].

It is not surprising that an exercise programme needs to be ongoing to have a lasting effect on fall rates. Peer-led classes such as Steady As You Go©, Aligned to Go and Taurite Tū have demonstrated their ability to attract participants to engage long term due to strong social connections and culturally appropriate exercises that enable older adults to maintain their balance, strength and reduce their falls risk. The social connections provide the ongoing relationships important in programmes for long-term health conditions to not only encourage continuous attendance but support to keep exercising[41]. The key point to emphasise is that whilst it is well known that exercise can reduce falls in older adults, the exercises have to be tailored to the targeted group, for example age (OEP vs Steady As You Go©) or culturally appropriately developed such as Taurite Tū. A one size fits all programme does not enable initial accessibility or facilitate long term engagement.

Conflict of interest

The authors declare no conflict of interest.

Author's contributions

Vlietstra L, Bryant KP, Hale L, Dando M, Waters DL: Conceptualization; Writing – original draft; Writing – review & editing; Approval of the final version.

Declaration regarding the use of artificial intelligence tools in the article writing process

The authors did not use artificial intelligence tools for preparation of the manuscript.

Availability of research data and other materials

The contents are already available.

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Reviewers' assessment

Reviewer A

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Comments

The first part of the manuscript presents clear information's about the importance of the topic, highlighting the relevance of the OEP for fall prevention in the elderly. One suggestion is to insert a link that directs the reader to the "instructions for the OEP," where they can view the exercises and gain a better understanding of the program's applicability.

Additionally, the description of the frequency and duration needed to perform the exercises in the OEP could be improved. While it is mentioned that there are 17 exercises, how are they distributed throughout the weeks?

In the description of "Steady as You Go," what does "longer duration session and long length of the program by offering peer-led classes" mean? Similarly, the suggestion below doesn't include a link for accessing more information about the exercises. This could be important for the practical application of the program.

Page 4, lines 7-8: Please correct the text in gray.

For Taurite Tu and Aligned to Go, the names of the responsible researchers are included. It might be a good idea to use the same format for OEP and Steady as You Go.

Page 6, line 4: For "tea o Maori," I suggest using quotation marks to indicate the expression. Another suggestion is to add one or two sentences that highlight the characteristics of the Maori people and explain why it is important to develop a different program for this population group. How can one access the exercises proposed by the program?

I suggest including in the text a description of the number of participants in each of the programs, in addition to the number of centers. I believe it can give a good dimension of the impact and reach of each of them.

Lastly, a figure summarizing each program could be useful. It could present a timeline of the evolution and differences between them, highlighting their aims and exercises.

Reviewer B

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Comments

The manuscript is a peace of work, pretty well written and of interest for professional and scientists dealing with older adults. In addition, it is potentially of interest of health policymakers. I enjoy a lot the reading and have no suggestions before its publication. Congratulations on a very nice paper.