Clinician's Commentary on Wilhelm et al.[1]

Osteoporotic fracture is associated with restricted physical function and difficulties with activities of daily living (ADL).[2] Part of *Physiotherapy Canada*'s special series on Bone Health, the systematic review by Wilhelm and colleagues was carried out to determine whether resistance exercise improves physical function and ADL in older adults with osteoporosis or osteopenia.[1] The authors used Jette's definition of physical function as "the individual's performance of daily activities required to sustain oneself. Examples include performance of basic life activities (basic ADL) such as dressing, bathing, and walking and more complex life activities (called instrumental ADLs, IADL) such as meal preparation, shopping and transportation."[3(p.530–1)] Wilhelm and colleagues calculated effect sizes for each self-reported physical function outcome but were unable to pool data. Based on the qualitative synthesis of five small trials of moderate quality (5–7 on the PEDro scale), they conclude that resistance exercises improve self-reported physical function in older adults with low bone mass. Their systematic review is one of the few sources of high-level evidence on how resistance exercise affects ADL in postmenopausal women with osteoporosis and osteopenia.

Wilhelm and colleagues highlight the need for a high-quality randomized controlled trial to determine whether exercise improves "performance of daily activities"[3] in older adults with osteoporosis or osteopenia.[1] Factors that precluded quantitative synthesis of the data available to date include the small number of trials, variability in intervention and assessment methods, and inclusion of different study populations. The five trials included in the review recruited older women with osteoporosis and osteopenia based on areal bone-mineral density (aBMD) measures,[4–8] but one study included only women with a history of fracture,[4] three included women regardless of fracture status,[5–7] and one excluded women with a history of fracture.[8]

Identifying people at risk for osteoporotic fracture is a challenge. In 1994 the World Health Organization operationalized the definition of osteoporosis and developed guidelines for using aBMD derived from dual-energy X-ray absorptiometry (DXA) of the proximal femur and lumbar spine to assign individuals to one of three diagnostic categories (normal, osteopenic, or osteoporotic).[9] Thresholds for each diagnostic category (T-scores calculated as difference from mean aBMD value for gender-matched young adults divided by standard deviation of the spread in aBMD values for young adults) were determined largely based on epidemiological rates of osteoporotic fracture in Caucasian postmenopausal women.[9] On a population basis, aBMD predicts risk for osteoporotic fracture, such that fracture risk doubles for each unit reduction in T-score,[10] but among people with low bone mass it is difficult to predict who will experience an osteoporotic fracture.[10] In 2001 the definition of osteoporosis was updated to reflect the fact that factors other than bone density (bone mass) contribute to the risk of osteoporotic fracture.[11]

Osteoporosis is defined as "a skeletal disorder characterized by compromised bone strength predisposing to an increased risk of fracture. Bone strength primarily reflects the integration of bone density and bone quality . . . Bone quality refers to architecture, turnover, damage accumulation [e.g., microfractures], and mineralization."[11(p.786)] The Canadian clinical practice guidelines for diagnosis and management of osteoporosis, published in 2010, recommend basing treatment decisions on each individual's absolute 10-year fracture risk,[12] estimated as low (<10%), moderate (10–20%), or high (>20%) based on a combination of key clinical factors (age, gender, fracture history, parental fracture history, use of glucocorticoids) and aBMD at the hip or lumbar spine.[12] Indeed, the presence of certain clinical factors (e.g., fragility fracture after age 40 and daily systemic glucocorticoid use for more than 3 months) can identify individuals at high risk of fracture regardless of aBMD results.[12] An individual's 10-year fracture risk is used to guide decisions about prescription of osteoporosis medications, and the type of drug therapy will influence outcomes such as pain and fracture risk.[12] In designing future trials, it will be important to consider the target population and medication usage carefully to determine the effect of resistance exercise on physical function in men and to test the real possibility that resistance exercise training may have a different effect in those who have sustained an osteoporotic fracture and are at higher risk of subsequent fractures than in those who have a lower fracture risk.

Wilhelm and colleagues point out that poorer physical function (difficulties with ADL) has been observed following hip and spine fractures and that resistance training may improve outcomes following fracture.[1] The relationship between resistance exercise training and physical function in older people who have not experienced an osteoporotic fracture is less clear. A pilot trial by Chien and colleagues was designed to inform a larger trial addressing that very question.[8] Although these pilot data could be meaningfully pooled with those from similar trials (if available), extreme caution should be used when interpreting the results in isolation, since pilot studies are designed to address feasibility objectives rather than effectiveness of interventions.[13] If the hypothesis is that better physical function, achieved through resistance exercise training, mediates reductions in falls and prevents osteoporotic fracture, it will be important to include rates of incident falls and fragility fractures as outcomes in future trials. Again, identifying the target population will be key to facilitate interpretation and clinical application of the findings.

In general, the methodological quality of the available trials limits the potential for future meta-analyses. For example, one trial included the experimental data from the same women initially randomized to the wait-list control group,[5] and only one of the five included a sham-exercise group as the control arm to minimize attention bias.[7] An important consideration for future trials is the inclusion of a sham-exercise arm (placebo control), which could enable blinding of participants, since the primary outcome is self-reported physical function, and risk of bias increases (i.e., effect size is overestimated) when participants are not blinded. As Wilhelm and colleagues note, performance-based and self-reported measures of physical function assess different attributes of the construct.[1] Only two of the five included trials assessed physical function using both performance-based tests (functional reach and/or tandem walk) and a self-report questionnaire,[4,5] but walking/mobility tests are commonly used to measure physical function in exercise trials in people

with established osteoporosis.[14] To date, performance-based measures to assess ADLs in this population, such as the Continuous-Scale Physical Functional Performance test[15] and the Safe Functional Motion test,[16] have not been used as outcomes in exercise trials. To determine the effect of resistance exercise on physical function in people who have or are at elevated risk of osteoporotic fracture, both self-reported and performance-based measures of physical function are required.

Trials that involved interventions other than resistance exercises were excluded from Wilhelm and colleagues' systematic review.[1] This decision facilitated interpretation of the findings on the effect of resistance training. While the quality of the available evidence limits our confidence in the estimates, resistance training does appear to improve physical function to some extent in women with low bone mass, whether or not they have suffered an osteoporotic fracture. As the population ages and more people develop osteoporosis, it will be important to identify effective multicomponent physiotherapy interventions tailored to various levels of fracture risk. Wilhelm and colleagues' work provides evidence to support including progressive resistance exercise training in a tailored management plan for postmenopausal women with osteoporosis or osteopenia.

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