



# Increased vertebral bone marrow fat content can be associated with vertebral fractures and back pain

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In their letter to the editor, Yi Xiáng J. Wáng and colleagues have studied the quantification of vertebral bone marrow fat (BMF) content among two different communities of women over 65 years with significant differences in the prevalence and severity of osteoporotic vertebral fractures (OVF) (1).

Although Rome Caucasian women have a higher prevalence of OVF, with a greater number of vertebrae affected, and a more severe fracture pattern than Hong Kong Chinese women, the authors of the study did not find significant differences in the bone marrow fat content of the third lumbar vertebra, using MR spectroscopy, between both communities (1).

Despite of patients who sustained OVF have increased BMF content, there are few publications that have concluded that bone marrow fat composition might be higher in patients with osteoporosis (2) or type 2 diabetes mellitus (3). And to date, only one study has correlated higher marrow fat content with lower trabecular bone mineral density (BMD) and an association with prevalent vertebral fracture, but only in men (4). Nevertheless, some authors have proposed the MR spectroscopy of spinal bone marrow fat as an imaging tool for BMD-independent fracture risk assessment (5,6).

Beyond vertebral BMF content, there are several factors that must be considered when we delve into the study of the pathophysiology of the OVF in women from different communities. Age, ethnicity, BMI and sociodemographic aspects as women's situation in the labour market, work-

family gender roles or social consideration of women, which include participation in social life, sports (7) or free time activities, can differ widely between different population groups. Moreover, nutritional status and regional diet style can impact profoundly on BMF content (8,9). In addition, comorbidities such as anorexia nervosa, diabetes mellitus or osteoporosis are often associated with changes in marrow adiposity (10). And finally, prescribed osteoporosis medications as bisphosphonates or teriparatide can significantly affect on BMF content (11,12). Even although all the previously described aspects can have an impact on BMF content, they can be considered as potential biases that should be taken into consideration when researchers try to correlate vertebrae bone marrow composition and vertebral fractures.

Another interesting finding from the study of Wáng and colleagues, which deserves a commentary, is that patients with back pain had a higher lumbar BMF than that of healthier community subjects (1).

In this sense, some authors have demonstrated an association between lumbar vertebral BMF content and paraspinal muscle fat composition (13,14), and at the same time a correlation between paraspinal muscle fat infiltration with a higher number of vertebral fractures and a lower BMD (14-16). It is worth highlighting the study published by Elysee *et al.* where the authors found that global sagittal malalignment is related to fat infiltration of the posterior vertebral musculature throughout the lumbar and thoracic

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spine in patients with adult spinal deformity (17). And in relation to this, numerous studies have demonstrated a relationship between sagittal spinal imbalance and back pain (18,19). Therefore, it seems that there may be a relationship between vertebrae BMF content and back pain, but we need further research in this area, in order to provide us a better understanding of the impact of the fat replacement in spinal bone marrow on back pain.

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## References

1. Wáng YXJ, Diacinti D, Griffith JF, et al. Lumbar L3 marrow fat content in older Italian women is not apparently higher than in older Chinese women. *Ann Transl Med* 2022;10:648.
2. Yeung DK, Griffith JF, Antonio GE, et al. Osteoporosis is associated with increased marrow fat content and decreased marrow fat unsaturation: a proton MR spectroscopy study. *J Magn Reson Imaging* 2005;22:279-85.
3. Baum T, Yap SP, Karampinos DC, et al. Does vertebral bone marrow fat content correlate with abdominal adipose tissue, lumbar spine bone mineral density, and blood biomarkers in women with type 2 diabetes mellitus? *J Magn Reson Imaging* 2012;35:117-24.
4. Schwartz AV, Sigurdsson S, Hue TF, et al. Vertebral bone marrow fat associated with lower trabecular BMD and prevalent vertebral fracture in older adults. *J Clin Endocrinol Metab* 2013;98:2294-300.
5. Patsch JM, Li X, Baum T, et al. Bone marrow fat composition as a novel imaging biomarker in postmenopausal women with prevalent fragility fractures. *J Bone Miner Res* 2013;28:1721-8.
6. Schellinger D, Lin CS, Lim J, et al. Bone marrow fat and bone mineral density on proton MR spectroscopy and dual-energy X-ray absorptiometry: their ratio as a new indicator of bone weakening. *AJR Am J Roentgenol* 2004;183:1761-5.
7. Belavy DL, Miller CT, Owen PJ, et al. Exercise may impact on lumbar vertebrae marrow adipose tissue: Randomised controlled trial. *Bone* 2022;157:116338.
8. Spurny M, Jiang Y, Sowah SA, et al. Changes in Bone Marrow Fat upon Dietary-Induced Weight Loss. *Nutrients* 2020;12:1509.
9. Trudel G, Melkus G, Sheikh A, et al. Marrow adipose tissue gradient is preserved through high protein diet and bed rest. A randomized crossover study. *Bone Rep* 2019;11:100229.
10. Devlin MJ, Rosen CJ. The bone-fat interface: basic and clinical implications of marrow adiposity. *Lancet Diabetes Endocrinol* 2015;3:141-7.
11. Yang Y, Luo X, Xie X, et al. Influences of teriparatide administration on marrow fat content in postmenopausal osteopenic women using MR spectroscopy. *Climacteric* 2016;19:285-91.
12. Yang Y, Luo X, Yan F, et al. Effect of zoledronic acid on vertebral marrow adiposity in postmenopausal osteoporosis assessed by MR spectroscopy. *Skeletal Radiol* 2015;44:1499-505.
13. Wong AK, Chandrakumar A, Whyte R, et al. Bone Marrow and Muscle Fat Infiltration Are Correlated among Postmenopausal Women With Osteoporosis: The AMBERS Cohort Study. *J Bone Miner Res* 2020;35:516-27.
14. Zhao Y, Huang M, Serrano Sosa M, et al. Fatty infiltration of paraspinal muscles is associated with bone mineral density of the lumbar spine. *Arch Osteoporos* 2019;14:99.
15. Sollmann N, Dieckmeyer M, Schlaeger S, et al.

- Associations Between Lumbar Vertebral Bone Marrow and Paraspinal Muscle Fat Compositions—An Investigation by Chemical Shift Encoding–Based Water–Fat MRI. *Front Endocrinol (Lausanne)* 2018;9:563.
16. Li X, Zhang Y, Xie Y, et al. Correlation Between Bone Mineral Density (BMD) and Paraspinal Muscle Fat Infiltration Based on QCT: A Cross-Sectional Study. *Calcif Tissue Int* 2022;110:666-73.
  17. Elysee JC, Lovecchio F, Lafage R, et al. The relationship of global sagittal malalignment to fatty infiltration in the aging spine. *Eur Spine J* 2021;30:2480-5.
  18. Glassman SD, Bridwell K, Dimar JR, et al. The impact of positive sagittal balance in adult spinal deformity. *Spine (Phila Pa 1976)* 2005;30:2024-9.
  19. Hira K, Nagata K, Hashizume H, et al. Relationship of sagittal spinal alignment with low back pain and physical performance in the general population. *Sci Rep* 2021;11:20604.

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