The effects of dance on fall-related self-efficacy and quality of life, and the relationship between psychosocial and physical effects in older adults in New Zealand

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A research project submitted in partial fulfilment of the requirements for the degree of Master of Osteopathy, Unitec Institute of Technology, 2013.
Declaration

Name of candidate: Tania Russell

This Research Project entitled "The effects of dance on fall-related self-efficacy and quality of life, and the relationship between psychosocial and physical effects in older adults in New Zealand" is submitted in partial fulfilment for the requirements for the Unitec degree of Master of Osteopathy.

CANDIDATE’S DECLARATION

I confirm that:

- This Research Project represents my own work;
- Research for this work has been conducted in accordance with the Unitec Research Ethics Committee Policy and Procedures, and has fulfilled any requirements set for this project by the Unitec Research Ethics Committee.
  Research Ethics Committee Approval Numbers: 2011-1199; 2011-1248

Candidate Signature: __________________________        Date: __________________________

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**Acknowledgements**

An investigation into the physical factors associated with aging and the effects of dancing on these physical factors forms the basis of a research project undertaken concurrently by Steve Chesterfield. Results of physical outcome measures from the dancing intervention in Steve Chesterfield’s study were used to compare to the results of psychosocial outcome measures in this research project.

To Steve, thank you for your amazing organisational skills, enthusiasm, support and encouragement to just keep going (and thank you Julie for your delicious baking).

Thank you to Dance Aotearoa New Zealand (DANZ), Felicity Malloy, Terrence James and Susan Jordan for organising and delivering the Dance Mobility programme, and for creating such a positive, friendly and supportive environment for the participants and for us. Thank you also to Justin Keogh for your initial advice in getting this project started.

Thank you to the staff of Selwyn Retirement Village and Unitec New Zealand who helped set up the Folk Dancing programme, including Denise Te Tai, Rod Perkins, Janice Sanders, Catherine Bacon and Rob Moran. Thank you to Ruth Ames for being a wonderful folk dance instructor, your enthusiasm, friendliness and flexibility were much appreciated.

To my supervisors, Catherine Bacon and Rob Moran, thank you for your amazing knowledge, support and dedication and for going above and beyond what was required in order to make this project a success with as much ease as possible. Thank you also to Jamie Mannion, Elizabeth Niven and the participants of the research forum for your valuable input.

Thank you to all the wonderful dancing participants for your enthusiasm and friendliness.

To my precious family and friends, thank you for your endless patience, understanding and support. I could not have done any of this without you.
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Glossary

*Balance* – Requires postural control and “the complex integration of sensory information regarding the position of the body relative to the surroundings and the ability to generate appropriate motor responses to control body movement” (Sturnieks, St George, & Lord, 2008, p. 467). Balance involves the interaction of many physiological mechanisms, as grouped by Horak (2006) into biomechanics, cognitive processing, control of dynamics, orientation in space, sensory strategies and movement strategies. There are two types of balance or postural control: static, where the base of support remains stationary but the center of mass moves; and dynamic, where both the base of support and the center of mass move (Granacher, Bridenbaugh, Muehlbauer, Wehrle, & Kressig, 2011).

*Balance-confidence* – Closely related to fall-related self-efficacy and fear of falling. The degree of confidence a person has in performing activities of daily living (ADLs) without losing balance or becoming unsteady (Jørstad, Hauer, Becker, & Lamb, 2005).

*Cognition* – Involves comprehension and gaining knowledge, including mental processes involved in “thinking, knowing, remembering, judging, and problem-solving” (Cherry, 2013).

*Depression* – Defined by the World Health Organization (WHO) as “a common mental disorder, characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration” (WHO, 2013).

*Fall* – Defined by the Prevention of Falls Network Europe (ProFANE) working group as “an unexpected event in which the participants come to rest on the ground, floor, or lower level” (Lamb, Jorstad-Stein, Hauer, & Becker, 2005, p. 1619).

*Fall-related Self-Efficacy* – Encompasses fear of falling, self-efficacy, balance-confidence and activity limitation and defined by the ProFANE working group as “the degree of confidence a person has in performing common activities of daily living without falling” (Lamb et al., 2005, p. 1620).

*Fear of Falling* – Closely related to fall-related self-efficacy. The level of fear a person has in relation to falling (Jørstad et al., 2005).

*ProFANE* – Prevention of Falls Network Europe. A collaborative project set up to reduce “the burden of fall injury in older people through excellence in research and promotion of best practice (www.profane.eu.org)” (Lamb et al., 2005, p. 1618).
Quality of life – Also known in the context of healthcare as health-related quality of life (HRQoL), it is a broad-ranging concept measuring “a person’s perceived physical health, psychological state, personal beliefs, social relationship, and relationship to relevant features of the person’s environment” (Jahnke, Larkey, Rogers, Etnier, & Lin, 2010, p. e19).

Successful Aging – Defined as independence and living well in advanced age (Hayman et al., 2012), successful aging is associated with living a longer, better quality of life (Andrews, Clark, & Luszcz, 2002).
Introduction

There are physical and psychosocial factors that contribute to and predict falls and successful aging in older adults. Interventions which can improve these factors present an opportunity to reduce the social and economic costs associated with aging, which are forecast to escalate over the next two decades (Statistics New Zealand, 2009). The aims of this thesis were to review psychosocial factors associated with successful aging, including reduced falls risk, and current interventions thought to improve these factors, and to investigate whether dancing as an intervention in a New Zealand setting has any effect on these psychosocial factors in independently-living older adults within New Zealand. An investigation into the physical factors associated with aging and the effects of dancing as an intervention on these physical factors forms the basis of another thesis undertaken concurrently.

This thesis consists of a literature review followed by a manuscript. The literature review introduces fall risks and successful aging in older adults and specifically provides a rationale for the importance of investigating psychosocial factors in addition to physical factors. Interventions that may improve these are outlined, including a rationale for investigating dancing as one of these interventions. This is followed by an in depth review and analysis of studies already undertaken into the effects of dancing on psychosocial factors associated with falls risk and successful aging in over 65 year olds.

The manuscript that follows details a double cohort pilot study in independently living over 65 year olds in New Zealand that investigates the effects of two dance programs on two psychosocial risk factors associated with falls risk and successful aging: fall-related self-efficacy and quality of life and the relationship of these psychosocial factors to physical factors. This manuscript follows the format expected by the Archives of Gerontology and Geriatrics (Elsevier) journal, available at http://www.elsevier.com/journals/archives-of-gerontology-and-geriatrics/0167-4943/guide-for-authors.

Appendices to this thesis contain ethics letters, research questionnaires and additional full result tables with baseline and follow-up data.
Section 1: Literature Review
1. Aging Successfully
New Zealand, like many other countries, has an aging population. Statistics New Zealand (2009) project the proportion of people in the 65+ age group in New Zealand to increase from 13% in 2009 to over 20% (over 1 million people) in the late 2020s. Helping this population to age successfully could reduce the social and economic costs associated with aging.

Successful aging is defined as independence and living well in advanced age (Hayman et al., 2012) and is associated with living longer and a better quality of life (Andrews et al., 2002). There are many factors involved in successful aging, which have been investigated in overseas longitudinal studies of aging, most notably in the United States (Berkman et al., 1993) and Australia (Andrews et al., 2002), and which are currently being investigated in New Zealand (Hayman et al., 2012). Key determinants identified so far include age, socioeconomic status, social interaction, education, lifestyle (such as driving a car, smoking), physical function (such as peak expiratory flow rate, disease), physical activity, ability to perform activities of daily living without disability, cognition, perceived control, self-esteem and depression (Andrews et al., 2002; Berkman et al., 1993; Hayman et al., 2012). Identifying these factors is important to help direct health funding and support and to reduce the social and economic burdens of aging.

2. Falls
Preventing falls is a key goal in aging successfully due to the high prevalence of falls in over 65 year olds, the high morbidity, mortality and healthcare costs associated with falls and the subsequent decline in many determinant factors of successful aging following a fall. One in three adults aged over 65 years living in the community is estimated to fall at least once per year. Falls account for 90% of all hip fractures in New Zealand and result in serious injuries in 10-15% of cases (Accident Compensation Corporation, 2006; Sturnieks et al., 2008). They are the leading cause of injury related hospitalisation and death in adults aged over 65 years, accounting for between 55% (aged 65 to 69 years) and 85% (aged 80 years and over) of injury related deaths (Accident Compensation Corporation, 2005). A fall is defined as “an unexpected event in which the participants come to rest on the ground, floor, or lower level” (Lamb et al., 2005, p. 1619). The Accident Compensation Corporation (ACC) of NZ have postulated that falls can result in a decreased ability to perform activities of daily living, decreased physical activity, increased
social isolation and a fear of falling again through pain and disability, which can reduce quality of life and decrease independence and wellbeing (Accident Compensation Corporation, 2005, 2006). These factors are then thought to be risk factors for future falls, as depicted in the positive feedback cycle of falls in Figure 1. Along with these, many other non-modifiable and modifiable risk factors have been identified in order to classify those at risk of falls and to prevent future falls in this at-risk age group.

Figure 1. Positive feedback cycle of falls, adapted from Accident Compensation Corporation

3. Risk Factors for Falls
Non-modifiable risk factors for falls include vision deficit; female sex; history of a previous fall, particularly two or more falls as identified by Pluijm et al. (2006); age over 80 years; a high educational level; urinary incontinence in those over 80 years; dizziness and to some extent arthritis (American Geriatrics Society, 2001; Ersoy, MacWalter, Durmus, Altay, & Baysal, 2009; Lamb et al., 2005; Pluijm et al., 2006; Rubenstein & Josephson, 2002). Modifiable risk factors can be split into external and internal factors. External factors include living alone; being on four or more medications; use of benzodiazepines; use of an assistive device, for example canes, walkers and hip protectors; and drinking 18 or more units of alcohol per week. Internal factors are both physical and psychosocial. Physical factors include muscle weakness, gait deficit, balance deficit, weak grip strength, functional limitations, and low body weight. Psychosocial factors include fear of falling or fall-related self-efficacy, quality of life; impaired activities of
daily living, depression; and cognitive impairment (American Geriatrics Society, 2001; Ersoy et al., 2009; Lamb et al., 2005; Pluijm et al., 2006; Rubenstein & Josephson, 2002).

Although a review of fall risk factors by Rubenstein and Josephson (2002) shows that presence, compared to absence, of various physical risk factors exhibit higher relative risk and odds ratios than for psychosocial factors, is still thought that addressing psychosocial factors is key to preventing falls. Psychosocial factors such as fear of falling and activity limitation have an intricate link in the positive feedback cycle of falls, as illustrated in Figure 1 (Accident Compensation Corporation, 2006) and have been identified as important aspects to measure in fall prevention trials. ProFANE (Prevention of Falls Network Europe) is a group aimed at promoting excellence and best practice in fall prevention research (Lamb et al., 2005). Based on increasing evidence (Jørstad et al., 2005), they recommend all fall prevention trials measure fall-related self-efficacy and health-related quality of life, in addition to physical activity, number of falls and fall injury. Whilst physical factors are almost always measured in fall prevention trials, psychosocial risk factors for falls are less frequently investigated and so will form the focus of this review.

4. Psychosocial Risk Factors for Falls

Fall-related self-efficacy is defined as “the degree of confidence a person has in performing common activities of daily living without falling” (Lamb et al., 2005, p. 1620). It encompasses the concepts of fear of falling, decreased self-efficacy and activity limitation. Reliable and valid measures include the Falls Efficacy Scale, Activities-specific Balance Confidence (ABC) scale and Survey of Activities and Fear of Falling in the Elderly (Jørstad et al., 2005). ProFANE recommend the modified Falls Efficacy Scale (mFES) be used in falls prevention trials for its practicality, test-retest reliability, internal consistency and specificity to frailer populations over the ABC scale (Lamb et al., 2005). The self-report questionnaire asks participants to rate how confident they are in performing 14 activities without falling. The ABC Scale, whilst not recommended by ProFANE directly, is recommended as reliable and valid by Jørstad et al. (2005) and may be more appropriate to a group of younger or more functional over 65 year olds since it has a focus on higher performance. Similar to the mFES, it is a 16-item self-report questionnaire evaluating a person’s confidence in performing everyday activities without losing
their balance, for example, standing on a chair and reaching for something, or being bumped into by people while walking through a shopping center (Parry, Steen, Galloway, Kenny, & Bond, 2001). Falls-related self-efficacy is a key risk factor for falls and needs to be measured using the appropriate tool for the population being investigated.

Quality of life, or also known in the context of healthcare as health-related quality of life (HRQoL), is a broad-ranging concept measuring “a person’s perceived physical health, psychological state, personal beliefs, social relationship, and relationship to relevant features of the person’s environment” (Jahnke et al., 2010, p. e19). An important component of quality of life is the perceived ability to perform activities of daily living. Reported impairment of activities of daily living, compared to no reported impairment, has been determined to have a risk ratio for falls of 2.3 (Rubenstein & Josephson, 2002). Quality of life has been measured through many tools such as the Sickness Impact Scale; 36-item Short Form Health Survey (SF36); 12-item Short Form Health Survey (SF12); European Quality of Life Instrument (EuroQoL EQ-5D); Late Life Function Index (LLFI); Life Satisfaction Scale (LSS) and several other measures specific to disease states (Keogh, Kilding, Pidgeon, Ashley, & Gillis, 2012; Lamb et al., 2005; Lin, Mcclear, & Tabourne, 2008). ProFANE recommends the use of the SF12 version 2 or the EuroQoL EQ-5D for their practicality, simplicity and responsiveness in older populations (Lamb et al., 2005). The SF12 evaluates health related quality of life across eight domains: bodily pain; energy/fatigue; general health; mental health; physical functioning; social functioning; role limitations due to physical health; and role limitations due to emotional problems (Haywood, Garratt, & Fitzpatrick, 2005). The SF36, which is the expanded version of the SF12, has been widely validated for use across a range of health care professions, settings and patients (Haywood et al., 2005) but may be impractical owing to the longer time to complete compared to the SF12. The EuroQoL EQ-5D has not previously been used in fall prevention trials and although it has been used widely with older adults, it may be more sensitive in frail rather than healthy populations. Quality of life is an important aspect to monitor in the elderly and is linked to key risk factors for falls, Tools to monitor health-related quality of life need to be chosen according to the specific population and the time available for measurement.
Depression is “a common mental disorder, characterized by sadness, loss of interest or pleasure, feelings of guilt or low self-worth, disturbed sleep or appetite, feelings of tiredness, and poor concentration” (WHO, 2013), and is one of the most frequent psychiatric conditions in older adults, along with the cognitive-related impairment of dementia (Brown, Raue, Halpert, & Titler, 2009). It is commonly measured in the elderly through the Geriatric Depression Scale (GDS) or Beck Depression Inventory (BDI) which are tools recommended by the American Geriatrics Society (AGS) and the American Association for Geriatric Psychiatry (AAGP) (2003) for use in those with mild to moderate impairment. The GDS has been validated for use with a wide range of older adults and is also available in a shortened form (SGDS) (Brown 2009). Other measures include the Centers for Epidemiologic Studies Depression Scale (CES-D), the Profile of Mood States Depression Subscale, the Hamilton Rating Scale for Depression (HRSD), the Depression Anxiety and Stress Scale 21 (DASS 21), the depression-dejection dimension of the Profile of Mood States (POMS), the depression subscale of the psychological Symptom Checklist-90, Revised (SCL-90R) or depression scales specific to certain chronic health conditions. ProFANE does not specifically recommend depression be measured in fall prevention trials however it has a risk ratio for falls of 2.2 (Rubenstein & Josephson, 2002), very close to the risk ratio for impaired activities of daily living. Depression is another important fall risk factor and is recommended to be measured using the GDS or BDI for detecting those with mild to moderate impairment.

Cognition involves comprehension and gaining knowledge, including mental processes involved in “thinking, knowing, remembering, judging, and problem-solving” (Cherry, 2013). Along with an increased risk of cognitive-related impairments such as dementia, older adults can experience cognitive decline in information-processing speed, reasoning and memory in particular (Chang, Nien, Tsai, & Etnier, 2010; Salthouse, 2004). Cognition is thought to have a strong dependence on social relationships with emotional support being shown to be a significant predictor of cognitive performance (Seeman, Albert, Lusignolo, & Berkman, 2001). Cognition can be measured by tasks including those testing executive function (Trail Making test, clock drawing, digit-span tests), general information processing (digit symbol tests), attention, concentration, mental tracking (digit-span tests), task improvement (choice-reaction-time tasks), semantic-fluency and memory recall of stories or addresses. The Mini-Mental State Examination (MMSE)
tests for cognitive deficits and is widely used in screening for dementia (Brown et al., 2009; Folstein, Folstein, & McHugh, 1975) but may not be sensitive enough to change from an intervention (Chang et al., 2010; Salthouse, 2004). Along with depression, cognitive impairment is not specifically recommended to be measured in fall prevention trials but has been identified has having a risk ratio for falls of 1.8 (Rubenstein & Josephson, 2002). The choice of measure depends on the type of cognition being investigated.

