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Bone quality in older adults with intellectual disabilities

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ABSTRACT

Although osteoporosis is a progressive bone disease leading to increased risk of fracture, it has rarely been investigated on a large scale in older people with intellectual disabilities (ID). In this study, 768 persons with ID (aged $\geq$ 50 years) were measured with quantitative ultrasound to determine the prevalence of low bone quality. The association of low bone quality with patient characteristics, mobility, physical activity, body mass index (BMI), prior fractures, anticonvulsant drug use, intake of calcium, and vitamin D3 levels was also investigated. The prevalence of low bone quality was 43.9%. Low bone quality was positively associated with female gender, age, more severe level of ID, mobility impairment, and anticonvulsant drug use, and negatively with BMI. In clinical practice, people with ID who are at risk for low bone quality should periodically be screened for osteoporosis and be given advice about nutritional supplements and appropriate lifestyle.

1. Introduction

Osteoporosis is a disease characterized by low bone mineral density (BMD), leading to an increase in fracture risk and, as a consequence, an increased risk of pain, deformity, loss of mobility, and independence. In the general population, osteoporosis is particularly common among older people. In the Netherlands, the prevalence of osteoporosis increases from 1.1% among men aged 45–64 years to 8.6% among men aged $\geq$ 75 years, and from 8.5% among women aged 45–64 years to 42.3% among women aged $\geq$ 75 years (Van der Linden, Westert, De Bakker, & Schellevis, 2004). In people with intellectual disabilities (ID), osteoporosis is also highly prevalent. Prevalence rates vary up to 78.5% depending on the population of interest (Center, Beange, & McElduff, 1998; Haveman et al., 2011; Jaffe & Timell, 2003; Jaffe, Timell, & Gulanski, 2001; Leslie, Pahlavan, Roe, & Dittberner, 2009; Mergler et al., 2009; Srikanth, Cassidy, Joiner, & Teeluckdharry, 2011; Zylstra, Porter, Shapiro, & Prater, 2008). For older people with ID, it is assumed that the prevalence of osteoporosis is even higher than in the general older population due to a combination of age-related and ID-related risk factors for this disease. Remarkably, osteoporosis has rarely been studied on a large scale in this specific population. Therefore, the present study investigates the prevalence of osteoporosis and its associated factors in older people with ID.

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In the general population, a low vitamin D3 serum level, chronic malnutrition, and physical inactivity are associated with a low BMD, apart from the known risk factors in the ID population (Espallargues et al., 2001). The risk factors for the latter group have been examined in different populations. In adults with ID living in a residential facility, female sex, immobility, use of anticonvulsant drugs, and a more severe level of ID were found to be risk factors for low BMD (Jaffe, Timell, Elolia, & Thatcher, 2005). Leslie et al. (2009) confirmed immobility as an associated factor for osteoporosis in institutionalized adults with ID, together with a low body mass index (BMI) and prior fractures. In a study among 94 young adults with ID living in the community, Down syndrome (DS) was associated with low BMD (Center et al., 1998). However, information about risk factors in the heterogeneous group of older people with ID living inside or outside the institutions is currently lacking.

In clinical practice, osteoporosis is diagnosed using dual energy X-ray absorptiometry (DXA; World Health Organization, 1994). However, in large-scale research, this technique may not be regarded as feasible for people with ID because the DXA scan equipment is often located in hospitals and people have to lie completely still to prevent artifacts. Therefore, quantitative ultrasound (QUS) measurement of the heel bone has been used among people with ID to identify persons with a high fracture risk (Aspray et al., 1998; Jaffe et al., 2005). Advantages of QUS are its lack of radiation and its portability. On the other hand, it is not possible to directly measure BMD with the QUS device. Instead, speed of sound (SOS) and broadband ultrasound attenuation (BUA) are measured, both of which provide data on other indicators of bone quality. Both variables are found to be predictive of fracture risk (Khaw et al., 2004). Some QUS devices provide additional variables, like a stiffness index, which is a parameter derived from a linear combination of BUA and SOS. The QUS is feasible for people with ID. In a study by Mergler, Lobker, Evenhuis, and Penning (2010), QUS measurements were successfully performed in 94.7% and induced barely or no stress in 90.4% of people with ID living in residential care.

To obtain insight into bone quality in older adults with ID, the current study aims to: (1) determine the prevalence of low bone quality in older adults with ID, and (2) identify the association of low bone quality with gender, age, level of ID, residential status, DS, mobility, physical activity, BMI, prior fractures, anticonvulsant drug use, intake of calcium, and vitamin D3 serum level.

2. Methods

2.1. Study design and participants

This study was part of the large cross-sectional study 'Healthy Ageing in people with Intellectual Disability' (HA-ID). Details on the design, recruitment, and diagnostic methods are already published (Hilgenkamp, Bastiaanse, et al. 2011).

The study population consisted of adults aged $\geq$ 50 years who receive support or care from three Dutch care provider services (Abrona, Amarant, and Ipse de Bruggen). Informed consent was obtained from 1069 older adults with ID or their legal representatives, and 1050 persons actually participated in the assessments. For collection of blood a separate consent procedure was followed. The study population was nearly representative for the total Dutch client population aged $\geq$ 50 years receiving formal ID care, with a slight overrepresentation of women, and a slight underrepresentation of individuals living independently and individuals aged $\geq$ 80 years (Hilgenkamp, Bastiaanse, et al. 2011).

The study was approved by the Medical Ethical Committee of the Erasmus MC, University Medical Centre Rotterdam (MEC 2008-234) and by the ethical committees of the participating care provider services. The entire study adheres to the Declaration of Helsinki for research involving human subjects.

2.2. Bone quality

Bone quality of the heel bone was measured using the Lunar Achilles (type Insight, GE Medical Systems Europe, Diegem, Belgium), a portable device that measures ultrasound variables to provide a clinical measure called the stiffness index. The stiffness index indicates risk of osteoporotic fractures, comparable to BMD as measured by DXA. Results of the stiffness index are expressed as T-scores and are used to assist physicians in the diagnosis of osteoporosis, comparable to T-scores as obtained by DXA (GE Medical Systems Lunar, 2006). The Lunar Achilles device uses built-in reference values based on age and gender (obtained from healthy German adults) to calculate the T-scores, expressed in standard deviation (*SD*) units of the stiffness index. These T-scores result from comparison of the participants' bone status with the average peak value in healthy young persons. In accordance with the guideline for prevention of fractures of the Dutch College of General Practitioners (Elders et al., 2012), T-scores obtained by DXA equal to or lower than -2.5 *SD* indicate treatment with bisphosphonates. In the present study, we used the same cut-off score for T-scores as obtained with the Lunar Achilles.

The QUS measurement was part of a broad physical assessment carried out by specially trained medical assistants. To minimize the burden for participants, people in a wheelchair were measured in their own wheelchair (sometimes this was not possible due to the wheelchair design). Measurements started with positioning the participant (with bare feet) in either a chair or their wheelchair in front of the QUS device. After thoroughly spraying the ankle with alcohol, one foot was placed in the device. Then, the two membranes of the Lunar Achilles on either side of the ankle automatically filled with lukewarm water, enabling the transducers on both sides of the ankle to transmit and receive the ultrasound signal. If possible, bone status of both feet was determined. The lowest T-score was used for the analysis. When the ultrasound signal does not reach the receiving transducer, e.g., in case of insufficient spraying with alcohol or in case of insufficient water levels in the membranes, the lunar device displays the result 'out of range'. This can also occur when bone mass is either extremely high