The Future Is Physio ...

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The year 2000 saw the beginning of a worldwide international collaboration that sought to improve “the quality of life of people with musculoskeletal problems around the world.”^{1(p.1)} This initiative, the Bone and Joint Decade,¹ aimed to inform and address the scope of musculoskeletal problems to develop effective prevention strategies. It is not surprising that this was a worldwide approach, as musculoskeletal injuries are universally prevalent and their consequences (including pain and disability) have far-reaching personal and societal consequences. Physiotherapists are all too familiar with the impairments, limitations, and restrictions resulting from musculoskeletal health conditions. They also play a vital role in the management of mobility, which is inextricably linked to bone health across the lifespan.

The US surgeon general defines bone health “as a public health issue with an emphasis on prevention and early intervention to promote strong bones and prevent fractures and their consequences.”^{2(p.1)} Bone health, therefore, is an indicator of the state of our musculoskeletal system, and good bone health is important for mobility. We can measure bone health in a number of ways, both clinically and from a research perspective. A low-trauma fracture, one that occurs from a standing height or less,³ is considered an indicator of low bone mass; in addition, bone can also be measured clinically via imaging. Dual-energy X-ray absorptiometry (DXA) is considered the criterion standard for diagnosis of osteoporosis. More recently, we have seen the introduction of FRAX,⁴ an online calculator that determines the 10-year fracture risk based on the presence of known risk factors (with or without DXA scores). From a research perspective, there have been novel developments that provide an estimate of bone strength (or resistance to fracture). Although DXA gives an estimate of bone density, it is limited by the fact that it provides only a two-dimensional view of bone and cannot separate cortical bone from trabecular bone. Despite these limitations, however, landmark work by McKay et al.^{5,6} in the 1990s used DXA to highlight the unique window of opportunity of maximizing bone health in childhood and adolescence.

More recent developments in imaging include peripheral quantitative computed tomography (pQCT), which

provides a three-dimensional view of bone and separate analyses for cortical and trabecular bone. This level of detail is important to determine the relative contributions of lifestyle interventions, such as exercise, to bone health. Examples of how this newer imaging advances knowledge are provided in the work of Liu-Ambrose et al.⁷ and Pang et al.⁸ Both these studies highlighted the beneficial effects of group exercise programmes on bone health in older adults, including those with stroke.

High-resolution pQCT (HR-pQCT) is the next generation and provides an even more detailed look at trabecular microstructure and cortical porosity. This detailed characterization of bone is helpful in understanding underlying mechanisms and, again, the potential benefits of exercise interventions. Macdonald et al.⁹ have recently used HR-pQCT to describe changes in bone microstructure and cortical porosity that occur with ageing. Cortical porosity may also be part of the changes associated with bone health in adults with type 2 diabetes mellitus (T2DM).¹⁰

Issues related to bone health are difficult to separate from other body systems. For example, after a stroke there are observed changes in bone density in the extremities¹¹ and an increased risk for fractures.¹² Likewise, adults with T2DM are at greater risk for low-trauma fractures,¹³ despite a normal or even higher than normal bone-mineral density.¹³ Importantly, we know that good bone health starts early in childhood,¹⁴ and therefore, from a clinical perspective, bone health is not just an issue for physiotherapists working in musculoskeletal areas but crosses all age groups and clinical practice areas.

Two of the most common musculoskeletal concerns for adults are hip fractures and osteoarthritis-related joint replacements. In Canada, approximately 27,000 hip fractures¹⁵ occur each year, and estimated direct costs in the first year following a hip fracture are approximately CAN\$26,000 per fracture.¹⁶ This is likely an underestimation, as the personal costs are even greater. Up to one-fifth of seniors who experience a hip fracture may die within the first year after the fracture,¹⁷ and half may not regain their pre-fracture mobility^{18,19}—mobility being a key element of physiotherapy practice. Interestingly, recent work from Bischoff-Ferrari et al.²⁰ noted

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that extended physiotherapy treatment following a hip fracture significantly reduced falls in older adults. In a previous study, Binder et al.²¹ also noted an improvement in physical function and quality of life with additional physiotherapy treatment following discharge.

Mobility disability is related to difficulties in walking²² and is often defined as the inability to walk 400 m or a similar distance.²³ A meta-analysis by Cooper et al.²⁴ recently published in the *British Medical Journal* noted the significant relationship between physical capability (e.g., gait speed, grip strength) and increased risk of mortality (all causes). The relationship between mobility and bone strength in older adults after hip fracture requires further investigation; however, a cross-sectional pQCT study highlighted significant side/side differences in bone geometry and density in the lower leg following hip fracture.²⁵ An older adult who experiences a first hip fracture is at risk for a second,^{26,27} and low bone mass and impaired mobility are significant risk factors.²⁸ As the management of mobility falls within the parameters of physiotherapy practice, we play an important leadership role.

The second musculoskeletal condition affecting a significant proportion of our population is osteoarthritis and its consequences—replacement of hip and knee joints. Approximately 10% of the Canadian population has osteoarthritis,²⁹ and Canadian Joint Replacement Registry (CJRR) data³⁰ indicate that in 2008–2009 there were more than 62,000 hospitalizations for hip and knee replacement surgeries (the true total is higher, as CJRR data do not include Quebec). Importantly, a three times greater risk of joint replacement is associated with obesity.³¹ Once again, this is an area where physiotherapists play a significant role in the rehabilitation and recovery phases. But what is the relationship between osteoporosis (low bone mass) and osteoarthritis? Despite the potential similarities of the populations, previous research³² has suggested an inverse relationship between osteoarthritis and osteoporosis, but this question requires further investigation.³³

Preventing bone-health-related problems requires a lifespan approach, and we know that this starts in childhood. In particular, regular physical activity and a reduction in sedentary behaviours (defined as “sleeping, sitting, lying down, and watching television and other forms of screen-based entertainment”^{34(p.174)}) are essential to maintaining good overall health. Physical activity, and exercise in particular, is an important management option. However, we also need to focus on reducing sedentary behaviour. An emerging literature on this topic suggests that just as there is a physiology associated with being active, there may be a distinctly different physiology associated with sitting too much.^{34–38} In particular, there is evidence that prolonged time spent in activities such as watching TV and using a computer can have negative health consequences. We are just starting to

realize the impact of sedentary behaviour on cardio-metabolic outcomes,³⁹ and we need to investigate what all that sitting is doing to our bones and our brains. In the words of Dr. Steven Blair, a world expert in physical activity, “We’ve engineered energy expenditure out of our lives.”⁴⁰ As physiotherapists, we assess an individual’s ability in order to determine how to add appropriate activity into his or her daily routines. Given the low rate at which Canadians are meeting physical activity guidelines,^{41,42} we have a lot to do.

The next several issues of *Physiotherapy Canada* will feature a new series focused on bone health, written for, and in many cases by, physiotherapists. The goal of the series is to provide an overview of the importance of good bone health, its ubiquitous role in our clinical practice, and our potential leadership role in fostering good bone health among all Canadians. This series will take a lifespan approach, looking at bone health from childhood to older age. In addition, we aim to provide new and relevant information on bone health as it relates to topics such as bone mass and stroke, T2DM, and osteoarthritis. But because we know that preventing fractures also involves preventing falls,⁴³ we also aim to provide a perspective on physical activity, the muscle–bone relationship, and the role of balance and strengthening exercises in reducing fall risk. A main theme throughout the series is the importance of physical activity—and exercise prescription for health.

Physiotherapists continue to play an important role in the health of all Canadians. As we end the Bone and Joint Decade, let’s make sure it is the beginning of good health for all.

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