Improving these key psychosocial risk factors for falls through fall prevention interventions could help to reduce falls and ensure more people age successfully. As the Accident Compensation Corporation in NZ hypothesise, fall prevention may “improve older people’s quality of life by reducing pain, fear and isolation and increasing independence and wellbeing”, therefore by reducing future falls, economic, health and social burdens could be minimised (Accident Compensation Corporation, 2005, p. 12). Research into fall prevention strategies has become a focus for the New Zealand government and a wide range of fall interventions have been investigated both in New Zealand and overseas.

5. Fall Prevention Strategies

Interventions include exercise as well as medications (including vitamin D and calcium supplementation), surgery (including cataract surgery), fluid or nutritional therapy, cognitive behavioural therapy, environmental modification (including home modifications, assistive mobility devices, eyeglasses and footwear modification), social environment modifications, and education (Gillespie et al., 2009; Prevention of Falls Network Europe, 2007). Research has taken place into both the community-dwelling elderly population (Gillespie et al., 2009) and those in an institutional-setting such as a hospital or rest home (Cameron et al., 2010). Although risk of falling is greater over the age of 80 (Accident Compensation Corporation, 2005; American Geriatrics Society, 2001; Bloch, 2010), research into community-dwelling populations has been highlighted as a priority by ProFANE (Lamb et al., 2005) given the importance of preventing first falls which are common even in high-functioning community-dwelling older adults while completing normal daily activities like walking and using stairs (Muir, Berg, Chesworth, Klar, & Speechley, 2010). This review will focus on exercise interventions for community-dwelling older adults.
Exercise interventions are classified according to exercise type as gait/balance/functional training; strength/resistance training; flexibility; 3D (including tai chi, qi gong, dance and yoga); general physical activity; endurance; or other kinds of exercise (Gillespie et al., 2009; Prevention of Falls Network Europe, 2007). Interventions that have been shown to reduce falls in older adults living in the community are Tai Chi and multiple-component exercises that target two or more of strength, balance, flexibility and endurance, either as part of a supervised group or individually prescribed at home (Gillespie et al., 2009).

In New Zealand, group-based Tai Chi classes and the individually administered home-based strength and balance focused Otago Exercise Programme (OEP) are recognised by ACC as key fall prevention interventions, claiming to reduce falls by 47% and up to 35% respectively (Accident Compensation Corporation). Through ACC funding, these programs have been delivered to 30,000 people since 2007 (Campbell & Robertson, 2010), and have been associated with a concurrent change in the trajectory of ACC compensation claims for fall injuries, from a formerly increasing trend to a decreasing trend since the 2006-2007 financial year (Campbell & Robertson, 2010). In order to optimise ACC funding, Robertson and Campbell (2008) recommended Tai Chi for over 60-year olds and OEP for over 80-year olds (or over 75-year olds with a fall in the past year). However, whilst research has shown that older adults may prefer to exercise on their own (Mills, Stewart, Sepsis, & King, 1997; Wilcox, King, Brassington, & Ahn, 1999), as is the case with OEP, some consideration might be given to balancing preference and enjoyment levels with cost-effectiveness whilst also encouraging social interaction in order to achieve a fall prevention program which is successful for the individual as well as for society. This appeared to be the case in New Zealand recently where despite its demonstrated effectiveness in preventing falls in over 80-year olds, ACC ceased funding of OEP in January 2010, citing return on investment as a driving factor, choosing instead to increase the number of modified group-based Tai Chi classes available nationally (Williams, 2009).

Worldwide, there has been significant research into the effectiveness of Tai Chi, with large trials involving both healthy individuals and those with chronic health conditions such as heart disease, diabetes, breast cancer, stroke, arthritis, musculoskeletal pain (Chang et al., 2010; Gillespie et al., 2009; Jahnke et al., 2010; Schleicher, Wedam, & Wu, 2012; Wang et al., 2010). Tai Chi has
been shown to reduce fall rates (RaR 0.63, 95%CI 0.52 to 0.78) and risk of falling (RR 0.65, 95%CI 0.51 to 0.82) in community-dwelling older adults in a Cochrane review by Gillespie et al. (2009) into exercise interventions for falls prevention in community-dwelling older adults. This review, as well as four other Tai Chi-specific reviews (Chang et al., 2010; Jahnke et al., 2010; Schleicher et al., 2012; Wang et al., 2010), has also found that Tai Chi improves key psychosocial risk factors associated with aging.

In the Cochrane review by Gillespie et al. (2009), two out of five studies showed fall-related self-efficacy (fear of falling) was improved in adults with a mean age between 76 and 79 compared to stretching and balance exercise control groups but not in a trial of “transitionally frail” older adults with a mean age of 81. The two successful trials involved sessions twice per week for 6 months and three times per week for 15 weeks. Furthermore, the recent review by Schleicher, Wedam and Wu (2012) into the effects of Tai Chi on fall prevention and balance control in the elderly found that fall-related self-efficacy was measured in only 5 out of 24 studies but that all showed significant improvement except for the one that had a very high baseline Activities-specific Balance Confidence score. Three successful trials involved transitionally frail or those prone to falls compared to a control group but even the fourth trial of healthy over 65 years olds showed improvement (although not compared to a control group). Trials were of significant duration or frequency, commonly taking place over 12 weeks 2-3 times per week. However one trial was 48 weeks long twice per week and one was 8 weeks long though involved 7 sessions per week.

Quality of life was measured in only two out of the five Tai Chi studies reviewed by Gillespie et al. (2009). The only trial to measure quality of life through a standardised tool (Sickness Impact Profile) showed no benefit in “transitionally frail” older adults but one trial did measure the participant’s perceived ability to do all that they would like to do, termed “intrusiveness” which approached significance (Wolf et al., 1996). However, Jahnke et al. (2010) also reviewed quality of life outcomes in 77 studies of Tai Chi as well as Qigong across all age groups. Out of the 33 Tai Chi intervention studies involving over 65 year olds, 10 reported on quality of life and 9 of those showed improvements in at least one measure of quality of life compared to controls. The one study which did not show improvement was with healthy older females and the explanation
for the lack of response was unexplained. The duration of these 9 trials was significant, all involving 40-60 minute sessions 2-3 times per week over 12-48 weeks.

The Cochrane review (Gillespie et al., 2009) did not find Tai Chi to have any impact on depression in the two (out of five Tai Chi studies) which measured it, in over 60 year olds and in “transitionally frail” older adults. Depression was only measured in 4 out of 33 studies of over 65 year olds reviewed by Jahnke et al. (2010). Three of these studies showed improvement but only in participants with a history of depression or chronic illnesses and only with studies involving 2 to 3 sessions per week over a course of 12 to 16 weeks. In fact a significant decline was shown in the one study with healthy individuals. In the systematic review and meta-analysis by Wang et al. (2010) depression was reported in an additional 5 studies (not already reviewed by Jahnke et al. (2010)) involving adults over 65 years of age. Of these 5 studies, 3 showed positive changes in depression however only one study involved healthy participants and took place twice per week over 24 weeks. One other study involved participants with rheumatoid arthritis and another was an observational study of 1 year duration rather than a randomized controlled trial.

In a review into the effects of Tai Chi on cognition by Chang et al. (2010), three out of six studies showed positive effects, in particular on measures of cognitive executive function. These studies were all recently published (since 2009) suggesting an emerging area of research interest. Of the three studies showing no effect, one study measured task improvement through choice reaction-time tasks, and two studies used the MMSE which has been suggested as not sensitive enough to change in intervention studies. One of these studies also combined other exercises with the Tai Chi intervention.

Overall, whilst Tai Chi has been shown to have many health benefits for over 65 year olds, there has been less investigation into the effects on psychosocial functioning compared to physical functioning in this age group. Quality of life is most well researched but there is less research into fall-related self-efficacy, depression and cognition, although cognition has received more attention recently. Tai Chi has been found to improve aspects of quality of life, fall-related self-efficacy (with clearer and greater effects in those already at risk of falling or with low baseline
scores), depression (but only likely in symptomatic individuals) and cognition (but with less effect in those aged over 80 years). In addition, the large majority of studies which showed psychosocial benefits involved sessions taking place 2 to 3 times per week over a period of between 12 and 48 weeks.

Tai Chi appears to improve the key psychosocial risk factors associated with aging but seems to require a significant frequency and duration to have an effect in older 65 year olds. Further research into the effects of Tai Chi with less frequent sessions and more frequent monitoring over the intervention period would be useful in determining the dose-response relationship of Tai Chi. In addition, although adherence rates can be high and acceptability strong amongst study participants, there has been limited investigation into individual’s perceptions and exercise preferences compared to other forms of exercise or recreation, particularly in New Zealand. Tai Chi may be culturally acceptable in China but there is no evidence as to its acceptability in over 65 year olds in New Zealand. There have been qualitative studies evaluating individual’s attitudes towards and perceptions of Tai Chi including those in China (Qiao, 2012), Norway (Uhlig, Fongen, Steen, Christie, & Ødegaard, 2010) and the United States (Beaudreau, 2006) but only amongst study participants and not amongst the general population. There is a need to evaluate the acceptability of Tai Chi amongst a general population in New Zealand, unrelated to a Tai Chi intervention study, and also to consider alternative forms of exercise to improve successful aging.

In a study evaluating the socio-environmental exercise preferences of older adults (Cohen-Mansfield, Marx, Biddison, & Guralnik, 2004), exercise preferences were found to vary amongst subgroups of elderly populations and type of exercise was ranked as important by 52.5% of participants and very important by 27.8%. This suggests no one exercise type is going to be suitable, acceptable or most effective for all older adults. Campbell and Robertson (2010) conclude that programs need to have “broad coverage, good uptake and adherence” (p. 729) and Young, Weeks, and Beck (2007) highlight that to “optimize long-term voluntary participation, exercises must be simple to perform, low cost, safe and appealing” (p. 1379). Despite Tai Chi’s proven effectiveness in improving psychosocial factors associated with successful aging,
alternative exercise types warrant investigation to cater for different exercise preferences amongst older adults in order to reach the widest population possible.

6. Dancing for Fall Prevention and Successful Aging

Dance may be one such alternative to Tai Chi as an exercise intervention to prevent falls. Dance may be a more familiar concept to the current aging population since it was more a part of the fabric of life in the early and mid-20th century than it is today (Judge, 2003). It is classified as a “3D” exercise, along with Tai Chi, since it involves “constant movement in a controlled, fluid, repetitive way through all 3 spatial planes” (Prevention of Falls Network Europe, 2007, p. 21), but may appeal to a different subgroup of the older population than Tai Chi. Dance “implies body movements, steps, expression, and interaction, which positively affect both physical function and psychological well-being” and “may be a particularly enjoyable activity, which can enhance motivation” (Holmerová et al., 2010, p. 108). Keogh, Kilding, Pidgeon, Ashley and Gillis (2009) also suggest that dancing would be beneficial for improving physical balance and reducing the risk of falls since many forms of dance:

1. Are similar to Tai Chi and Tae Kwon Do in that they are generally performed in an upright posture and require substantial periods of unilateral stance and the transfer of the line of gravity (vertical line through the body’s center of mass) outside the base of support
2. Can involve moderate to moderately high ground-reaction forces and joint torques
3. “Can result in relatively high heart rates (68–90% of age-predicted maximum heart rate), levels of oxygen consumption (42–90% of VO2max), or ratings of perceived exertion”.

(Keogh et al., 2009, p. 481)

In a review by Gillespie (2009), dance has been shown to reduce the rate of falls by 23% in one study (Shigematsu et al., 2008). Two other studies which were classified as dance interventions in this review and which measured fall rates cannot be additionally useful in determining the effects of dance on fall risk since they were actually multi-component exercises involving activities such as jumping, walking, flexibility exercises and strengthening exercises, in which dancing was only a minor aspect (Korpelainen, 2006; Lord et al., 2003). One recent study
(Keogh et al., 2012) measured number of falls however the duration and sample size was not sufficient to calculate fall rates.

Dance may be an alternative exercise intervention to Tai Chi which may be applicable and enjoyable for over 65 year olds and requires further investigation in order to determine whether it can improve the modifiable risk factors related to falls risk and successful aging.

7. Psychosocial Effects of Dancing – Literature Review Methods

A successful dancing intervention for older adults would address both physical and psychosocial factors related to falls risk and successful aging. A literature review was carried out in order to evaluate what dancing studies had already been undertaken, with a focus on psychosocial factors and enjoyment outcomes in community-dwelling adults over 65 years. A review of physical factors will be reported elsewhere.

Initially, original studies were sought from reviews of exercise or dancing interventions in older adults. A review of the physical benefits of dancing for older adults by Keogh et al. (2009) included 18 studies involving adults over 60 years where the dance intervention was either longer than eight weeks or included an age-matched comparison group, where the study reported physical outcome measures and where the study was published in a peer-reviewed journal. Studies were selected for inclusion in this literature review from the review by Keogh et al. (2009) if they were published in English, if they included older adults over 65 years and if they reported on at least one of the four key psychosocial outcomes related to falls risk and successful aging or on enjoyment. The four key psychosocial outcomes searched for were: fall-related self-efficacy; quality of life; depression and cognition.

Following this, a search for original articles in the following electronic databases was conducted using the EBSCOhost search engine: AMED – The Allied and Complementary Medicine Database; CINAHL; Medline; SPORTDiscus. Studies which were published up until January 2012 were included. The following keywords were used in title searches, grouped into two headings:
1. Older Adults – Older, Aged, Aging, Elder*, Geriatric*
   AND
2. Dance – Danc*

To be included, studies needed to have been published in peer-reviewed journals and include dance as the primary intervention. Studies were included if they were of eight weeks duration or longer and involved participants who were living independently in the community or in a residential village. Studies involving participants diagnosed with specific conditions were excluded such as Parkinson’s disease, obesity; diabetes or osteoporosis however conditions related directly to the four psychosocial outcomes being investigated were included such as depression and dementia. Studies with or without a control group, covering all types of dance such as traditional, contemporary, mobility and aerobic dance were included. Only studies published in English, those involving adults over 65 years old (as opposed to the 60 years criterion employed in the previous review) and those assessing at least one key psychosocial outcome or enjoyment outcome were selected. The reference sections of relevant studies were also hand searched for further studies.

8. Psychosocial Effects of Dancing – Literature Review Results
In total, 12 dancing intervention studies were found. One (Shigematsu et al., 2008) out of three studies was sourced from the Cochrane review into exercise interventions for preventing falls in older adults (Gillespie et al., 2009). The other two studies identified as dance in this review were effectively general exercise programs with dance as only a minor component so were excluded. Of the 18 studies reviewed by Keogh et al. (2009), six were selected for inclusion: Eyigor, Karapolat, Durmaz, Ibisoglu and Cakir (2009); Engels, Drouin, Zhu and Kazmierski (1998); McKinley et al. (2008); Verghese (2006); and Hackney, Kantorovich and Earhart (2007). An additional 5 studies were found through the electronic database search and from hand searching reference sections: Alpert et al. (2009); Haboush, Floyd, Caron, LaSota, and Alvarez (2006); Hui, Chui and Woo (2009); Keogh, Kilding, Pidgeon, Ashley and Gillis (2012); and Lin, McClear and Tabourne (2008).
Of the 12 studies found, 5 reported quality of life, 3 measured fall-related self-efficacy, 6 measured depression and 4 included cognition. Enjoyment was evaluated in 4 studies, either through a Likert scale measure or through qualitative or descriptive feedback. Only 4 of these studies (Eyigor et al., 2009; Hackney et al., 2007; Hui et al., 2009; McKinley et al., 2008) reported robust psychosocial outcome measures for fall prevention trials. These were measures which were either recommended by the ProFANE working group, or were shown to have validity and reliability in measuring the two psychosocial outcomes recommended by the ProFANE group: quality of life (Haywood et al., 2005); and the psychological consequences of falling (Jørstad et al., 2005). Furthermore, no study measured both quality of life and the psychological consequences of falling (such as fall-related self-efficacy).

