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PREVENTION & REHABILITATION: OBSERVATIONAL STUDY

Changes in gait and balance parameters in elderly subjects attending an 8-week supervised Pilates programme

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Summary Falls in the elderly have important clinical and economic costs and interventions that may reduce the risk of such problems are potentially important. Although evidence exists for a range of exercise interventions, few have looked at a Pilates-based intervention in a supervised community-based setting and none have specifically measured gait parameters as an outcome.

This observational study investigated gait parameters including inter-stride variability (ISV) and postural sway in a group ($n = 9$) of elderly (age range, 60–76) subjects attending a weekly Pilates class over eight weeks.

The results suggest that significant improvement in walking speed (0.14 m/s (95% CI: 0.06 −0.21)), step cycle (0.07 m (95% CI: 0.01–0.14)) and length (0.10 m (95% CI: 0.05–0.15)) and a composite ambulation index (6.5% (95% CI: 1.85–11.26)) were seen post the intervention, while coefficients of variation decreased around 15%. In addition both anterior–posterior sway decreased along with a improvement in a fall risk index (FRI). Inter-stride variability on the other hand did not change.

The results of this study suggest that a short Pilates program may have the potential to improve gait and sway parameters, including those associated with fall risk.

Background

Falls amongst the elderly population account for 71% of fatal accidents in over 65 year olds (ROSPA, 2009) and contribute significantly to immobility, early nursing home placement and even mortality (Rubenstein, 2006). The consequences of falling in the elderly have an estimated

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cost of £15 million per year of direct health funding, and it is clear that reducing fall risks through identification and appropriate modification would considerably reduce the cost to individuals, carers and health providers alike.

Falls are multi-factorial in origin, with prominent risk factors including gait dysfunction and balance (Rubenstein, 2006).

Gait disorders affect 20–40% of people aged over 65, and 40–50% of those over 85 (Rubenstein, 2006). Among the parameters associated with impaired gait are increases in stride or step variability, which has been highlighted as an important predictor of falling (Maki, 1997). The association between stride or step variability and fall risk has been theorised as neurological in nature and centre upon the supposition that healthy physiological systems display dynamics that include optimum noise mixed with regularity. This has been termed "complexity" and is theorised to be at a maximum in healthy physiological systems (Hong et al., 2006).

The link with stride variability and neurological deficit was initially investigated by Hausdorff et al. (1998) who reported a doubling of inter-stride variability in Parkinson's patients and a tripling in Huntington's patients in comparison to healthy subjects. Subsequently a number of authors have linked neuro-degeneration with loss of complexity in gait parameters (Scafetta et al., 2009). However, it has also been suggested that patients free of neurodegenerative diseases but with psychological factors, such as fear of falling may also display increased gait variability (Herman et al., 2005). Despite a lack of consensus regarding the origins of this increased variability, changes in this parameter have been strongly linked with raised falling risk.

In addition to inter-stride or step variability (ISV), deterioration in balance parameters is also unsurprisingly associated with falling risk (Bergland et al., 2003). Using centre of pressure measures (CoP), Bergland and Wyller (2004) reported that increased sway, particularly in the frontal plane, was associated with a heightened risk of sustaining a serious fall related injury. It is thought that elderly individuals are predisposed to falls due to the decline in proprioception and slower protective reflexes caused by ageing (Rubenstein, 2006).

Ideally, in addition to identification of risk for falling, primary or secondary prevention of falling may be achieved by modifying these risk factors. As a generic means to address many of these factors, exercise is a common choice among health professionals (Chang et al., 2004).

Exercise can improve determinants of risk of falling such as physiological capacity, the most effective methods being balance and strength training (Morgan et al., 2004). Low-intensity exercise may reduce risk factors such as poor balance, reduced step velocity, muscle weakness and functional capacity. It is, however, best targeted at elderly men and women as it has been shown to be detrimental to individuals with higher physical function (Morgan et al., 2004). A web-based study showed that Swiss ball training has been seen to improve strength and balance in the elderly, and this combined with the use of the Internet offers a cost effective method of broadcasting information to reach a wider audience (Yardley and Nyman, 2007).

Although generic exercise has been shown to improve fall risk, targeting particular exercise regimes to appropriate groups may serve to ameliorate problems such as motivation and compliance. Particular exercises that emphasise balance (Tai Chi) or target improved core stability and strength (Pilates) are chosen by individuals as they best fit into lifestyle and philosophical choices. As such, both of these interventions have been associated with improved postural stability (Li et al., 2003; Johnson et al., 2007; Bergland and Wyller, 2004).

Although studies have explored the potential benefits of home-based Pilates exercise, none have investigated any association between a Pilates-based exercise programme, on gait parameters, including inter-stride variability. The aim of this study therefore is to investigate whether elderly subjects attending a community-based supervised Pilates-based programme improved in terms of both gait and balance parameters.

Method

Subjects

Subjects applying to the institutions established Pilates programme were invited to take part on a voluntary basis. Those eligible for the study fulfilled the following inclusion criteria: Age over 60 years and no known injuries or pathology that would affect gait or postural stability.

Participants were excluded if they had taken part in any Pilates-based exercise within the last 2 years or if their Pre-Activity Readiness Questionnaire (PAR-Q) revealed contra-indications for participation in exercise testing. Participants signed a written informed consent form and the institution Ethics Committee approved the protocol.

Intervention

The 8-week intervention involved a 1-h, supervised Pilates session per week taken by the same qualified instructor. In these classes, core stability was addressed by the use of abdominal bracing and pelvic tilt exercises. Spinal mobility (e.g. (i) sitting with knees tucked into chest and rolling backwards or (ii) whilst supine, tucking knees into chest and performing gluteal contractions and bridging) was also targeted. Lower limb exercises addressed quadriceps, hamstrings, gastrocnemieus, soleus and tibialis anterior (e.g. (i) placing a cushion under knee/calf and performing straight leg raises and (ii) plantarflexion and dorsiflexion using Theraband). Upper limb exercises included abduction and flexion using weights. A wobble board was used primarily to strengthen the ankle and improve mobility. A swiss ball was used to enhance core stability exercises (e.g. abdominal brace and pelvic tilt) (Yardley and Nyman, 2007) (further detail can be found in Appendix 1).

The frequency of participation was logged and kept by each individual.

Apparatus and procedures for measuring outcome

Gait parameters

Participants walked on a Biodex Gait Trainer 2 (*Biodex Medical Systems Inc*) which consisted of a motorised