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Brief Report

The relationship between body composition and femoral neck osteoporosis or osteopenia in adults with previous poliomyelitis

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Abstract

Background: Articles in the literature describing the association between body composition and osteoporosis in subjects with poliomyelitis are scarce.

Objective: To assess the relationship between body composition and femoral neck osteoporosis or osteopenia in adults with previous polio.

Method: After excluding postmenopausal women, 44 polio (mean age ± standard deviation, 46.1 ± 3.3 years) and 44 able-bodied control volunteers (47.0 ± 4.0 years) participated in the study. Each participant's femoral neck bone mineral density (FNBMD) and whole body composition were measured using dual-energy X-ray absorptiometry. With local reference BMD values of normal young adults installed in the instrument, we obtained *T*-score values that depended on each FNBMD value. A *T*-score value of ≤−1.0 indicated decreased *T*-score, including osteoporosis (*T*-score ≤ −2.5) and osteopenia (−1.0 to −2.5). This study conducted logistic regression analyses to find factors associated with osteoporosis and osteopenia.

Results: Based on the FNBMD *T*-score values, 60.0% of middle-aged men with polio had osteoporosis. In adjusted logistic regression analyses, total lean tissue mass (Adjusted odds ratio [95% confidence interval], 0.74 [0.56−0.99], $P < 0.05$) and male gender (947.16 [6.02−148,926.16], $P < 0.01$) were important factors associated with decreased *T*-score in polio group.

Conclusions: Osteoporosis or osteopenia is a common medical problem for middle-aged men with polio. Reduced total lean tissue mass seems to be one of the important factors associated with osteoporosis or osteopenia among subjects with polio. Further research for a clinical tool to assess lean tissue mass for subjects with polio is needed.

Keywords: Osteoporosis; Poliomyelitis; Femoral neck; Body composition

Osteoporosis is an important global medical issue, and bony fracture is one of its most serious complications. Among the various types of bony fractures, hip fractures often have compromised outcomes. A recent study shows that approximately 1 year following a hip fracture, 20–30% of the individuals affected had died,[1] 40% were dependent in walking, and 60% had some difficulty with the activities of daily living. Thus, estimating the rate of

Abbreviations: BFM, body fat mass; BMD, bone mineral density; DXA, dual-energy X-ray absorptiometry; FNBMD, femoral neck bone mineral density; HDL, high-density lipoprotein; LDL, low-density lipoprotein; LTM, lean tissue mass.

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experiencing osteoporosis of the femoral neck and identifying the risk factors of osteoporosis are essential tasks in caring for those people at risk.

Bone mineral density (BMD) is a major predictor for the risk of osteoporotic fracture.[2] However, this continuous measurement is subject to ethnic differences.[3] BMD values of Caucasian people are often higher than those of Chinese.[4] A BMD cutoff value to differentiate a high risk of developing fractures from low risk is lacking. For clinical practice and the assessment of fracture risk,[5] BMD values are typically expressed as a *T*-score or the standard deviation (SD) from the mean BMD value of normal young adults aged 20–40 years of the same sex and race.[6] According to the WHO criteria,[5] a BMD *T*-score of −1.0 to −2.5 is classified as being osteopenic, and a *T*-score of ≤−2.5 is osteoporotic. Combined with age and sex, *T*-scores offer a useful way to estimate the long-term risk of osteoporotic fracture.[3]

Polio was an epidemic in children aged ≤3 years in Taiwan from 1950 to 1970.[7,8] Many of those survivors lived an active adult life of mild to moderate degree of physical activity.[9] Because subjects with polio often have physical disabilities and low endurance of knee extensor muscles,[10] they are susceptible to bony fractures caused by falls. A questionnaire survey study showed that two-thirds of polio subjects had experienced a fall from a standing height in the previous 1-year period.[11] Bony fractures were the most common injury. The literature also shows that fractures with low-impact trauma are usually osteoporosis-related.[3,12] Compared to able-bodied controls, men with polio have 13–23% lower values for femoral neck BMD (FNBMD).[13] Smeltzer et al showed that >40% of adult women with previous polio had osteoporosis at the os calcis.[14] However, the rate of osteoporosis at the femoral neck in polio subjects of different sexes remains unknown. In addition, BMD is related to body composition, including body fat mass (BFM), lean tissue mass (LTM), and bone mass. Recent articles show a positive association between LTM and BMD.[15–17] Body fat mass is also related to BMD,[18] and this is especially true for women.[19] Compared to able-bodied controls, polio subjects have a decreased LTM and increased BFM for the whole body and the leg region.[20] Thus, changes in body composition could influence the occurrence of osteoporosis among subjects with prior polio. To our knowledge, previous literature describing the association between body composition and osteoporosis in subjects with polio is scarce. The aim of this study was to assess the relationship between body composition and the presence of osteopenia or osteoporosis among subjects with previous polio.

Methods

Participants

This was a cross-sectional study with subjects who experienced acute paralytic polio at the age of 3 years or younger (polio group). All subjects experienced flaccid paralysis of one or both lower extremities. Having a leg-length discrepancy, each subject with polio often had a shorter leg, which was shorter than his/her other leg (the longer leg). This study also recruited able-bodied persons without a history of any neuromuscular disease as controls (control group). Both groups' participants had a body mass index range of 16–30 kg/m^2.[21] To focus on the association between polio and early bone loss, postmenopausal women were excluded from the study. Considering that rapid bone loss often begins after the age of 40 years[12] and age of >65 years is an important risk factor for osteoporosis in the general population,[22] this study recruited people of both groups between the ages of 40 and 65 years. This study also excluded those who had a body weight of <40 kg,[23] those who had a metal implant or a history of a leg fracture, those who had used glucocorticoids or other bone metabolism-related medications in the most recent 3 months, and those with a history of other neuromuscular diseases. This study used advertisements to recruit participants from the community of urban areas in northern Taiwan. A total of 51 subjects with polio and 44 able-bodied controls were recruited and assessed by an experienced physiatrist. Of the subjects with polio, three had a body weight of <40 kg, three had a history of exclusion criteria (one oophorectomy, one hip fracture, and one stroke), and one failed in measuring FNBMD. Thus, 44 subjects with polio (response rate: 86%) and 44 able-bodied controls (response rate: 100%) completed this study. The Institutional Review Board of our university-affiliated hospital approved this study. Each participant signed an informed consent form before entering this study.

Measurements

This study used dual-energy X-ray absorptiometry (DXA; Norland XR-36, version 2.5.3 software, Norland Corp., Fort Atkinson, Wisconsin, USA) to measure the FNBMD and whole-body composition of all participants at a university-affiliated hospital. This study measured the shorter leg's FNBMD because, on average, the shorter leg has lower FNBMD in patients with polio.[13] This study arbitrarily chose the control participants' right leg as the reference leg for measuring FNBMD. A densitometry technologist certified by the International Society for Clinical Densitometry performed these measurements. The long-term coefficient of variation of the instrument was 1.2% for FNBMD. With local reference BMD values of normal young adults installed in the instrument,[6] this study obtained *T*-score values that depended on each FNBMD value. Because both osteopenia and osteoporosis are risk factors for low-trauma fractures,[24] legs with a *T*-score of ≤−1.0 were identified as having "decreased *T*-score." This study obtained weights of the body compositional variables of the whole body and both legs from a whole-body DXA scan, and identified the weights of the LTM and BFM distal