There was a wide variety of dance styles investigated including: modified jazz; aerobic dance-based exercise; Turkish folkloric dance-based exercise; Ballroom dance; Argentine tango; contemporary dance; therapeutic dance; square-stepping exercise and social dance. The most investigated styles were aerobic dance-based exercise (3 studies) and Argentine tango (2 studies). The frequency of dancing varied between the studies, ranging from once per week to three times per week. Most dancing sessions lasted around 60 minutes except McKinley et al. (2008) which was two hours per week, Keogh et al. (2012) which ranged from 25 to 50 minutes and Alpert et al. (2009) which was unreported.

Most studies (n=10) involved those living independently in the community, one study involved those living independently in a residential village and one study involved healthy adults attending a rehabilitation unit. Within the over 65 year old age group, there was wide range of ages covered. Excluding the one study (Hackney et al., 2007) which did not report mean age (but participants were “at least 55 years of age” (p. 729)), 6 studies reported on a younger subgroup with an average age between 65 and 74, 3 reported on participants aged between 75 and 79 and the remaining 2 involved older participants aged between 80 and 83. An older age group of adults has the potential to be less well functioning and therefore may theoretically either show lesser effect because of less functional ability or greater effect because of further scope for change in outcome measure results, than a younger cohort. Of the studies on younger age
groups, 3 out of 6 showed positive improvements in psychosocial measures (Eyigor et al., 2009; Hui et al., 2009; Shigematsu et al., 2008).

Most studies took place in the United States (6), followed by Japan (2), with one study each from Canada, Hong Kong, Turkey and New Zealand. One study was retrospective (Verghese, 2006) comparing social dancers to non-dancers and all other studies except for one (Alpert et al., 2009) included a control group. Sample sizes used in the studies appeared powerful enough to detect changes. Assuming a statistical power of 80%, even the smaller sample sizes of n = 13 (Alpert et al., 2009) and n = 15 (Lin et al., 2008) would have been sufficient to detect effect sizes in the order of 0.8. The majority of studies, with sample sizes between n = 25 to n = 111 were sufficient to detect moderate effect sizes between 0.3 and 0.6. The characteristics of studies are detailed further in Table 1.

Overall the studies seemed to be well reported, with adequate descriptions of interventions, participants, inclusion/exclusion criteria and results however effect sizes were not reported in the majority of studies. Shigematsu et al. (2008) and Lin et al. (2008) reported confidence intervals but not Cohen’s standardised differences (d). Keogh et al. (2012) described effect sizes for some results but did not report the values. Effect sizes have been calculated in Table 1 from reported means and standard deviations or estimated from figures where possible in order to compare effects between studies. Effect size calculations are based on the formula for Cohen’s d = (post-mean – pre-mean)/average(standard deviations). Hopkins effect size descriptors will be used in this review (Hopkins, 2011).
Table 1. Characteristics of dancing studies involving adults over 65 years that have reported key psychosocial outcome measures related to fall risk or successful aging

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Location, Journal</th>
<th>Participants (No, Description, Age)</th>
<th>Intervention Type</th>
<th>Intervention Duration</th>
<th>Control Group</th>
<th>Outcome Measures (Effect)</th>
<th>Effect Size **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpert et al. (2009)</td>
<td>USA, Journal of the American Academy of Nurse Practitioners</td>
<td>13, Healthy, community-dwelling, mean 68 years</td>
<td>Modified jazz dance: “choreographed traditional ballet movements” (p. 109)</td>
<td>15 wks (session time not reported x 1 d/wk)</td>
<td>No control</td>
<td>Depression: GDS (N) Cognition: MMSE (N)</td>
<td>GDS: -0.05 MMSE: 0.07</td>
</tr>
<tr>
<td>Engels et al. (1998)</td>
<td>USA, Gerontology</td>
<td>34, Healthy, community-dwelling, mean 69 years</td>
<td>Low impact aerobic dance: moderate-intensity, interventions with and without wrist weights</td>
<td>10 wks (60 min x 3 d/wk)</td>
<td>No dance</td>
<td>Depression: Depression-dejection dimension in Profile of Mood States inventory (N) WW: 0.00 NW: -0.90 NE: -0.22</td>
<td></td>
</tr>
<tr>
<td>Eyigor et al. (2009)</td>
<td>Turkey, Archives Of Gerontology And Geriatrics</td>
<td>37, Rehabilitation unit, healthy adult elderly, mean 72 years</td>
<td>Turkish folkloric dance-based exercise</td>
<td>8 wks (60 min x 3 d/wk plus walking 30 min x 2 d/wk)</td>
<td>Usual physical activity</td>
<td>Depression: GDS (N) QoL: SF-36 (Y* physical functioning; general health; mental health)</td>
<td>GDS: ¥ SF-36: Physical functioning: 0.62 Role—physical: 0.27 Pain: 0.44 General health: 0.63 Vitality: 0.36 Social functioning: 0.40 Role—emotional: 0.41 Mental health: 0.54</td>
</tr>
<tr>
<td>Haboush et al.(2006)</td>
<td>USA, The Arts in Psychotherapy</td>
<td>20, Depressed elderly, mean 69 years</td>
<td>Ballroom dance</td>
<td>8 wks (60 min x 1 d/wk)</td>
<td>Usual physical activity (wait list)</td>
<td>Depression: GDS (N); HRSD (N); SCL-90R ¥ for subscales Enjoyment: 2 open-ended questions: “What was the most helpful part of the program?” and “How could the treatment be improved?”</td>
<td>GDS: -0.69 (0.47 Control) HSRD: -1.05 (0.50 Control) SCL-90R: ¥ for subscales</td>
</tr>
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<tr>
<td>Hackney et al. (2007)</td>
<td>USA, American Journal of Dance Therapy</td>
<td>38, Healthy, community-dwelling and those with Parkinson’s Disease, ≥ 55</td>
<td>Argentine Tango: traditional exercise using imagination.</td>
<td>13 wks (60 min, 20 sessions)</td>
<td>Healthy group traditional exercise (CE); Parkinson’s Disease group Tango (PT); Parkinson’s Disease group traditional exercise (PE). Note: Parkinson’s Disease groups outside scope</td>
<td>Depression: The Philadelphia Geriatric Center Morale Scale (N) Fall-related self-efficacy: FES (N - PT only) Fall-related Self Efficacy: Self-perceived balance, single item, 5 point Likert scale (N compared to exercise control) Enjoyment: Single item, 5 point Likert scale (N compared to exercise control) Enjoyment: 2 open ended questions on what they liked best and what they liked least</td>
<td>Depression: ¥ (Healthy group) FES: -0.40 (-0.50 control) ¥¥ ABC: 0.00 (0.17 control) ¥¥ Self-perceived balance: 1.53 (1.30 control) Enjoyment: -0.67 (0 control)</td>
</tr>
<tr>
<td>Hui et al. (2009)</td>
<td>Hong Kong, Archives of Gerontology &amp; Geriatrics</td>
<td>111, Community-dwelling, mean 68</td>
<td>Low impact aerobic dance: consisting of “cross steps and Cha-cha steps” (p. e46)</td>
<td>12 wks (50 min x 2 d/wk for 6 wks then 60 min x 2 d/wk for 6 wks), 23 sessions</td>
<td>Usual daily activities</td>
<td>QoL: SF-36 (Y* bodily pain; general health; emotional health (negative)) QoL: Self-perceived improvement in psychological health, single item, 5 point Likert scale (83% reported helpful or extremely helpful in improving psychological health)</td>
<td>SF-36: bodily pain: -0.09 (0.30 control) general health: 0.36 (0.02 control) emotional health: -0.18 (0.31 control) Other subscales: ¥ Self-perceived psychological health: ¥</td>
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<tr>
<td>Keogh et al. (2012)</td>
<td>NZ, European Journal of Sports and Exercise Science</td>
<td>45, Retirement village residents, mean 78</td>
<td>Modern/ contemporary dance</td>
<td>12 wks (1 group 25-50 min x 1 d/wk and 1 group 25-50 min x 2 d/wk)</td>
<td>No dance</td>
<td>QoL: LLFI (2 d/wk): Total function Y* Upper extremity Y Basic lower extremity Y* Advanced lower extremity Y LLFI (1 d/wk): Total function Y Upper extremity Y Basic lower extremity Y Advanced lower extremity Y</td>
<td>LLFI (2 d/wk): Total function: 0.76 (0.40 1 d/wk; -0.13 control) Upper extremity: 0.57 (0.44 1 d/wk; -0.09 control) Advanced lower extremity: 0.61 (0.28 1d/wk; -0.06 control)</td>
</tr>
<tr>
<td>Lin et al. (2008)</td>
<td>USA, American Journal of Recreation Therapy</td>
<td>15, Community-dwelling, attendees at a senior day care unit, mean 83</td>
<td>Therapeutic dance movement: “Dancing Heart Program”</td>
<td>12 wks (60 min plus 30 min story telling x 1 d/wk)</td>
<td>No dance</td>
<td>QoL: LSS (N) Enjoyment: qualitative results of participants perceptions from a 5-10 min guided interview</td>
<td>LSS: Y (means and confidence intervals reported but standard deviations not)</td>
</tr>
<tr>
<td>McKinley et al. (2008)</td>
<td>Canada, Journal of Aging &amp; Physical Activity</td>
<td>25, Community-dwelling, older adults at risk for falls, mean 78</td>
<td>Argentine Tango</td>
<td>10 wks (120 min x 2 d/wk)</td>
<td>Walking</td>
<td>Fall-related self-efficacy: ABC (Y group and time but significance not calculated owing to discrepancy in baseline scores)</td>
<td>ABC: 0.81 (0.10 control)</td>
</tr>
<tr>
<td>Shigematsu et al. (2002)</td>
<td>Japan, Age and Ageing</td>
<td>38, Healthy, community-dwelling, mean 79</td>
<td>Dance-based aerobic exercise</td>
<td>3 mo (60 min x 3 d/wk)</td>
<td>No dance</td>
<td>Cognition: motor processing measured through hand-reaction time and foot tapping (N)</td>
<td>Hand reaction time: -0.24 (0.14 control) Foot tapping: -0.42 (-0.12 control)</td>
</tr>
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<tr>
<td>Shigematsu et al. (2008)</td>
<td>Japan, The Journals of Gerontology</td>
<td>68, Community-dwelling, mean 69</td>
<td>Square-stepping exercise</td>
<td>12 wks (70 min x 2 d/wk)</td>
<td>Supervised walking (40 min x 1 d/wk plus instructed to increase number of daily steps)</td>
<td>Fall-related self-efficacy: Self-perceived fear of falling, single item, 3 point Likert scale (Y) Self-perceived health status, single item, 5 point Likert scale (Y*) Cognition: simple reaction time – vertical jump (Y* group but not time) Cognition: choice reaction time – stepping direction (Y* group and time) Enjoyment: pleasure during exercise, single item, 0-100 point line scale (Y)</td>
<td>Self-perceived fear of falling: 1.91 (1.91 control) Self-perceived health status: 3.93 (-0.89 control) Simple reaction time: -2.69 (2.62 control) Choice reaction time: -4.28 (1.10 control) Pleasure during exercise: 4.52 (2.73 control)</td>
</tr>
<tr>
<td>Verghese (2006)</td>
<td>USA, The American Geriatrics Society</td>
<td>108, Community-dwelling, mean 80</td>
<td>Social dancing: including ballroom, line, swing, square, unspecified</td>
<td>Retrospective</td>
<td>Non-dancers</td>
<td>Cognition: general mental status – Blessed Information Memory Concentration test; memory – Free and Cued Selective Reminding Test; executive function – Digit Span, Digit Symbol, Block Design Tests from Wechsler Adult Intelligence Scale-revised, Verbal Fluency Test, Trail Making Tests A &amp; B (N) Depression: GDS (N)</td>
<td>Blessed: 0.05 Free and cued selective reminding: 0.00 Digit span: 0.13 Digit symbol: 0.05 Block design: 0.00 Verbal fluency:0.09 Trail making test A: 0.03 Trail making test B: 0.20 GDS: 0.11</td>
</tr>
</tbody>
</table>
* Significant compared to control (p < 0.05)
** Effect size calculation where possible: Cohen’s d = (post-mean – pre-mean)/average(pre-standard deviation, post-standard deviation)
¥ Mean ± SD not reported and unable to be estimated
¥¥ Mean ± SD not reported but estimated from a figure
GDS = Geriatric Depression Scale
MMSE = Mini Mental State Examination
POMS = Profile of Mood States inventory
HRSD = Hamilton Rating Scale for Depression
SCL-90R = Symptom Checklist-90, Revised
QoL = Quality of Life
SF-36 = Model Outcome Study 36-item Short Form Health Survey
ABC = Activities-specific Balance Confidence Scale
FES = Falls Efficacy Scale
LLFI = Late Life Function Index
LSS = Life Satisfaction Scale
8.1. Quality of Life

Of the 5 studies reporting quality of life, 4 studies used reliable measures. The 36-item Short Form Health Survey (SF-36) was used in 2 studies (Eyigor et al., 2009; Hui et al., 2009), confirmed as valid and reliable by Haywood et al. (2005), one used the Late Life Function Index (LLFI), which is another tool with reliability and validity particularly with older adults (Keogh et al., 2012), and another used the Life Satisfaction Scale (LSS) which has proven reliability (Lin et al., 2008). Of these 4 studies, 3 showed significant improvement in quality of life in at least one subscale measure. The study by Lin et al. (2008) used the LSS and did not report subscales so it is difficult to determine whether some aspects of quality of life did show a change even if overall quality of life did not.

Moderate effects were shown for physical functioning, total function and basic lower extremity function. Small to moderate effects were shown for general health and small effects were shown for mental health and bodily pain. One study also showed a negative impact on emotional health although this was small (Hui et al., 2009). The 3 dance styles showing an effect on quality of life were Turkish folk dance, low impact aerobic-based dance and contemporary dance. Low impact aerobic-based dancing twice per week for 12 weeks (Hui et al., 2009) had a small effect, contemporary dancing twice per week (but not once per week) had a moderate effect (Keogh et al., 2012) and folk dancing three times per week for 8 weeks showed mostly moderate effects (Eyigor et al., 2009).

There were design limitations in 2 of the 3 studies. The folk dancing study cannot be used as reliable evidence to support dancing since the participants were also asked to walk 30 minutes twice per week as part of the intervention (Eyigor et al., 2009). The aerobic-based dancing study provides reliable evidence owing to the large sample size used (n = 111) (Hui et al., 2009) however we are unable to conclude whether it in fact showed any further effects on quality of life since only the 3 SF-36 subscales which had a significant result were reported. In addition, we are unable to compare non-significant effect sizes between the 2 studies reporting SF-36 measures to possibly identify trends over a combined larger sample.

Non-standardised single-item measures evaluating perceptions of health were used in 2 studies, either as a supplement to the standardised quality of life measure (Hui et al., 2009) or as a stand-alone quality of life measure (Shigematsu et al., 2008). Low-impact aerobic based dancing twice per week for 12 weeks was perceived by 83% of participants (n = 111) to be
helpful or extremely helpful in improving psychological health. Although this was a large study, means, standard deviations and control group results were not reported for this measure which prevents effect size calculations or comparison to the control group to support this finding.

On the other hand, a square stepping exercise twice per week for 12 weeks in another relatively large study (n = 68) was perceived to improve health status with very large effect (d = 3.93), in comparison to a moderate negative effect in the walking control group (d = -0.89). However, the walking control group in this study only walked once per week, as opposed to the intervention group which danced twice per week. Furthermore, the number of daily steps taken (as measured by a pedometer) was significantly different between the groups. In three time periods measured, the walking group took less average daily steps (with a moderate to nearly perfectly effect size) and in the final time period from 9-12 weeks they took more (with a very large effect size).

Even though these 2 studies used non-standardised measures and there was an imbalance between intervention and control group characteristics in one study, the large sample sizes in both studies and the large difference in effect size between the intervention and control group in one study provides a reliable indication that dancing improves self-perceived quality of life.

Dancing has been shown to have an effect on some aspects of quality of life and appears more likely with twice per week dancing as opposed to once per week. There are only 3 studies of low-impact aerobic-based dance (Hui et al., 2009), contemporary dance (Keogh et al., 2012) and square-stepping (Shigematsu et al., 2008) which reliably support this. Although some non-standardised single-item measures have been shown to have a positive result, standardised, widely used, reliable quality of life measures with subscales and validity in older populations provide stronger evidence and allow comparison between studies.

8.2. Fall-related Self-Efficacy
Standardised scales were used in 2 out of 3 studies measuring fall-related self-efficacy. Both of these studies investigated Argentine Tango dancing. Hackney et al. (2007) showed no significant change using the Falls Efficacy Scale (FES) or the Activities-specific Balance Confidence (ABC) scale but the baseline scores for these measures were very high. When
effect sizes were calculated, there was a small negative effect for FES both in the intervention and control groups and no effect for ABC, compared to a small positive effect in the control group. McKinley et al. (2008) showed a moderate improvement (d = 0.81) using the ABC scale, as opposed to the walking control group which showed only a trivial improvement (d = 0.10) and this effect was maintained at follow-up one month later (d = 0.93) compared to control (d = 0.11).

