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Body Composition Is Associated With Multisite Lower Body Musculoskeletal Pain in a Community-Based Study

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Abstract: Population-based studies suggest that pain in the lower body is common and that pain at multiple sites is more prevalent than single-site pain. Obesity is a risk factor for multisite musculoskeletal pain, but there are limited data on the role of body composition. Therefore, we sought to determine whether body composition is associated with multisite musculoskeletal pain involving the low back, knee, and foot. A total of 133 participants were recruited for a study examining the relationship between obesity and musculoskeletal disease. Participants completed validated questionnaires that examined levels of pain at the low back, knee, and foot. Body composition was assessed using dual-energy x-ray absorptiometry. Multisite pain was common, with 26.3% of participants reporting pain at 2 sites and 31.6% at 3 sites, and only 20% were pain free. The low back was the most common site of pain (63%). Greater fat mass and fat mass index, but not fat-free mass, were associated with pain at a greater number of sites, independent of age, gender, and fat-free mass ($P < .01$). Longitudinal studies exploring the mechanism of action by which increased fat mass is associated with pain may provide important insights into therapeutic strategies for the prevention of multisite pain.

Perspective: ***Greater fat mass and fat mass index were associated with a greater number of lower body pain sites, with no association observed for fat-free mass. Understanding the mechanism by which increased fat mass is associated with pain may provide important insights into therapeutic strategies for the prevention of pain.***

Key words: *Body composition, fat mass pain, epidemiology.*

Musculoskeletal pain is an important clinical and public health problem. Although most studies focus on musculoskeletal pain at a single site, pain in more than one anatomical site is common. In a study of 12,410 employed adults across 18 different countries, multisite pain (or pain located at ≥2 sites) was more common than pain located at one site.[6] Similarly, a population-based study of 3,179 Norwegian adults found that 53% had multisite pain compared to 17% with single-site pain.[19]

Population-based studies have also suggested that localized musculoskeletal pain (eg, back or knee pain) is more disabling when accompanied by pain at other sites than when a single site is affected.[24] Results from cross-sectional studies show that there is an almost linear increase in functional problems with increasing number of pain sites.[19] Moreover, the number of pain sites has been shown to be a strong independent predictor of work absenteeism.[12]

Potential risk factors for multisite pain include older age,[6,13] female gender,[6,9] high physical workload,[6,14,29] and psychological factors such as somatizing tendency.[6,29] There is also growing evidence to indicate a role of obesity. For instance, a study of female kitchen workers found obesity (body mass index [BMI] ≥ 30 kg/m^2) to be associated with an increased prevalence of multisite

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musculoskeletal pain,[14] and a population-based study reported a greater number of pain sites in individuals with higher BMI.[18] Moreover, in a study of 48 participants, musculoskeletal pain improved in obese subjects after undergoing bariatric surgery at 6 and 12 months postprocedure.[15] Although 100% had lower extremity musculoskeletal pain before surgery, only 37% reported pain after weight loss. Similarly, 79% had upper extremity musculoskeletal conditions before surgery and 40% after weight loss.[15] Given that this is a non–weight bearing region, it suggests that the effect of adipose tissue on musculoskeletal pain is unlikely to be simply due to physical loading on joints, but rather that fat (or adipose tissue) may also contribute to pain through systemic mechanisms.[20,27]

The emerging evidence suggests that fat and muscle mass have different roles in the pathogenesis of musculoskeletal disease.[28] The detrimental effects of adipose tissue on musculoskeletal health have previously been reviewed.[20] In a study of synovial leptin (an adipose tissue–derived hormone), Dumond et al found that leptin was overexpressed in human osteoarthritic knee joints, and the level of leptin expression related to the degree of cartilage destruction, suggesting its role in the pathogenesis of osteoarthritis.[8] Moreover, high synovial leptin levels have been associated with high levels of lower limb joint pain.[21] The role of body composition has only recently been addressed as previous studies have used weight and BMI as measures of obesity and these do not allow examination of body composition (muscle and fat mass). However, recent studies have examined body composition and their association with pain at single anatomical sites. These studies have found that greater fat mass, but not lean tissue mass, is associated with greater levels of low back pain and disability,[31] incident foot pain,[3] and early structural changes at the knee, which are predictors of knee osteoarthritis (cartilage defects, bone marrow lesions, and decreased cartilage volume).[2,34] However, few studies to date have assessed the relationship between body composition and pain at multiple sites.

The aim of this study was to examine the associations between body composition and lower body pain at 3 sites (low back, knee, and foot). These lower body sites were our focus in the study because of the high prevalence of lower body pain in the general population[19,25] and because lower body musculoskeletal pain causes significant disability and burden in society.[10,17] Our hypothesis was that greater fat mass would be associated with a greater number of pain sites in the lower body.

Methods

Participants

A total of 133 participants, who ranged from normal weight to obese, were recruited through local media and community weight loss clinics to take part in a study of obesity and musculoskeletal health. These participants were not recruited on the basis of having pain. All provided informed consent. Exclusion criteria included malignancy or inability to complete the study. The study was approved by the Alfred Human Research Ethics Committee (HREC), Monash University HREC, Austin Health HREC, and the University of Melbourne Central HREC.

Data Collection

Demographic and Anthropometric Data

Age, gender, weight, and height were recorded. Height was measured using a stadiometer and weight measured using a single set of electronic scales, to the nearest .1 kg with shoes and bulky clothing removed. BMI (weight $\div$ [height^2]; kg/m^2) was calculated.

Body Composition Measurement

Body composition was measured using dual-energy x-ray absorptiometry (GE Lunar Prodigy, using operating system version 9; GE Healthcare, Chalfont St Giles, Buckinghamshire, United Kingdom), which had a weight limit of approximately 130 kg. Standard regional analyses were used to measure total body fat mass as well as total body lean tissue mass. Lean tissue mass was used as a measurement of skeletal muscle mass. Fat mass index and fat-free mass index were calculated as follows: fat mass index = fat mass/height^2 and fat-free mass index = fat-free mass/height^2, where fat-free mass = lean tissue mass + bone mineral content.

Pain Prevalence

Data on pain prevalence at the low back, knee, and foot were obtained using region-specific questionnaires. To examine the prevalence of low back pain, the question "Have you had low back pain in the past month?" was used, along with a figure of a mannequin that marked the low back as a squared area between the lower border of the rib cage and the gluteal folds. The Western Ontario and McMaster Universities Osteoarthritis Index and a visual analog scale, validated tools for use in populations with knee pain,[1] were used for the identification of knee pain. The Western Ontario and McMaster Universities Osteoarthritis Index is composed of 24 items divided into 3 subscales—pain, stiffness, and physical function. In this study, only the pain subscale was used. A cut-off of $\geq$20 on a 0–100-mm visual analog scale was used to determine clinically significant knee pain.

To establish foot pain prevalence in our study, the Manchester Foot Pain and Disability Index was used,[11] which has been validated in rheumatology patients, patients of general health practitioners who have reported foot-related problems, and people from the general community.[23] The Manchester Foot Pain and Disability Index consists of 19 items that are preceded with the phrase "because of pain in my feet," formalized under 4 categories: functional limitation (10 items), pain intensity (5 items), personal appearance (2 items), and difficulties with work or leisure activities (2 items). Each item is scored according to frequency (eg, "none of the time" [0 points], "on some days" [1 point], or "on most/everyday" [2 points]); scores on the Manchester Foot