However, significance was not calculated in the study by McKinley et al. (2008) owing to the large difference in baseline scores between the two groups but it would still have been useful to see whether there was any significance in time effect (as opposed to group effect). Interestingly, the walking group which showed only a trivial change had a very high baseline score. In addition, the study participants were older adults already at risk for falls, with a mean age of 78 whereas the participants in the study by Hackney et al. (2007) may have been younger with participants “at least 5 5 years of age” (p. 729) although this is inconclusive since mean age was not reported in this study. The two studies had the same number of overall sessions and danced 1-2 times per week but the study by McKinley had twice the dancing time per session (120 min compared to 60 min) which may be another reason for the difference in results. It appears that standardised scales of fall-related self-efficacy may only show a change in older adults or adults who are already at risk of falling. Results may also be influenced by increased session dancing time.

One single-item of self-perceived balance improvement was measured post-intervention and one assessing fear of falling was measured pre and post intervention. The study by Hackney et al. (2007) showed that participants perceived their balance to have improved following an Argentine Tango intervention (1.22 ± 0.44) compared to those in the exercise control group (2.22 ± 1.10). A large improvement (d = 1.91) in self-perceived fear of falling occurred as a result of a square-stepping program (Shigematsu et al., 2008) but this was matched by an equally large improvement (d = 1.91) in the supervised walking control group, despite the walking control group only walking once per week, as opposed to the intervention which was twice per week. Single-item measures of perceived balance and fear of falling provide an indication of positive trend in fall-related self-efficacy but have been shown to be of limited use (Myers et al., 1996) and are not sufficient to show statistically reliable change as a result of dancing.
There is very limited evidence that dancing improves fall-related self-efficacy. Only one study of Argentine Tango (dancing twice per week for 2 hours) (McKinley et al., 2008) provided weak support for this using a standardised, reliable scale. The conflicting results with another study by Hackney et al. (2007) suggest that fall-related self-efficacy may only improve in older age groups or in adults who are already at risk of falling, and that results may be influenced by session dancing time. Further research, using standardised scales rather than single-item measures, is required.

8.3. **Depression**

All 6 studies measuring the effects of dancing on depression used standardised scales. The Geriatric Depression Scale (GDS) was used in 4 studies. One study measured depression using the GDS, the Hamilton Rating Scale for Depression (HRSD) and the depression subscale of the psychological Symptom Checklist-90, Revised (SCL-90R), one study used the Philadelphia Geriatric Center Morale Scale and one study used the depression-dejection dimension of the Profile of Mood States inventory. None of the studies found a significant effect on depression from modified jazz dance (Alpert et al., 2009), low impact aerobic dance (Engels et al., 1998), Turkish folk dance (Eyigor et al., 2009), Ballroom dancing (Haboush et al., 2006), Argentine tango (Hackney et al., 2007) or social dancing (Verghese, 2006).

When considering effect sizes, Engels et al. (1998) did show a (non-significant) moderate effect from low impact aerobic dance without the use of wrist weights (d = -0.90) compared to the no dancing control group which showed a small effect (d = -0.22). However, the second group using wrist weights showed no effect (d = 0.00) on depression. The study size may have been underpowered considering the use of three groups: wrist weights (n = 12); no-wrist weights (n = 11) and no exercise control (n = 11) and further studies with larger sample sizes may increase the chance of a significant finding, without the use of wrist weights in particular. This may suggest that low impact aerobic dance three times per week for 10 weeks may have the potential to have an effect on depression-dejection as measured by the POMS inventory if a larger sample size was used.

Haboush et al. (2006) showed larger (non-significant) effects in depression compared to the wait-list control group after ballroom dancing only once per week for 8 weeks, although this was with participants already diagnosed with depression. The sample size (n = 20) in this study may have been too small to show significant effects. There is no evidence that
modified jazz dancing or social dancing have an impact on depression owing to study design limitations. Alpert et al. (2009) showed a trivial effect size (d = -0.05) from modified jazz dancing with a small sample (n = 13) and no comparison to a control group and Verghese (2006) only showed a small difference between social dancers and non-dancers (d = 0.11). Although the sample size was large (n = 108) the study design was retrospective and measured participants who currently danced (n = 24), using a wide range of social dance styles, compared to a disproportionately large control group (n = 84) of non-dancers.

Effect sizes were unable to be calculated from two studies (Eyigor et al., 2009; Hackney et al., 2007) due to unreported means and standard deviations so it is not possible to further investigate whether there was a trend in effect sizes across studies of robust design despite the lack of significance of individual studies. However, investigating the results reported by Eyigor et al. (2009) further, it appears that 11.7% participants shifted from the “depression category” to the “borderline depression” category, although this was inconclusive when compared to the control group which appeared to decrease in “borderline depression” (by 23.1%) and increase in “no depression” and “depression” (by 15.4% and 7.7% respectively). In addition, as already noted the intervention in this study combined dancing and walking so it is not possible to attribute the effects to folk dancing alone.

A lack of statistical significance for an effect on depression could be attributed to the age of study participants since 75-79 year olds are at a higher risk for depression (Blazer, Burchett, Service, & George, 1991), as pointed out in the study by Eyigor et al. (2009) where the mean age was 72 and where 82.4% of participants did not have depression at baseline. This may also be the case in the studies by Alpert et al. (2009) and Engels et al. (1998) with mean ages of 68 and 69 respectively but may not have affected results in the study by Verghese (2006) with a mean age of 80 years. It is not possible to ascertain whether age affected results in the study by Hackney et al. (2007) since there was no mean age reported in this study and the only description of age was that participants were “at least 55 years of age” (p. 729).

Although 6 studies used standardised scales to measure the effects of dancing on depression, no significant effect was shown. Several studies were underpowered and had other study design limitations, such as a retrospective study design or no control group. Only 3 robustly designed studies with small samples reported means and standard deviations to allow effect sizes to be compared (Alpert et al., 2009; Engels et al., 1998; Haboush et al., 2006). One of
these studies weakly suggested that low impact aerobic dancing three times per week for 10 weeks may have an effect on depression-dejection as measured by the POMS inventory (Engels et al., 1998) and one suggested that ballroom dancing once per week for 8 weeks may have an effect in those already diagnosed with depression, measured by the GDS or HRSD (Haboush et al., 2006), however larger sample sizes are required to test these hypotheses. Further research with larger sample sizes and detailed reporting is required. Alternative measures more sensitive to change as a result of an intervention in an otherwise healthy population, possibly with more subscales that would measure different aspects of depression, may be useful. In addition, older age groups or those already with depression or borderline depression may be more likely to show an effect.

8.4. Cognition

Only one out of four studies that measured cognition showed a significant effect. A study of square-stepping exercise twice per week for 12 weeks (Shigematsu et al., 2008) found task improvement (as measured by simple reaction time) improved with a very large effect (d = -2.69) compared to the supervised walking control which declined with a similarly large effect (d = 2.62) and that choice reaction time improved with an extremely large effect (d = -4.28) as opposed to the control group which declined with a moderate effect (d = 1.10).

A study of dance-based aerobic exercise three times per week for three months (Shigematsu et al., 2002) did not show statistically significant changes in motor processing but did show small effects compared to control. Motor processing as measured by hand reaction time and foot tapping improved (d = -0.24 and d = -0.42 respectively) compared to the no exercise control group (d = 0.14 and d = -0.12 respectively). No other randomised controlled study measured motor processing using these tests but it would be interesting to see whether future studies show a similar effect or whether larger studies reach significance. The study by Alpert et al. (2009) may not have shown a change from modified jazz dancing due to the Mini-Mental State Examination (MMSE) being insufficiently sensitive to detect changes from an intervention (Chang et al., 2010; Salthouse, 2004) or due to the small sample size (n = 13) in this pilot study. The study by Vergheese (2006) showed trivial effects for a range of cognitive measures but this was a retrospective study rather than a randomised controlled trial so cannot be used as reliable evidence for a lack of effect on cognition.
Two out of four studies indicate that dance improves cognition but only one of these reached significance. Square-stepping twice per week for 12 weeks has been shown to have a significant effect on cognitive task improvement (Shigematsu et al., 2008) and dance-based aerobic exercise three times per week for three months may have an effect on cognitive motor processing (Shigematsu et al., 2002) but further investigation is warranted. The remaining studies cannot be used as evidence due to study design limitations such as retrospective study design and small sample size.

8.5. Relationship between Psychosocial and Physical Factors

Whilst the link between psychosocial and physical factors of fall risk and aging has been hypothesised (Accident Compensation Corporation, 2006; Lamb et al., 2005), only three studies directly compared physical outcomes with psychosocial outcomes, and only two of those studies performed statistical analyses of the relationship between these outcomes.

Lin et al. (2008) discussed the fact that participants perceived therapeutic dance to help in maintaining their physical function (through interview data) and reducing their fear of falling but there were no statistically significant changes shown in outcome measures of flexibility, agility and dynamic balance, upper body co-ordination, upper body strength, endurance and life satisfaction. McKinley et al. (2008) found no statistically significant correlation between balance-confidence, fast walk, normal walk and sit-to-stand tests following a tango dancing intervention despite these variables independently showing significant changes between baseline and post-intervention. Similarly, Alpert et al. (2009) found no statistically-confirmed correlations between a physical measure of balance (Sensory Organization Test) and psychosocial measures of depression (GDS) and cognition (MMSE). The physical measure of balance independently showed a statistically significant improvement but the psychosocial measures did not. However, as already noted, this study was underpowered (n = 13) and the measure of cognition may not have been appropriate for an intervention study. The relationship between psychosocial and physical outcomes is inferred rather than sufficiently investigated.

8.6. Enjoyment

Participants enjoyed the dance programs overall, two studies showing this quantitatively using single-item measures compared to control groups (Hackney et al., 2007; Shigematsu et al., 2008). One of these studies also combined this with two open ended questions about what the participants liked best and least about the dance program (Hackney et al., 2007) and
the other study (Lin et al., 2008) reported qualitative results from a 5-10 minute guided interview. Whilst Hackney et al. (2007) used a quantitative measure compared to an exercise control group, this measure was a yes or no answer only so the range of possible values led to insufficiently informative results. All participants answered yes to enjoying both the Argentine tango dancing and the exercise program. Shigematsu et al. (2008) showed an increased pleasure during exercise which was nearly perfectly different from baseline to follow-up ($d = 4.52$), compared to the supervised walking control group, which was still very largely different from baseline to follow-up ($d = 2.73$).

Dancing was enjoyed however there is a lack of objective measures for this, however there is evidence that a square-stepping exercise twice per week for 12 weeks results in increased pleasure during exercise.

9. Summary of Literature Review Results

There has been limited research into the psychosocial benefits of dancing in an older adult community-dwelling population. The 11 studies found in this literature review covered a wide variety of dancing styles and included only one dance study in a New Zealand setting. Of these studies, four were significantly limited due to retrospective study design (Verghese, 2006), small sample size (Alpert et al., 2009; Engels et al., 1998) and the dancing intervention being combined with walking (Eyigor et al., 2009).

Dancing has been shown to have an effect on some aspects of quality of life, supported by three studies (Hui et al., 2009; Keogh et al., 2012; Shigematsu et al., 2008) which only showed significant findings with twice weekly dancing (all three studies) as opposed to once weekly dancing (Keogh et al., 2012). There is very limited evidence that dancing improves fall-related self-efficacy, as supported by one study only (McKinley et al., 2008), and the conflicting results from two studies (Hackney et al., 2007; McKinley et al., 2008) suggests that fall-related self-efficacy may only be likely to improve in older age groups or in adults who are already at risk of falling, and that results may be influenced by session dancing time. Two robustly designed studies with small samples showed no significant effect on depression (Alpert et al., 2009; Engels et al., 1998). One of these studies (Engels et al., 1998) did show a moderate-sized non-significant improvement using the depression-dejection scale from the POMS inventory but may have been statistically underpowered to detect an important clinical
effect. Further studies with larger sample sizes are required before any reliable conclusion can be drawn. In addition, older age groups or those already with depression or borderline depression may be more likely to show an effect. One study showed a significant improvement in cognitive task improvement from dance (Shigematsu et al., 2008) and one other study showed an improvement in cognitive motor processing (Shigematsu et al., 2002) although this did not reach significance and requires further testing.

The relationship between psychosocial and physical outcomes is inferred rather than sufficiently investigated. Only two studies performed statistical analyses of the relationship between these outcomes (Alpert et al., 2009; McKinley et al., 2008) and found no correlation, although one study was statistically underpowered (Alpert et al., 2009). Dancing was shown to be enjoyable in the three studies which measured it (Hackney et al., 2007; Lin et al., 2008; Shigematsu et al., 2008) and whilst one study statistically showed increased pleasure during exercise (Shigematsu et al., 2008), there was a lack of objective measures for enjoyment.

Dance styles which showed psychosocial benefits were low-impact aerobic-based dance, contemporary dance, square-stepping and Argentine tango. Dancing frequency of at least twice per week was associated with changes although only two studies measured dancing once per week and one of these was underpowered.

Further research following the ProFANE methodology for fall prevention trials or using standardised, widely used, reliable measures with subscales and validity in older populations would provide stronger evidence and allow comparison between studies. Reporting of means and standard deviations would also allow for effect size comparison between studies. Further research into dancing interventions for over 65 year olds is required in order to conclude whether dancing has an effect on psychosocial functioning and what the relationship is with the effect on physical functioning, particularly in a New Zealand setting. Dancing could possibly reduce fall risk and improve successful aging in order to direct and reduce healthcare costs and warrants further investigation.
10. References


doi:http://dx.doi.org/10.1046/j.1532-5415.2003.51415.x


Cameron, I. D., Murray, G. R., Gillespie, L. D., Robertson, M. C., Hill Keith, D., Cumming, R. G., & Kerse, N. (2010). Interventions for preventing falls in older people in nursing


Section 2: Manuscript
1. Title
The effects of dance on fall-related self-efficacy and quality of life, and the relationship between psychosocial and physical effects in older adults in New Zealand.

2. Short Title
The effects of dance on fall-related self-efficacy and quality of life in older adults.

3. Abstract
This double cohort pilot study aimed to investigate the effects of two dancing programs on fall-related self-efficacy and quality of life, and the relationship between changes in these psychosocial measures and physical performance measures in adults over 65 years living independently in New Zealand. Eight adults participated in a dance mobility program and another ten adults in a folk dancing program, each nine-week program consisting of weekly one-hour dance classes followed by a half hour of social interaction. Participants were assessed using the modified Activities-specific Balance Confidence Scale UK, the RAND 36-Item Health Survey and three physical performance measures at baseline and nine weeks, and rated their enjoyment of the dance program at nine weeks. There was a small reduction in the role of emotional health on daily activities which approached significance (d = 0.48, p = 0.06) but there was also a moderate increase in bodily pain (d = -0.65, p = 0.02) despite high enjoyment levels for both dance programs. No other measure of health-related quality of life or fall-related self-efficacy showed significant change. There was no statistically significant relationship between psychosocial and physical outcomes, although a moderate correlation between a small increase in bodily pain and a large improvement in physical co-ordination and dynamic balance approached significance (r=0.33, p = 0.08). These findings demonstrate that dance programs for older adults may have a limited effect on quality of life and that there is a limited relationship between psychosocial and physical effects. Dancing may be beneficial and enjoyable for older adults and further investigation into this mode of exercise is warranted to contribute to measures that may reduce the escalating social and economic impacts of an aging population in New Zealand.
4. Introduction

New Zealand, like many other countries, has an aging population. Statistics New Zealand (2009) project the number of people aged over 65 in New Zealand to increase from 13% in 2009 to over 20% in the late 2020s. Successful aging, defined as independence and living well in advanced age (Hayman et al., 2012), is associated with living a longer, better quality of life (Andrews et al., 2002). Falls are common and can have serious and costly consequences. One in three over 65 year olds in New Zealand are estimated to fall at least once per year and falls are the leading cause of injury related hospitalisation and death in this age group (Accident Compensation Corporation, 2005). The cost to the Accident Compensation Corporation (ACC) for falls claims for those aged 65 years or older in 2006/07 was $82 million (Robertson & Campbell, 2008), which made up 51% of the total costs of all claims for this age group. Falls can result in social costs such as activity restriction and social isolation which can reduce quality of life (Accident Compensation Corporation, 2005). Falls reduce independence, well-being and quality of life and therefore negatively impact successful aging.

Modifiable risk factors for falls present an opportunity to implement interventions to reduce falls and improve successful aging. As well as external factors such as environment and medications, there are internal factors which are physical or psychosocial. Physical factors associated with a high risk of falling include muscle weakness, gait deficit, balance deficit, weak grip strength, functional limitations, and low body weight whilst risk factors in the psychosocial domain associated with a high risk of falling include fall-related self-efficacy (or fear of falling), impaired activities of daily living, depression; and cognitive impairment (American Geriatrics Society, 2001; Ersoy et al., 2009; Lamb et al., 2005; Pluijm et al., 2006; Rubenstein & Josephson, 2002). Although physical factors were associated with a higher risk of falls than psychosocial factors (Rubenstein & Josephson, 2002), psychosocial factors such as fear of falling and activity limitation have an intricate link in the positive feedback cycle of falls, as illustrated in Figure 1, and have been less well researched.
Figure 1. Positive feedback cycle of falls, adapted from Accident Compensation Corporation (2006)

ProFANE (Prevention of Falls Network Europe), who promote best practice in fall-prevention research, recommend that in addition to number of falls, fall injury and physical activity, the psychosocial measures of fall-related self-efficacy (the degree of confidence a person has in performing activities of daily living without falling) and health-related quality of life (the impact of self-perceived health on activities of daily living) should be measured in all fall prevention trials. The less commonly investigated fall-related self-efficacy and health-related quality of life factors are the focus of this particular study.

ProFANE recommend prioritising fall-prevention research in community-dwelling populations (Lamb et al., 2005). Although the risk of falling is greater over the age of 80 (Accident Compensation Corporation, 2005; American Geriatrics Society, 2001; Bloch, 2010), it is important to prevent first falls and falls in even high-functioning community-dwelling populations are common and costly. Having a history of falls is a key risk factor for future falls, as illustrated in the positive feedback cycle of falls in Figure 1. There were 95,865 claims to ACC for falls from adults aged 65 years or older in 2006/07, and of those, 89% were from adults not in a rest home with a total cost of $72 million (Robertson & Campbell, 2008). Exercise interventions which have been shown to improve falls risk factors and reduce falls in community-dwelling older adults are Tai Chi and multiple-component exercises that target two or more of strength, balance, flexibility and endurance, either as part of a supervised group or individually prescribed at home (Gillespie et al., 2009). Tai Chi
classes are currently funded by ACC as a preferred fall prevention exercise in New Zealand, since they are considered relatively cost-effective.

Tai Chi has been shown to reduce falls by 47% (Accident Compensation Corporation, 2006) and reduce risk factors for falls, although psychosocial factors have not been extensively investigated. Quality of life was only reported in 10 out of 33 Tai Chi studies reviewed by Jahnke et al. (2010), yet 9 of these studies showed improvements in at least one measure of quality of life. Fall-related self-efficacy was only reported in 5 out of 24 studies reviewed by Schleicher, Wedam and Wu (2012) and improvement was shown in 4 of these studies, with clearer and greater effects in those already at risk of falling. Although Tai Chi has been shown to improve quality of life and fall-related self-efficacy, and although acceptability is also strong amongst Tai Chi study participants, exercise preferences have been shown to vary amongst subgroups of older adults (Cohen-Mansfield et al., 2004), suggesting that no one exercise type is going to be effective for all older adults. There is a need to evaluate attitudes and preferences across a range of exercises, including Tai Chi, in New Zealand and investigate alternative forms of exercise to reduce falls and improve successful aging in the widest population possible.

Dance may be one such alternative exercise and may be a familiar concept to the current aging population since it was more a part of the fabric of life in the early and mid-20th century than it is today (Judge, 2003). It is classified as a “3D” exercise, along with Tai Chi (Prevention of Falls Network Europe, 2007, p. 21), but may appeal to a different subgroup of the older population than Tai Chi. Dance “implies body movements, steps, expression, and interaction, which positively affect both physical function and psychological well-being” and “may be a particularly enjoyable activity, which can enhance motivation” (Holmerová et al., 2010, p. 108). Dance is less well researched than Tai Chi but was shown to reduce the rate of falls by 23% in one study (Shigematsu et al., 2008). As with Tai Chi, there has been limited investigation into the effects of dance on quality of life and fall-related self-efficacy. Out of 11 studies investigating the psychosocial effects of dancing in community-dwelling adults aged over 65 years, only 5 studies reported quality of life (Eyigor et al., 2009; Hui et al., 2009; Keogh et al., 2012; Lin et al., 2008; Shigematsu et al., 2008) and only 3 reported fall-related self-efficacy (Hackney et al., 2007; McKinley et al., 2008; Shigematsu et al., 2008). Of these studies, 3 showed improvement in some aspects of quality of life from low-impact aerobic-based dance (Hui et al., 2009), contemporary dance (Keogh et al., 2012) and square-
stepping (Shigematsu et al., 2008) and one study showed improvement in fall-related self-efficacy from Argentine Tango (McKinley et al., 2008). In addition, no study measured both quality of life and fall-related self-efficacy, as recommended by ProFANE. The remaining studies, which did not show differences in either variable, were underpowered, used measures with unproven reliability or validity, combined dancing interventions with walking, or used study samples with high baseline fall-related self-efficacy scores. Only one study took place in New Zealand (Keogh et al., 2012) and despite the hypothesized link between psychosocial and physical risk factors for falls (Accident Compensation Corporation, 2006; Lamb et al., 2005) as shown in Figure 1, only two studies (Alpert et al., 2009; McKinley et al., 2008) investigated this correlation and found no statistically significant results. Dancing was shown to be enjoyable in the three studies which measured it (Hackney et al., 2007; Lin et al., 2008; Shigematsu et al., 2008) and was shown to be more pleasurable than walking in one study (Shigematsu et al., 2008).

Further research into the psychosocial effects of dance for community-dwelling older adults is required. Dance may be enjoyable and provide an alternative exercise intervention to Tai Chi in New Zealand in order to reduce falls risk and improve successful aging. The purpose of this pilot study was to determine the effects of dance on two key psychosocial factors associated with falls risk: quality of life and fall-related self-efficacy. Secondary aims were to explore the relationship between the effects on these psychosocial risk factors and the effects on physical risk factors, and to determine the enjoyment of dancing.

5. Subjects and methods

5.1. Subjects

An opportunity arose to assess the effects of two dance programs in Auckland, New Zealand: a contemporary-based dance mobility program and a folk dance program. Study participants were aged over 65 years, living independently and enrolled in one of the two dance programs. The first cohort came from community-dwelling participants who registered to attend “Dance Mobility” classes organized by Dance Aotearoa New Zealand (DANZ) in Mt Albert, Auckland. The second cohort came from participants who registered to attend “Folk Dancing” classes at Selwyn Retirement Village in Point Chevalier, Auckland. The dance mobility classes were advertised through flyers, local papers, community notice-boards and the DANZ website and the folk dancing classes were advertised through a flyer drop in
Selwyn Village and in the village newsletter. Dancers were given the option to participate in the study and those who chose to take part gave their written, informed consent and filled out questionnaires collecting demographic, exercise and medical data. The study was approved by the Research Ethics Committee of Unitec, New Zealand (ethics application numbers 2011-1199 and 2011-1248).

5.2. Dancing interventions

Both dance programs consisted of 9 weekly dance classes of one hour duration followed by a half hour social interaction over a cup of tea. Dance classes took place between March 2010 and February 2011. Attendance, dancing time and social interaction time was monitored each week.

The Dance Mobility program was organized by DANZ and Creative Communities and delivered by two dance professionals at a local community hall. The program was based on contemporary dance and ballet exercises, specifically designed to meet the needs of older persons and aimed at increasing balance, coordination and strength whilst also fostering a sense of community. The dancing style emphasized mindful movements, balance, postural awareness, encouraging integration of past experiences into the dances using imagery and interaction with one another. The class began with a warm up including patterned walking and greeting each other followed by chair work, peripheral limb movements, sitting to standing and then incorporated rhythmic whole body movements. The class concluded with learning and practicing choreographed dance phrases aimed at encouraging spatial awareness, memorisation and performance followed by a brief warm-down, involving peripheral limb movements and encouraged acknowledgment of each other’s accomplishments through eye contact, shaking of hands or patting each other on the shoulder or back (Molloy & Jordan, 2012). Music from the 1930s and 1940s was chosen with the aim of enhancing relevance to the performers and reducing their anxiety (Molloy & Jordan, 2012).

The folk dance program was organized by Unitec New Zealand in conjunction with Selwyn Retirement Village and delivered by a highly experienced folk dance instructor with particular experience in teaching older adults. The program took place at the Selwyn Village hall. The dancing style emphasized activity, balance, strength, co-ordination and interaction with one another. Exercises were performed standing and those needing a rest between dances were encouraged to do so, although the class was adapted to fit participants’ abilities
and interests. Classes began with a warm up, followed by a maximum of five dances and concluded with a cool down. The music and dance movements were drawn from traditional folk dance, including Yugoslav, Shegra, St George Cross, Chinese, Greek and Tennesse Walk.

5.3. Outcome measures
Psychosocial and physical performance measures were assessed at baseline during the first dance class and at follow-up at the ninth and final dance class. The effect of the intervention on physical measures formed part of a concurrent study by another researcher and methods are described in greater detail elsewhere (in a parallel as yet un-submitted student thesis and in the Appendices of this thesis).

5.4. Psychological outcome measures
i. Activities-specific Balance Confidence Scale UK (ABC-UK)
The anglicized Activities-specific Balance Confidence Scale (ABC-UK) is a 16-item self-report questionnaire (Parry et al., 2001) measuring fall-related self-efficacy. North American words and expressions from the original version (Powell & Myers, 1995) have been “translated” in this version for easier comprehension by an older British population. Participants rate their confidence in maintaining their balance and remaining steady while performing 16 activities on a 0 to 100% scale, 0% being no confidence and 100% being completely confident. The overall score out of 1600 was divided by 16 to obtain each participants ABC-UK average percent confidence score (Powell & Myers, 1995), which was the first primary outcome measure. Scores greater than 80% indicate a high level of physical functioning, scores between 50 and 80% represent a moderate level and scores less than 50% indicate a low level (Myers, Fletcher, Myers, & Sherk, 1998).

ii. RAND 36-Item Health Survey (SF-36)
The SF-36 (RAND Corporation) is a 36-item self-report questionnaire designed to measure health-related quality of life and has been widely validated for use across a range of health care professions, settings and patients. The second primary outcome for this study was perceived change in health taken from one item of the survey. The remaining 35 items were combined into eight subscales which formed secondary measures: physical functioning (10 items); bodily pain (2 items); role limitations due to physical health (4 items); role limitations
due to emotional health (3 items); emotional well-being (4 items); social functioning (2 items); energy/fatigue (5 items); and general health perceptions (5 items). The 36 items of the RAND version of the survey are identical to the Medical Outcomes Short Form Health Survey (MOS SF-36) (Ware & Sherbourne, 1992) but the scoring procedure, which was used in this study, differs slightly in that each item is converted to a score in the range of 0 to 100, 100 representing a more favourable health state (RAND Corporation). The subscales were calculated based on the average score across applicable items, ignoring items left blank (RAND Corporation).

5.5. Physical outcome measures
Participants were required to complete a 5 – 15 minute warm-up prior to physical measurement. The 30 s Seated Chair Stand (SCS) test was used to measure lower limb strength (R. E. Rikli & C. J. Jones, 1999), involving participants standing from a seated position and sitting back down again with correct form as many times as possible within 30 seconds. Static balance was measured by the Single Leg Stand (SLS) test (J. M. Miotto, W. J. Chodzko-Zaijo, J. L. Reich, & M. M. Supler, 1999a) for which the length of time that participants could stay balanced on one chosen leg, up to a maximum of 30 s was recorded. The final physical measure was the Four Square Step Test, which was used to measure multi-directional dynamic balance and lower limb co-ordination. Two pieces of foam were taped to the ground in a ‘plus sign’ (+) and recorded as the length of time taken for participants to move in a clockwise direction from the bottom left corner around the plus sign to the starting position and then to move back in reverse to the original starting position. In each of the above tests, participants were allowed practice sessions and the average time from three tests was used for analysis.

5.6. Dance program evaluation
Participants were asked to complete a four-item questionnaire evaluating their enjoyment levels of the program. They were asked two closed questions: “How would you rate your enjoyment of this dance program overall?” and “How would you rate the music used in this dance program?”, which were both rated on a five-point Likert-scale from 1=“did not enjoy at all” to 5=“enjoyed immensely”. Participants were also asked two open questions: “What did you enjoy about this dance program?” and “What did you not enjoy about this dance program?”
5.7. Statistical methods

Results were analyzed using the Statistical Package for Social Sciences (SPSS) software for Windows version 19.0.0. Categorical demographic data, attendance, dancing and social time as well as the change in variables from baseline to follow-up were tested for assumptions of normality using Skewness and Kurtosis z-scores and the Shapiro-Wilk test, which is applicable to small sample sizes (Field, 2009). Demographic data, along with the results of the dance program evaluation questionnaire were evaluated using descriptive statistical methods.

When assumptions of normality were violated, Mann-Whitney U Exact test was performed to compare the results from the two dancing groups and Wilcoxin-Signed Rank test was used to analyse the change in variables from baseline to follow-up. Similarly, non-parametric correlation analysis using non-parametric Kendall’s tau-b, recommended for small data sets with many tied ranks (Field, 2009), was performed to establish whether there was a relationship between changes in psychosocial and physical variables. Levels of p < 0.05 were considered statistically significant. Effect sizes were calculated using Cohen’s standardized difference \[ d = (\text{follow-up mean} - \text{baseline mean}) / (\text{standard deviation of change}) \]. Scale of magnitudes for standardized differences in means and correlation coefficients were evaluated using Hopkin’s effect size descriptors (Hopkins, 2011). Feedback from the program evaluation questionnaire was grouped into themes for descriptive comparison between the two groups.

6. Results

6.1. Participant characteristics

Baseline characteristics of the participants are summarized in Table 1. All participants were female (n = 18) in both the dance mobility group (n = 8) and the folk dancing group (n = 10). Of those who were originally recruited for the combined physical and psychosocial study (n = 27) not all chose to participate in the psychosocial aspect (n = 3). Of the remaining 24 participants, 4 failed to return questionnaires (1 from the dance mobility group and 3 from the folk dancing group) and 2 withdrew, 1 due to injury outside of class and 1 because of planned surgery.
Due to the timing of the program and research, all participants in the dance mobility group had attended a previous program for 9 or 18 weeks (with a 3 week break between programs), whereas participants in the folk dancing group had not attended any dance classes in the last 6 months. Most participants (n = 15) had regularly taken part in exercise in the past year, the most common being walking (n = 12), followed by Tai Chi (n = 3) and going to the gym (n = 2). Other forms of exercise were highly varied and differed between the two dancing groups. Dance Mobility participants specified physiotherapy exercises, Pilates, hydrotherapy, swimming and Move for Health as alternative forms whereas Folk Dancing participants specified line dancing, exercise class, exercise in the village, balance exercises and Lindis exercises.

Demographic data and outcome variables violated assumptions of normality, both cross-sectionally and for changes following the interventions so non-parametric tests were applied throughout. No statistically significant differences between cohorts for baseline psychosocial and physical measures were found, although dance mobility participants tended to be younger (p = 0.08) than folk dancing participants. Compared to NZ normative data (Scott, Tobias, Sarfati, & Haslett, 1999), SF-36 mean scores were all between 0.1 and 12.4 above NZ norms for females 75 years and over, except for the SF-36 Role Limitations Due to Emotional Health score which was 5.4 below the NZ norm.
Table 1. Baseline Characteristics of Participants

<table>
<thead>
<tr>
<th></th>
<th>Dance Mobility Group (n = 8)</th>
<th>Folk Dancing Group (n = 10)</th>
<th>Combined Group (n = 18)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>70.0 [67.3-81.0]</td>
<td>80.0 [76.8-82.8]</td>
<td>79.0 [70.5-81.3]^</td>
</tr>
<tr>
<td><strong>SF-36</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical functioning</td>
<td>75 [55-89]</td>
<td>70 [48-80]</td>
<td>75 [54-81]</td>
</tr>
<tr>
<td>Role limitations – physical health</td>
<td>88 [0-100]</td>
<td>88 [19-100]</td>
<td>88 [0-100]</td>
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<tr>
<td>Role limitations – emotional health</td>
<td>100 [67-100]</td>
<td>83 [0-100]</td>
<td>100 [25-100]</td>
</tr>
<tr>
<td>Energy</td>
<td>63 [50-69]</td>
<td>63 [53-76]</td>
<td>63 [50-71]</td>
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<td>Social functioning</td>
<td>94 [69-100]</td>
<td>100 [81-100]</td>
<td>100 [81-100]</td>
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<tr>
<td>Bodily pain</td>
<td>85 [68-98]</td>
<td>90 [57-100]</td>
<td>90 [65-100]</td>
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<tr>
<td>General health</td>
<td>73 [49-84]</td>
<td>63 [60-69]</td>
<td>65 [60-80]</td>
</tr>
<tr>
<td>Perceived change in health</td>
<td>50 [50-69]</td>
<td>50 [50-81]</td>
<td>50 [50-75]</td>
</tr>
<tr>
<td><strong>ABC-UK (%)</strong></td>
<td>92 [78-95]</td>
<td>90 [79-92]</td>
<td>91 [80-94]</td>
</tr>
<tr>
<td><strong>PHYSICAL FUNCTION TESTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCS</td>
<td>10 [9-12]</td>
<td>11 [8-12]</td>
<td>11 [9-12]</td>
</tr>
<tr>
<td>SLS (s)</td>
<td>16.0 [8.5-21.3]</td>
<td>6.7 [1.7-18.0]</td>
<td>10.8 [3.3-21.1]</td>
</tr>
<tr>
<td>FSST (s)</td>
<td>10.2 [8.5-14.2]</td>
<td>11.5 [9.6-13.9]</td>
<td>11.2 [8.8-13.9]</td>
</tr>
<tr>
<td><strong>NUMBER OF PEOPLE (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall in past 6 months</td>
<td>3 (38)</td>
<td>2 (20)</td>
<td>5 (28)</td>
</tr>
<tr>
<td>≥ 4 medications</td>
<td>4 (50)</td>
<td>2 (20)</td>
<td>6 (33)</td>
</tr>
<tr>
<td>Parkinson disease</td>
<td>2 (25)</td>
<td>0 (0)</td>
<td>2 (11)</td>
</tr>
<tr>
<td>Walks with an assistive device</td>
<td>1 (13)</td>
<td>1 (10)</td>
<td>2 (11)</td>
</tr>
<tr>
<td>Major illness</td>
<td>4 (50)</td>
<td>2 (20)</td>
<td>6 (33)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2 (25)</td>
<td>2 (20)</td>
<td>4 (22)</td>
</tr>
<tr>
<td>Exercises ≥ once per week</td>
<td>7 (88)</td>
<td>8 (80)</td>
<td>15 (83)</td>
</tr>
</tbody>
</table>

Data are presented as median [inter-quartile range] or number (% of respondents) for frequencies

^ p = 0.08, significant at p ≤ 0.1

p-value calculated using Mann-Whitney U Exact test
SF-36 = RAND 36-Item Health Survey
ABC-UK = Activities-specific Balance Confidence scale (UK)
SCS = Seated Chair Stand (number of times)
SLS = Single Leg Stand (seconds)
FSST = Four Square Step Test (seconds)
6.2. *Psychosocial and physical outcome measures*

The change in psychosocial and physical outcome measures did not differ significantly between the two dancing groups for any measure so the results were analysed together (Table 2). For psychosocial variables (Table 2), there was a moderate significant increase in SF-36 Bodily Pain ($d = -0.65$, $p = 0.02$) and a tendency for a small improvement in SF-36 Role Limitations Due to Emotional Health (from SF-36) which approached significance ($d = 0.48$, $p = 0.06$). ABC-UK and SF-36 Perceived Change in Health did not change significantly. Missing data from the SF-36 survey ($n = 4$) reduced the sample size for the SF-36 results. For physical variables (Table 2), there was a moderate significant improvement in SCS ($p = 0.001$) and FSST ($p = 0.004$) and a tendency for a small improvement in SLS ($p = 0.09$).

**Table 2. Change in psychosocial and physical measures between baseline and follow-up.**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Change between baseline and follow-up</th>
<th>Effect Size (d)</th>
<th>Effect Size Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical functioning</td>
<td>-2.5 [-10.0-5.0]</td>
<td>0.4</td>
<td>-0.17</td>
</tr>
<tr>
<td>Role limitations – physical health</td>
<td>0.0 [0.0-25.0]</td>
<td>0.4</td>
<td>0.19</td>
</tr>
<tr>
<td>Role limitations – emotional health</td>
<td>0.0 [0.0-41.7]</td>
<td>0.06*</td>
<td>0.48</td>
</tr>
<tr>
<td>Energy</td>
<td>-2.5 [-10.0-2.5]</td>
<td>0.4</td>
<td>-0.17</td>
</tr>
<tr>
<td>Mental health</td>
<td>0.0 [-5.0-1.0]</td>
<td>0.7</td>
<td>-0.03</td>
</tr>
<tr>
<td>Social functioning</td>
<td>0.0 [-3.1-3.1]</td>
<td>0.4</td>
<td>-0.23</td>
</tr>
<tr>
<td>Bodily pain</td>
<td>0.0 [-10.6-0.0]</td>
<td>0.02*</td>
<td>-0.65</td>
</tr>
<tr>
<td>General health</td>
<td>0.0 [-1.3-5.0]</td>
<td>0.7</td>
<td>0.07</td>
</tr>
<tr>
<td>Perceived change in health</td>
<td>0.0 [0.0-25.0]</td>
<td>0.4</td>
<td>0.21</td>
</tr>
<tr>
<td>ABC-UK (%)</td>
<td>0.5 [-2.7-3.5]</td>
<td>0.8</td>
<td>-0.13</td>
</tr>
<tr>
<td>SCS</td>
<td>1.2 [0.3-2.1]</td>
<td>0.001*</td>
<td>0.99</td>
</tr>
<tr>
<td>SLS (s)</td>
<td>1.2 [-0.3-8.7]</td>
<td>0.09*</td>
<td>0.39</td>
</tr>
<tr>
<td>FSST (s)</td>
<td>-1.7 [-3.0-0.4]</td>
<td>0.004*</td>
<td>-0.83</td>
</tr>
</tbody>
</table>

Data are presented as median [inter-quartile range] unless specified

* significant at $p < 0.05$

^ significant at $p \leq 0.1$

p-value calculated using Wilcoxin-Signed Rank test

Effect sizes calculated using Cohen’s $d = (follow-up mean - baseline mean) / (standard deviation of change)$. Hopkin’s effect size descriptors.

SF-36 = RAND 36-Item Health Survey
ABC-UK = Activities-specific Balance Confidence scale (UK)
SCS = Seated Chair Stand (number of times)
SLS = Single Leg Stand (seconds)
FSST = Four Square Step Test (seconds)
6.3. Correlation between changes in psychosocial and physical outcome measures

Correlations between change in the four primary or significant psychosocial measures (ABC-UK, SF-36 Perceived Change in Health, SF-36 Bodily Pain and SF-36 Role Limitations Due to Emotional Health) and the change in the three physical measures (SCS, SLS, FSST) are shown in Table 3. None attained statistical significance however a moderate-sized correlation between SF-36 Bodily Pain and FSST approached significance (r=0.33, p = 0.08).

Table 3. Correlation results between the change in psychosocial measures (primary or significant) and the change in physical measures.

<table>
<thead>
<tr>
<th>Psychosocial Measures</th>
<th>Physical Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36 Perceived change in health</td>
<td>SCS</td>
</tr>
<tr>
<td>SF-36 Bodily pain</td>
<td>0.02</td>
</tr>
<tr>
<td>SF-36 Role limitations – emotional health</td>
<td>0.16</td>
</tr>
<tr>
<td>ABC-UK</td>
<td>-0.13</td>
</tr>
</tbody>
</table>

^p = 0.08, significant at p ≤ 0.1

r = Kendall’s tau-b correlation coefficient
SF-36 = RAND 36-Item Health Survey
ABC-UK = Activities-specific Balance Confidence scale (UK)
SCS = Seated Chair Stand
SLS = Single Leg Stand
FSST = Four Square Step Test

6.4. Dance program evaluation

Results from the dance program evaluation are summarized in Table 4. Dance mobility participants spent more time dancing than folk dancing participants, with a difference in median of 19 minutes (p = 0.004) and more time socialising, with a difference in median of 7.5 minutes (p = 0.004). They also tended to have attended a greater number of classes (p = 0.1). Participants seemed to enjoy the dancing, and particularly the music, in both dance groups. There were no statistically significant differences in enjoyment between the groups.
Table 4. Results from dance program evaluation

<table>
<thead>
<tr>
<th></th>
<th>Dance Mobility Group (n = 8)</th>
<th>Folk Dancing Group (n = 10)</th>
<th>Combined Group (n = 18)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>70.0 [67.3-81.0]</td>
<td>80.0 [76.8-82.8]</td>
<td>79.0 [70.5-81.3]</td>
<td>0.08^</td>
</tr>
<tr>
<td>Attendance (%)</td>
<td>88.9 [80.1-97.2]</td>
<td>77.8 [75.0-80.1]</td>
<td>77.8 [77.8-88.9]</td>
<td>0.1^</td>
</tr>
<tr>
<td>Dancing time (min)</td>
<td>55.5 [45.8-59.0]</td>
<td>36.5 [29.8-40.0]</td>
<td>41.0 [33.3-53.8]</td>
<td>0.004^</td>
</tr>
<tr>
<td>Social time (min)</td>
<td>20.5 [16.8-23.3]</td>
<td>13.0 [11.3-15.3]</td>
<td>15.5 [12.0-20.3]</td>
<td>0.004^</td>
</tr>
<tr>
<td>Dance enjoyment #</td>
<td>5.0 [4.3-5.0]</td>
<td>4.5 [4.0-5.0]</td>
<td>5.0 [4.0-5.0]</td>
<td>0.3</td>
</tr>
<tr>
<td>Music enjoyment #</td>
<td>5.0 [5.0-5.0]</td>
<td>5.0 [4.8-5.0]</td>
<td>5.0 [5.0-5.0]</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Data are presented as median [inter-quartile range].

# Possible responses ranged from 1="did not enjoy at all" to 5="enjoyed immensely"

* significant at p < 0.05

^ significant at p ≤ 0.1

p-value calculated using Mann-Whitney U Exact test

When asked what aspects of the program participants enjoyed they commented on eight key themes. Common themes between the two groups were keeping moving/using the whole body, social interaction, the instructors and the music. Participants in the dance mobility group also commented on body awareness and balance whereas participants in the folk dancing group also commented on brain concentration/memory and variation of dances.

7. Discussion

Combined data from the contemporary-based dance mobility program and the folk dance program showed small to moderate effects on two measures of health-related quality of life but no significant effect on fall-related self-efficacy. Dancing has previously been shown to have small to moderate effects on quality of life using reliable measures from low-impact aerobic dance (Hui et al., 2009), contemporary dance (Keogh et al., 2012) and Turkish folk dance (Eyigor et al., 2009). Dancing has only been shown to have an effect on fall-related self-efficacy using reliable measures in one (McKinley et al., 2008) of two studies of Argentine Tango (Hackney et al., 2007). There has been more research into Tai Chi, which has been shown to improve quality of life (Jahnke et al., 2010) and fall-related self-efficacy (Schleicher et al., 2012).

Similar to our study, one dance study found an increase in SF-36 Bodily Pain scores (Hui et al., 2009) but this was trivial compared to the slightly larger (moderate-sized) change shown in our study. This increase in pain may have been due to muscle aches from the
unaccustomed movements involved in dancing specifically rather than muscle aches from
general exercise. 90% of participants in the study by Hui et al. exercised 5.4 times per week
and the participants in our study were also active exercisers. Multi-directional dynamic
balance and lower limb co-ordination is a large component of dancing specifically (as
opposed to walking for example) and was found to have a moderate correlation with bodily
pain. Furthermore, even though bodily pain increased during this study, it may have been
transient, reflecting only the initial adaptation to the new exercise, and remained within NZ
norms therefore may be an acceptable result within this age group.

Using the SF-36 survey, Hui et al. (2009) reported a trivial deterioration in role limitations
due to emotional health, in comparison to our study which showed a small improvement that
approached significance. Other studies have reported improvements in general health
(Eyigor et al., 2009; Hui et al., 2009) which our study did not. Moderate improvement in
quality of life has also been reported in the New Zealand study by Keogh et al. (2012) using
the Late Life Function Index. Our study provides more limited results than previous studies
but does support previous research indicating that dance may have an effect on quality of life
across a variety of dance styles. The effect on fall-related self-efficacy is less clear.

Limited changes in outcomes may have been shown in the present study due to high baseline
scores for both quality of life and fall-related self-efficacy. Quality of life baseline scores
were all above NZ norms except for the role limitations due to emotional health score, which
was 5.4 below the NZ norm at baseline and showed an improvement that approached
significance to bring it up to 11.3 above the NZ norm. The median baseline ABC-UK score
was over 80% and as suggested by Myers et al. (1998) scores higher than this indicate a high
level of physical functioning which are unlikely to show further improvement. High baseline
values are unlikely to have been due to those in the dance mobility group having danced for 9
or 18 weeks previous to the intervention since there was no significant difference in baseline
values or effects shown between groups. It is more likely that high baseline values were due
to the high functioning study population since both groups were regular exercisers.

Previous dance and Tai Chi studies also show clearer effects for fall-related self-efficacy in
those already at risk for falls. The only dance study to show an improvement in fall-related
self-efficacy (yet of undetermined significance compared to control) involved older adults
already at risk for falls (McKinley et al., 2008). Hackney et al. (2007) showed no significant
change from Argentine Tango in participants who had very high baseline scores in both the Falls Efficacy Scale (FES) and Activities-specific Balance Confidence (ABC) scale. In five Tai Chi studies reviewed by Schleicher, Wedam and Wu (2012), the only one which did not show an improvement in fall-related self-efficacy compared to baseline or compared to a control group had very high baseline ABC scores (Murphy & Singh, 2008). Of the four studies which did show improvement, three involved transitionally frail or those prone to falls and whilst the fourth trial of healthy over 65 year olds also showed improvement, this was not compared to a control group. Our study supports the very limited current research suggesting that 3D exercise classes may not have an effect on fall-related self-efficacy in those who are not already at risk of falling.

Whilst the measure chosen in this study, the ABC-UK scale, differed from the mFES recommended by ProFANE (Lamb et al., 2005), it still has demonstrated reliability (Jørstad et al., 2005) and has more validity with the high functioning older adults in the present study sample than the mFES, which is more suited to frailer populations (Lamb et al., 2005). Initial pre-test pilot scores revealed lower scores on the ABC-UK scale than the mFES scale, however by the time the study started, dancers had already been dancing for 9 – 18 weeks and so had higher initial baseline scores than in the pre-test pilot.

Dance studies as well as Tai Chi studies have shown an effect for quality of life and fall-related self-efficacy that appears to be restricted to programs of significant duration. Keogh et al. (2012) showed that quality of life only improved significantly in twice-weekly dance classes as opposed to once-weekly classes. Other dance studies which have shown an effect on quality of life and fall-related self-efficacy have involved 60 minute sessions taking place twice-weekly over 12 weeks (Hui et al., 2009; Keogh et al., 2012; Shigematsu et al., 2008), although one study (McKinley et al., 2008) involved sessions of 120 minutes twice per week over 10 weeks. Most Tai Chi studies have involved sessions of 40 – 60 minutes taking place 2 to 3 times per week over a period of between 12 and 48 weeks, although one trial took place twice per week over 48 weeks and another involved 7 sessions per week over 8 weeks. Our study only involved 60 minute dance classes once per week over 9 weeks, which may have provided insufficient dancing time to elicit the effects on the psychosocial parameters noted in other dance and Tai Chi studies.
A secondary aim of this study was to explore the relationship between psychosocial and physical risk factors for falls. Although there was limited change in psychosocial outcomes in our study of once weekly dancing, all three physical outcomes did show significant improvements. Keogh et al. (2012) also found no significant improvement in quality of life despite improvements in physical measures from once weekly dancing, but did show an effect for both psychosocial and physical measures with twice weekly dancing. This suggests that psychosocial outcomes from dancing may be more likely to occur with increased dancing frequency.

In the present study no correlation between the changes in psychosocial and physical factors attained statistical significance. Two other dancing studies have correlated psychosocial and physical outcomes and have similarly observed no relationship between changes in these two types of variables (Alpert et al., 2009; McKinley et al., 2008). One of these studies was a pilot study so was likely underpowered (Alpert et al., 2009) and the other study found no relationship between changes in fall-related self-efficacy and physical variables (McKinley et al., 2008). No studies have reported the relationship between changes in quality of life and physical variables. Although Hui et al. (2009) did not statistically correlate psychosocial and physical outcomes, they showed an increase in quality-of-life-related bodily pain despite an improvement in physical measures of dynamic balance and agility. Our study also showed a moderate-sized correlation which approached significance between bodily pain and the measure of multi-directional dynamic balance and lower limb coordination which might support the possibility of a generalizable relationship between these parameters. The relationship between changes in psychosocial and physical variables remains under-investigated.

Participants did not perceive a significant change in their balance-confidence (fall-related self-efficacy) however their objectively measured physical balance did change and there was no correlation between these measures of balance. Although limitations of the present study, such as high baseline ABC-UK scores or possibly insufficient dancing time to elicit a change in this outcome, may explain this, the different types of balance being measured may provide another explanation. Balance is a complex task involving the integration of many physiological mechanisms including biomechanics, cognitive processing, control of dynamics, orientation in space, sensory strategies and movement strategies (Horak, 2006). The degree to which, and the way in which, these physiological mechanisms are integrated
depends on the type of balance required and the individual constraints present in each individual (Horak, 2006).

Fall-related self-efficacy not only involves multi-tasking while dynamically balancing but also involves perception and so would demand a more complex integration of physiological mechanisms than would static balance for example. Although Myers et al. (1996) has found that the ABC scale does correlate with a physical measure of balance, a physical measure of dynamic balance while multi-tasking a daily activity may compare more directly to fall-related self-efficacy, which measures the perception of this task.

Both dance programs were found to be enjoyable, as shown in previous dance studies (Hackney et al., 2007; Lin et al., 2008; Shigematsu et al., 2008). Further studies evaluating attitudes and preferences across a range of exercise types is necessary to place these findings in the context of the wider aging population in New Zealand. Although there were common themes enjoyed, the differing themes may have been due to the different dance styles or the higher attendance, dancing time and socialisation time in the dance mobility group. The themes found may be useful in identifying measuring tools which could lead to quantitative investigations in future research, particularly “brain concentration/memory” which relates to the falls risk factor of cognitive impairment and “social interaction” which is a key factor in successful aging (Hayman et al., 2012). Bassuk, Glass and Berkman (1999) have linked cognitive decline with social disengagement and Lin et al. (2008) found social contact to be important for integrating past experiences (reminiscing) and for dealing with the decline in physical and mental ability and the decline or death of peers.

The two major limitations of this pilot study were the convenience sampling method and the lack of control group. Assuming random sampling from the local population of this age group, it was calculated that a sample size of 24 would allow detection of moderate effect sizes in the primary outcome variables (d = 0.6, two-tailed, power = 80%, and $\alpha = 0.05$). This equates to changes in SF-36 General Health scores of around 11 – 13 (Eyigor et al., 2009; Hui et al., 2009) and in ABC-UK scores of around 8%. However, a sample size of 18 has previously been deemed reasonable for a pilot study (Alpert et al., 2009). Here we report results from 18 participants and sampling was non-random.
Study recruitment was constrained by the size of venues, the desire to maintain a manageable instructor/participant ratio and was limited by enrolments in the programs. Due to the narrow limits of the study population participants had high baseline values, and due to the pre-designed dancing programs, dancing frequency and program length were fixed. These factors may have limited the ability to detect effects in psychosocial variables. Without a control group, we cannot determine whether results (including the high enjoyment levels) were due to the dancing intervention itself or due to measurement bias introduced by the Hawthorne effect. The Hawthorne effect is “the existence of change due to the awareness of being studied” and is more noticeable when using subjective measures (Berthelot, Le Goff, & Maugars, 2011, p. 335) such as the self-perceived measures used in this study.

With the exception of the enjoyment levels, measures chosen in this study were recommended by ProFANE and had proven reliability and validity within the study population. We did not measure number of falls or fall injury as recommended by ProFANE given the limited time frame and small sample size in this pilot study but we did measure physical activity in a separate parallel study. Cognitive impairment was not measured due to time constraints and depression was not measured since previous dancing studies have found no significant effect on depression (Alpert et al., 2009; Engels et al., 1998; Eyigor et al., 2009; Haboush et al., 2006; Hackney et al., 2007; Verghese, 2006).

In order to generalize outcomes to a wider population beyond those who choose to enrol in a dance program in Auckland, further research into the psychosocial effects of dancing, and the relationship of these effects to physical effects, is required. Dancing interventions should take place for 60 minutes at least twice per week over 12 weeks. Studies should recruit participants who are already at risk of falling and should measure quality of life and fall-related self-efficacy, in addition to number of falls, fall injury and physical activity. It would also be useful to measure cognitive impairment and it may be useful to measure depression in those who already have a history of depression or chronic illness. Standardized measuring tools should be used, which are either recommended by ProFANE or shown to have proven reliability and validity for the study population. Larger sample sizes and inclusion of randomized control groups would clarify changes due to dancing and be able to highlight consistency or change in measures even with high baseline scores. This would allow easier comparison across dance studies as well as to existing studies of Tai Chi, which is currently the preferred fall prevention intervention in New Zealand.
8. Conclusion
This pilot study indicates that dancing may slightly reduce the impact of emotional health on
daily activities but moderately increase bodily pain. No evidence was found for any effect on
fall-related self-efficacy or any other aspect of quality of life but this may have been due to
the high-functioning study population or frequency of dance classes, which were limited to
once per week. Similarly, there was no clear evidence for relationships between psychosocial
and physical changes. Dancing may be beneficial and enjoyable for older adults. Further
investigation is warranted to determine the effects of dance on modifiable psychosocial risk
factors for falls in order to contribute to successful aging in independently-living older adults
in New Zealand.

9. Conflict of interest
None.

10. References
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Section 3: Appendices
Appendix A: Full Results Tables
<table>
<thead>
<tr>
<th>Item Health Survey</th>
<th>Baseline</th>
<th>Follow-Up</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36</td>
<td>Dance Mobility</td>
<td>Folk Dancing</td>
<td>Combined</td>
</tr>
<tr>
<td>Physical Functioning</td>
<td>75 [55-89]</td>
<td>70 [48-80]</td>
<td>75 [54-81]</td>
</tr>
<tr>
<td>Role limitations – physical health</td>
<td>88 [0-100]</td>
<td>88 [19-100]</td>
<td>88 [0-100]</td>
</tr>
<tr>
<td>Role limitations – emotional health</td>
<td>100 [67-100]</td>
<td>83 [0-100]</td>
<td>100 [25-100]</td>
</tr>
<tr>
<td>Energy</td>
<td>63 [50-69]</td>
<td>63 [53-76]</td>
<td>63 [50-71]</td>
</tr>
<tr>
<td>Mental health</td>
<td>80 [76-90]</td>
<td>88 [62-96]</td>
<td>82 [74-92]</td>
</tr>
<tr>
<td>Social functioning</td>
<td>94 [69-100]</td>
<td>100 [81-100]</td>
<td>100 [81-100]</td>
</tr>
<tr>
<td>Bodily Pain</td>
<td>85 [68-98]</td>
<td>90 [57-100]</td>
<td>90 [65-100]</td>
</tr>
<tr>
<td>General health</td>
<td>73 [49-84]</td>
<td>63 [60-69]</td>
<td>65 [60-80]</td>
</tr>
<tr>
<td>Perceived change in health</td>
<td>50 [50-69]</td>
<td>50 [50-81]</td>
<td>50 [50-75]</td>
</tr>
<tr>
<td>ABC-UK</td>
<td>92 [78-95]</td>
<td>90 [79-92]</td>
<td>91 [79-94]</td>
</tr>
</tbody>
</table>

Data are presented as median [inter-quartile range] unless specified
p-value¹ = between group p-value calculated using Mann Whitney U Exact test
p-value² = change p-value calculated using Wilcoxon-Signed Rank test
SF-36 = RAND 36-Item Health Survey
ABC-UK = Activities-specific Balance Confidence scale (UK)
SCS = Seated Chair Stand (number of times)
SLS = Single Leg Stand (seconds)
FSST = Four Square Step Test (seconds)
Baseline, Follow-Up and Change – Mean ± SD

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Follow-Up</th>
<th>Change</th>
<th>NZ Norm Mean³</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF-36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Physical Functioning</td>
<td>67.8 ± 19.1</td>
<td>66.1 ± 16.7</td>
<td>-1.7 ± 9.7</td>
<td>55.4</td>
</tr>
<tr>
<td>- Role limitations – physical health</td>
<td>62.5 ± 44.8</td>
<td>69.4 ± 35.9</td>
<td>6.9 ± 36.2</td>
<td>56.0</td>
</tr>
<tr>
<td>- Role limitations – emotional health</td>
<td>68.5 ± 42.0</td>
<td>85.2 ± 26.1</td>
<td>16.7 ± 34.8</td>
<td>73.9</td>
</tr>
<tr>
<td>- Energy</td>
<td>60.6 ± 19.5</td>
<td>58.3 ± 19.4</td>
<td>-2.2 ± 13.2</td>
<td>60.6</td>
</tr>
<tr>
<td>- Mental health</td>
<td>81.1 ± 13.5</td>
<td>80.7 ± 13.4</td>
<td>-0.4 ± 14.7</td>
<td>77.7</td>
</tr>
<tr>
<td>- Social functioning</td>
<td>86.8 ± 20.8</td>
<td>83.3 ± 21.9</td>
<td>-3.5 ± 15.3</td>
<td>81.9</td>
</tr>
<tr>
<td>- Bodily Pain</td>
<td>77.2 ± 26.1</td>
<td>71.1 ± 26.6</td>
<td>-6.1 ± 9.4</td>
<td>68.1</td>
</tr>
<tr>
<td>- General health</td>
<td>65.8 ± 15.0</td>
<td>66.4 ± 19.0</td>
<td>0.6 ± 8.4</td>
<td>65.7</td>
</tr>
<tr>
<td>- Perceived change in health</td>
<td>59.7 ± 17.4</td>
<td>63.9 ± 24.6</td>
<td>4.2 ± 19.6</td>
<td>-</td>
</tr>
<tr>
<td>ABC-UK</td>
<td>86.9 ± 9.0</td>
<td>86.0 ± 12.4</td>
<td>-0.9 ± 7.3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCS</td>
<td>10.2 ± 2.2</td>
<td>11.5 ± 2.7</td>
<td>1.3 ± 1.3</td>
<td>-</td>
</tr>
<tr>
<td>SLS</td>
<td>12.7 ± 9.2</td>
<td>15.2 ± 10.9</td>
<td>2.5 ± 6.4</td>
<td>-</td>
</tr>
<tr>
<td>FSST</td>
<td>11.3 ± 2.8</td>
<td>9.6 ± 2.4</td>
<td>-1.7 ± 2.0</td>
<td>-</td>
</tr>
</tbody>
</table>

Data are presented as mean ± standard deviation unless specified.


SF-36 = RAND 36-Item Health Survey

ABC-UK = Activities-specific Balance Confidence scale (UK)

SCS = Seated Chair Stand (number of times)

SLS = Single Leg Stand (seconds)

FSST = Four Square Step Test (seconds)
Appendix B: Physical Outcome Measures
Physical Outcome Measures

Participants were required to complete a 5-15 minute warm-up prior to physical measurement, were given instructions and a demonstration, and before each test told to do their best and never push themselves “to a point of overexertion or beyond what you think is safe” (R. E. Rikli & C. J. Jones, 1999).

i. Seated Chair Stand (SCS)

Lower body strength was recorded with a 30s chair-stand test (Jones, Rikli, & Beam, 1999). The test began with the participant sitting on a secured chair (approximately 43cm high) with no arm rests. The participant’s heel of the dominant foot was placed on the toe of the non-dominant foot then widened to shoulder width with arms crossed at the wrist and held against their chest (Jones et al., 1999). The participant performed three practice repetitions with correct form. On the signal ‘go’ the participant stood and sat down as many times as they could within the 30s without moving their feet. The total number of stands executed correctly within the 30s period was counted and the final score taken from the average of three tests. If a participant was more than half way up in a squat when the 30s elapsed, this was counted as a full stand. Sufficient rest time, (45-60s) was allowed between sets for muscular recovery, which has not been specified in reliability studies (Jones et al., 1999; R. E. Rikli & C. J. Jones, 1999).

ii. Single-leg Stand (SLS)

Static balance was measured with a single-leg stand test (J. M. Miotto, W. J. Chodzko-Zaijo, J. L. Reich, & M. M. Supler, 1999b). Participants were instructed to “stay balanced as long as you can without moving your arms, taking a step or touching the ground with the other foot.” Participants held their arms crossed at the wrist and against their chest, and the timer was started once they raised their non-preferred foot off the ground by flexing their hip to a comfortable position (Miotto et al., 1999b). Patients practiced the test twice on each leg to help them choose which leg they prefer to be tested on. The test was repeated with shoes on, three times with a 20-30s break in between and the average of the three times taken as the final score. There was a maximum time limit of 30s and the timer was stopped if any of the following occurred a) arms moved off their chest, b) the planted foot moved from the starting position, or c) the opposite foot in the air touched the ground (Yaguchi & Furutani, 1998).

iii. Four Square Step Test (FSST)

Multi-directional dynamic balance and lower limb co-ordination was recorded using the Four Square Step Test (Whitney, Marchetti, Morris, & Sparto, 2007). The test required the participant to step in sagittal and frontal planes. Two pieces of foam, one meter in length, were taped to the ground in a ‘plus sign’ (+). Each participant started with both feet flat on the ground in the bottom left corner facing forward with their feet together. Participants were required to move in a clockwise direction around the plus sign (forward, to the
right, backward then to the left), returning to the starting position and then reserve the sequence back to the original starting position. At least one part of each foot had to touch down in each section. The participants were instructed to “try to complete the sequence as fast and safely as possible without touching the pieces of foam while facing forward during the entire sequence”. The participant performed one practice trial, followed by three recorded timed trials. The times of three correctly completed sequences was taken as the final score.

iv. References


Appendix C: Ethics Approval
Rob Moran
Lecturer and Programme Leader, Osteopathy
Building 41, Room 1024
Unitec Mt Albert Campus
Auckland

20.7.2011

Dear Rob,

Your file number for this application: 2011-1199
Title: The effects of a dance mobility program on physical functioning, self-perceived health status and balance confidence.

Your application for ethics approval has been reviewed by the Unitec Research Ethics Committee (UREC) and has been approved for the following period:

Start date: 20.7.2011
Finish date: 20.7.2012

Please note that:

1. The above dates must be referred to on the information AND consent forms given to all participants.

2. You must inform UREC, in advance, of any ethically-relevant deviation in the project. This may require additional approval.

You may now commence your research according to the protocols approved by UREC. We wish you every success with your project.

Yours sincerely,

Scott Wilson
Deputy Chair, UREC
Catherine Bacon  
Research Supervisor - Osteopathy  
Building 23, Room 1020  
Unitec Mt Albert Campus  
Auckland  

25.8.2011  

Re: Request for changes  

Dear Catherine,  

Your file number for this application: 2011-1199  
Project Title: The Effects of a Dance Mobility Program on Physical Functioning, Self-Perceived Health Status and Balance Confidence.  

Your request for changes to the above application have been reviewed by the Unitec Research Ethics Committee (UREC) and have been approved for the following period:  

Start date: 20.7.2011  
Finish date: 20.7.2012  

Please note that:  

1. The above dates must be referred to on the information AND consent forms given to all participants  
2. You must inform UREC, in advance, of any ethically-relevant deviation in the project. This may require additional approval.  

You may now continue your research according to the protocols approved by UREC. We wish you every success with your project.  

Yours sincerely,  

Scott Wilson  
Deputy Chair, UREC  

cc: Rob Moran
Steve Chesterfield and Tania Russell
c/o Unitec Department of Osteopathy
Building 41
118 Carrington Road

26.1.2012

Dear Steve and Tania,

Your file number for this application: 2011-1248
Title: The Effects of a Dance Programme on Physical Functioning, Self-Perceived Health Status and Balance Confidence.

Your application for ethics approval has been reviewed by the Unitec Research Ethics Committee (UREC) and has been approved for the following period:

Start date: 15.12.2011
Finish date: 15.12.2012

Please note that:

1. The above dates must be referred to on the information AND consent forms given to all participants.

2. You must inform UREC, in advance, of any ethically-relevant deviation in the project. This may require additional approval.

You may now commence your research according to the protocols approved by UREC. We wish you every success with your project.

Yours sincerely,

Scott Wilson
Deputy Chair, UREC

cc: Catherine Bacon
Cynthia Almeida
Appendix D: Information Sheet for Participants
The Effects of a Dance Programme on Physical Functioning, Self-Perceived Health Status and Balance Confidence

You are invited to participate in a research investigation that is running alongside the dance class which you’re already attending at Selwyn Village.

Please read carefully through this information sheet and ask as many questions as you like before you make a decision about volunteering.

Important: Choosing not to participate in the research doesn’t effect your ability to continue with the dance classes.

Who are the researchers?
Steven Chesterfield and Tania Russell are students entering the final year of a Master of Osteopathy degree at Unitec New Zealand and are the research investigators. Rob Moran and Dr Catherine Bacon are the research supervisors and lecturers within the Faculty of Health and Social Sciences at Unitec New Zealand (Mt Albert campus).

What is this study all about?
The main aim of the study is to investigate the effects of a dance mobility programme on several key risk factors for falling in older adults.

The primary objectives are to determine if participating in a mobility-focused contemporary dance class once per week for nine weeks could improve:

1. Muscular endurance of the lower extremity and lower back
2. Multidirectional step coordination and balance
3. Single leg balance
4. Self-perceived health status
5. Self-perceived balance confidence

We will also be asking participants to rate their enjoyment levels at the end of the program on the dance program and if applicable, their enjoyment level of up to 5 other exercise forms that they may have previously participated in.

The characteristics we’re measuring have been linked to falling in older age groups and as the New Zealanders get older, preventing falls is an important consideration, both for the
health and well-being of individuals but also for the associated economic impact. According to Statistics New Zealand (2009) the projected population aged 65 years and older will have increased from 13% in 2009 (550,000) to over 20% (over 1 million) in the late 2020’s in New Zealand. It has been estimated that 1 in 3 people over 65 years of age who live in the community fall at least once per year, and that 10-15% of those falls are associated with serious injury.

Keeping mobile and exercising has been proposed to reduce the risk of falls in older adults, and whilst exercise programs like Tai Chi and the Otago Exercise Program have been proven to reduce falls and are recommended by ACC in New Zealand, a variety of exercise options needs to be available to cater for individual preferences across a wide population. Dance programs have been shown to be effective in reducing falls and the risk of falls, however, to date there is limited research into dance programs in New Zealand.

By participating in this study you will help us to start investigating the role that dance programmes like this one might have in preventing falls.

**Who may participate?**
Any person over the age of 65 who is attending the dance mobility programme is eligible to participate.

Unfortunately, you will not be able to be participate in the study if you have difficulty understanding written or spoken English.

Please feel free to contact the lead researcher (contact details below) if you are unsure about your eligibility.

**What will happen in the study?**
If you choose to participate in the study, here is what will happen:

At your first dance class, you will be asked to:
1. Carry out three physical measurement tests after the warm-up period of dance and provide some basic information regarding your general health. This should take no more than 10 minutes, after which time you will re-join the dance class. These tests are designed to be no more physical than the dance class itself and consist of:

   - **The first test is a 30 second Seated Chair Stand.** You will start this test by sitting down in a chair with your arms folded in front of you. Once you been given the instructors to start a timer will begin. You are required to stand and return to your seated position as many times as possible until the times stops after 30 seconds at which point the instructor will let you know you may stop.
- The second test is a **Four Square Step Test**. You are required to start in the bottom left corner and will move around in a clockwise direction making sure both feet touch in each square. (see appendix) Once you have returned to your starting position you will return in an anticlockwise direction back to where you started from. This test will be times also and the instructor will let you know when you will start. You will be give a practise run through first followed by three timed trials.

- The last test is a **single leg standing balance test**. In this test you will be required to stand on preferred leg and lift the other leg out in front of you and hold the position for as long as you can or when 30 seconds is up, whichever is first. You will also be given the chance to figure out which leg you preferred to use and three timed tests will be taken.

2. **Take home and fill out two questionnaires in your own time to be returned at the start of the next class.** The first one asks you to rate your current level of health, including physical and emotional health, called the medical outcomes study 36-Item Short Form Survey Instrument (SF-36). The second one asks you to rate your level of confidence in being able to perform 16 tasks, you might come across in daily life, without falling, called the Activities-specific Balance Confidence Scale (ABC).

At your final dance class in week 9, you will be asked to repeat the above physical tests and be asked to take home the questionnaires to fill out again, returning the questionnaires in pre-paid envelopes. There will also be an additional four-item questionnaire evaluating your enjoyment levels of the program and if applicable, your enjoyment levels of any previous exercise or movement program you may have participated in before.

**Discomforts/risks and benefits**
All of the physical measures taken during this study will be no more physical than the dance program itself. You will be guided through the tasks by the researcher with support from a research assistant where necessary. The tests will be re-explained to you at the time and you will be free to withdraw from participation in the study without reason at any time up until one week after the final week of class.

**What we do with the data and results, and how we protect your privacy.**
Personal information is collected and stored under the guidelines provided by the Privacy Act 1993 and the Health Information Privacy Code 1994. Your name will be recorded on the written consent form and the general health questionnaire. However, in all other instances of information collection your identity will remain anonymous and you will simply have an identification number. If the information you provide is reported or published, this will be done in a way that does not identify you as its source. All the data recorded will be stored securely and access to it will be limited to the principal researcher, the research supervisors, and yourself.
**Participation is voluntary**
The decision to participate in this study is totally voluntary. If at any time you feel uncomfortable you may inform the researcher and the measurement will be stopped immediately.

Your participation in this study will help to evaluate this dance mobility program and will provide a valuable addition to the ongoing research into exercise programs for the prevention of falls in older adults.

Please feel free to contact us at any time if you need further information about this study.

**Contact Details**

Stephen Chesterfield  
Phone: 021 626 657  
Email: chesterfieldsteve@hotmail.com

Tania Russell  
Phone: 021 031 4198  
Email: taniarussell@hotmail.com

**UREC REGISTRATION NUMBER:**
This study has been approved by the UNITEC Research Ethics Committee from 7th December 2011 to 6th December 2012 under ethics application number 2011-1248. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (ph: 09 815-4321 ext 6162). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
Appendix E: Participant Consent Form
PARTICIPANT CONSENT FORM

The Effects of a Dance Programme on Physical Functioning, Self-Perceived Health Status and Balance Confidence

This research project investigates a dance programme designed for older adults. We’re interested in knowing more about how your mobility and balance changes in response to dance.

Name of Participant: _______________________

I have seen the Participant Information Sheet and had the opportunity to read the contents and discuss the project with the primary researcher and I am satisfied with the explanations I have been given.

I consent to the researchers obtaining copies of the health status information that I provided to the class organisers prior to beginning the programme.

I understand that the anonymised data from the project will be held indefinitely for the purposes of future analysis and research.

I understand that taking part in this project is voluntary (my choice) and that I may withdraw from the project at any time prior to commencement of data analysis and this will in no way affect my access to the dance programme provided at Selwyn Village.

I understand that I can withdraw from the study if, for any reason, I want to do so.
I understand that I can withdraw my data from the study at any time up until the date of the last data collection session.

I understand that the data recorded in this research project is confidential, and no material that could identify me will be used in any reports of this project.

I acknowledge that any materials collected during the study will be stored securely so that only the researchers may access them. I understand that my data collection records will be made available on request.
I understand that any data collected (i.e. measurements) will be made anonymous and kept indefinitely to enable further analysis with data from other future studies.

I have had enough time to consider whether I want to take part.

I know whom to contact if I have any questions or concerns about the project.

The principal researchers for this project are Steven Chesterfield and Tania Russell supervised by Dr Catherine Bacon and Rob Moran.

Rob Moran
Tel: 815 4321 x8197
Mob: 021 073 9984
Email: rmoran@unitec.ac.nz

Signature: _____________________________ (participant)
Date:________________

Project explained by researcher

Signature:_____________________________
Date:________________

The participant should retain a copy of this consent form.

UREC REGISTRATION NUMBER:
This study has been approved by the UNITEC Research Ethics Committee from 7th December 2011 to 6th December 2012 under ethics application number 2011-1248. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (ph: 09 815-4321 ext 7248). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
Appendix F: Enrolment Form
Enrolment Form

Name: _______________________

Address: _______________________

Email: _______________________

Phone Hm: _______________________

Mobile: _______________________

Emergency Contact Name: _______________________

Phone: _______________________

Age: _______________________

Do any of the following apply to you? (please tick)

☐ I normally walk with an assistive device

☐ I have had a fall in the past 6 months (including a slip or trip in which you lost your balance and landed on the floor or ground or lower level)

☐ I am on four or more medications

☐ I have uncontrolled high blood pressure (over 160/100)

☐ I experience chest pain, dizziness or angina brought on by exercise

☐ My doctor has advised me not to perform cardiovascular exercise

Have you ever been diagnosed with any of the following? (please tick)

☐ Congestive heart failure

☐ Diabetes

☐ Stroke

☐ Parkinson’s Disease

This information is being collected for your safety. If you choose to take part in the optional research (by signing the separate consent form) this information may also be summarised for research purposes.

I agree to this information being used as stipulated above.

Signed: _______________________

Date: _______________________

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Appendix G: Medical History Questionnaire
History Questionnaire

Name:

Age:

1. In the past 6 months, have you experienced any of the following? (please tick)
   - Ankle, knee or hip injury
   - Changes to the way you walk
   - Orthopaedic surgery of the hip, knee or ankle
   - Any change to the way you walk

2. Have you ever been diagnosed with any of the following? (please tick)
   - Head injury
   - Arthritis that requires management
   - Inner ear disease
   - Neurological disease
   - Vestibular disease (poor balance)
   - Nystagmus (abnormal eye movements)
   - Horner’s syndrome (consists of drooping upper eyelid, constricted pupil)
   - Eye disease, e.g. glaucoma
3. Do any of the following apply to you? (please tick)
   - I normally wear corrective glasses/lenses for seeing in the distance or reading
   - I normally use a hearing aid
   - I am on pain medication

4. In the past year, have you participated in any other movement/mobility programme or form of exercise?
   - Yes
   - No

5. If Yes, please list each programme or exercise, your level of enjoyment of each, and if you currently still participate, how many days per week you take part.

<table>
<thead>
<tr>
<th>Exercise e.g. Walking, Tai Chi</th>
<th>Enjoyment level Enter a Number from 1-5: 1=do not enjoy at all, 5=enjoy immensely</th>
<th>How many days per week you currently take part Enter a Number from 1-7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I agree that the information from my Dance enrolment form may be used for analysis purposes as a part of this research in addition to the information collected in this questionnaire.

Signature: ___________________________ Date: ___________________
Appendix H: ABC-UK – Activities-specific Balance Confidence Scale (UK)
Activities-specific Balance Confidence Scale (ABC-UK)

Name:

For each of the following activities, please indicate your level of self confidence by choosing a corresponding number from the rating scale 0% to 100%, with 0% meaning you have no confidence and 100% meaning you feel completely confident.

How confident are you that you can maintain your balance and remain steady when you:

1. walk around the house? ____%
2. walk up or down stairs? ____%
3. bend over and pick up a slipper from the floor at the front of a cupboard? ____%
4. reach for a small tin of food from a shelf at eye level? ____%
5. stand on your tip toes and reach for something above your head? ____%
6. stand on a chair and reach for something? ____%
7. sweep the floor? ____%
8. walk outside the house to a parked car? ____%
9. get into or out of a car? ____%
10. walk across a car park to the shops? ____%
11. walk up or down a ramp? ____%
12. walk in a crowded shopping centre where people walk past you quickly? ____%
13. are bumped into by people as you walk through the shopping centre? ____%
14. step onto or off an escalator while holding onto the handrail? ____%
15. step onto or off an escalator while holding onto parcels such that you cannot hold onto the handrail? ____%
16. walk outside on slippery pavements? ____%

Signature: ___________________________ Date: _________________

Appendix I: SF-36 – RAND 36-Item Health Survey
RAND 36-item Health Survey (SF-36)

Name:

1. In general, would you say your health is:
   - Excellent [1]
   - Very good [2]
   - Good [3]
   - Fair [4]
   - Poor [5]

2. Compared to one year ago, how would you rate your health in general now?
   - Much better now than one year ago [1]
   - Somewhat better now than one year ago [2]
   - About the same [3]
   - Somewhat worse now than one year ago [4]
   - Much worse now than one year ago [5]

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? (Circle One Number on Each Line)

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Yes, Limited a Lot</th>
<th>Yes, Limited a Little</th>
<th>No, Not limited at All</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
<tr>
<td>4. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
<tr>
<td>5. Lifting or carrying groceries</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
<tr>
<td>6. Climbing several flights of stairs</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
<tr>
<td>7. Climbing one flight of stairs</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
<tr>
<td>8. Bending, kneeling, or stooping</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
<tr>
<td>9. Walking more than a mile</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
<tr>
<td>10. Walking several blocks</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
<tr>
<td>11. Walking one block</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
<tr>
<td>12. Bathing or dressing yourself</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
</tr>
</tbody>
</table>
During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health**? *(Circle One Number on Each Line)*

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Cut down the amount of time you spent on work or other activities</td>
<td>[1]</td>
<td>[2]</td>
</tr>
<tr>
<td>14. Accomplished less than you would like</td>
<td>[1]</td>
<td>[2]</td>
</tr>
<tr>
<td>15. Were limited in the kind of work or other activities</td>
<td>[1]</td>
<td>[2]</td>
</tr>
<tr>
<td>16. Had difficulty performing the work or other activities (for example, it took extra effort)</td>
<td>[1]</td>
<td>[2]</td>
</tr>
</tbody>
</table>

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)? *(Circle One Number on Each Line)*

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Cut down the amount of time you spent on work or other activities</td>
<td>[1]</td>
<td>[2]</td>
</tr>
<tr>
<td>18. Accomplished less than you would like</td>
<td>[1]</td>
<td>[2]</td>
</tr>
<tr>
<td>19. Didn't do work or other activities as carefully as usual</td>
<td>[1]</td>
<td>[2]</td>
</tr>
</tbody>
</table>

20. During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups? *(Circle One Number)*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>[1]</td>
</tr>
<tr>
<td>Slightly</td>
<td>[2]</td>
</tr>
<tr>
<td>Moderately</td>
<td>[3]</td>
</tr>
<tr>
<td>Quite a bit</td>
<td>[4]</td>
</tr>
<tr>
<td>Extremely</td>
<td>[5]</td>
</tr>
</tbody>
</table>

21. How much **bodily** pain have you had during the **past 4 weeks**? *(Circle One Number)*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>[1]</td>
</tr>
<tr>
<td>Very Mild</td>
<td>[2]</td>
</tr>
<tr>
<td>Mild</td>
<td>[3]</td>
</tr>
<tr>
<td>Moderate</td>
<td>[4]</td>
</tr>
<tr>
<td>Severe</td>
<td>[5]</td>
</tr>
<tr>
<td>Very severe</td>
<td>[6]</td>
</tr>
</tbody>
</table>

22. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)? *(Circle One Number)*

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>[1]</td>
</tr>
<tr>
<td>A little bit</td>
<td>[2]</td>
</tr>
<tr>
<td>Moderately</td>
<td>[3]</td>
</tr>
<tr>
<td>Quite a bit</td>
<td>[4]</td>
</tr>
<tr>
<td>Extremely</td>
<td>[5]</td>
</tr>
</tbody>
</table>
These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks . . . (Circle One Number on Each Line)

<table>
<thead>
<tr>
<th>Question</th>
<th>All of the Time</th>
<th>Most of the Time</th>
<th>A Good Bit of the Time</th>
<th>Some of the Time</th>
<th>A Little of the Time</th>
<th>None of the Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>27. Did you have a lot of energy?</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
<td>[4]</td>
<td>[5]</td>
<td>[6]</td>
</tr>
<tr>
<td>32. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)? (Circle One Number)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A little of the time</td>
<td>[4]</td>
<td>[5]</td>
<td>[6]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None of the time</td>
<td>[5]</td>
<td>[6]</td>
<td>[</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How TRUE or FALSE is each of the following statements for you. (Circle One Number on Each Line)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Definitely True</th>
<th>Mostly True</th>
<th>Don't Know</th>
<th>Mostly False</th>
<th>Definitely False</th>
</tr>
</thead>
<tbody>
<tr>
<td>33. I seem to get sick a little easier than other people</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
<td>[4]</td>
<td>[5]</td>
</tr>
<tr>
<td>34. I am as healthy as anybody I know</td>
<td>[1]</td>
<td>[2]</td>
<td>[3]</td>
<td>[4]</td>
<td>[5]</td>
</tr>
</tbody>
</table>

Signature: Date:

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Appendix J: Program Evaluation
Program Evaluation

Name:

1. How would you rate your enjoyment of this dance program overall? Please enter a number from 1-5: 1=did not enjoy at all, 5=enjoyed immensely _____

2. How would you rate the music used in this dance program? Please enter a number from 1-5: 1=did not enjoy at all, 5=enjoyed immensely _____

3. What did you enjoy about this dance program?
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

4. What did you not enjoy about this dance program?
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

Signature:

Date: