INTERNAL MEDICINE JOURNAL

doi:10.1111/imj.14391

Seasonality of hip fracture and vitamin D deficiency persists in a sub-tropical climate

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Key words
hip fracture, vitamin D, season.

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Received 30 July 2018; accepted 19 November 2018.

Abstract

Both hip fractures and vitamin D (25-hydroxyvitamin D (25-OHD)) deficiency are more common in winter in regions with temperate climates, but few data exist for a sub-tropical climate. In a South East Queensland tertiary hospital over a 7-year period, there were significantly more hip fractures in winter than the other three seasons (analysis of variance $P = 0.003$), with associated higher frequency of 25-OHD deficiency – 42.5% in winter compared to 28.5% in summer, odds ratio 1.86 (95% confidence interval 1.35–2.56), $P = 0.0001$. Seasonality of hip fracture and 25-OHD deficiency occurs even in a sub-tropical climate.

Osteoporosis and falls are risk factors for fragility fractures, particularly hip fractures in the older population. In Australia, there were over 24 000 hip fractures recorded in 2014; an ageing population and rise in chronic disease may lead to over 30 000 hip fractures per year from 2020 onwards.[1] Hip fracture is associated with an increased 1-year mortality rate of over 25%, with factors such as male sex, age, presence of heart failure and measures of functional independence being important determinants.[2]

Previous Australian data demonstrated a seasonal pattern for hip fractures in New South Wales[3] and Victoria.[4] In Geelong, Victoria, a fall in vitamin D (25-hydroxyvitamin D (25-OHD)) concentrations in winter was associated with increased levels of parathyroid hormone (PTH), bone resorption, falls and increased incidence of fractures both of the hip and wrist.[4] Australia extends from 12 to 43°S and 115 to 151°E situated in a tropical to mild latitude world region,[5] with Southeast Queensland located from 27.5°S in a sub-tropical world region.[6]

The aim of this study was to determine the relationship between season and low trauma hip fracture admission in South East Queensland. Currently, there is limited information about the relationship between hip fractures and season in a sub-tropical geographic location.

Patients presenting with a minimal trauma sub-capital or inter-trochanteric hip fracture to the Princess Alexandra Hospital, Brisbane, over a 7-year period between December 2008 to November 2015 inclusive, were identified from hospital medical records (paper-based 2009–2014 and from 2015, electronic), the orthopaedic department's fractured neck of femur database and the Osteoporosis Nurse Practitioner database. Patients with high trauma, pathological and non-fragility fractures were excluded. Estimates of serum 25-OHD concentration at the time of hospitalisation for hip fracture were retrieved from Pathology Queensland records. 25-OHD was measured using a liquid chromatography (LC), tandem mass spectrometry method. The method was transferred to new LC equipment along with minor processing modifications made to suit the new equipment, during study time frame. The laboratory reference range remained unchanged, 50–150 nmol/L throughout the study period. Interassay coefficients of variation (CV) in 2009 were 7.2% at 26.7 nmol/L and 8.0% at 72.7 nmol/L, while data from 2017 showed interassay CV of 6.4% at 27 nmol/L and 5.4% at 82 nmol/L. Vitamin D deficiency was defined as a serum 25-OHD concentration of <50 nmol/L.[7] Data were analysed by seasonality defined as follows: summer – December to February, autumn – March to May, winter – June to August and spring – September to November. Ethical approval for this audit was obtained through the Metro South Human Research Ethics Committee.

There were 1423 admissions for minimal trauma hip fracture (977 women and 446 men) during the 7-year time frame, with a mean of 203 patient admissions per year, with no difference in frequency between the years of the study ($P = 0.37$). The mean age was 80 years

Funding: None.
Conflict of interest: None.

(range 24–108). Serum 25-OHD was measured in 1349 patients (94.8%) during their admission.

There was a significant difference in the mean number of hip fractures between the seasons as outlined in Figure 1A (one way analysis of variance (ANOVA), P = 0.003). Post hoc analysis demonstrated a higher number of fractures occurring during winter (63 ± 4 fractures) compared to the other three seasons ($P < 0.05$ for each), but no significant differences were found between summer (47 ± 4 fractures), autumn (47 ± 3 fractures) and spring (46 ± 3 fractures).

Over the 7-year period, 470/1349 patients whose 25-OHD was measured (34.8%) had 25-OHD deficiency (<50 nmol/L). χ^2 analysis showed a significant effect of season on the prevalence of 25-OHD deficiency (Fig. 1B, P = 0.0004), which was higher in patients presenting during the winter (42.5%) vs summer (28.5%), Fisher exact test – odds ratio 1.86 (95% confidence interval 1.35–2.56), P = 0.0001. Over the 7-year period, there was a significant reduction in the number of people with 25-OHD deficiency (analysed by % deficient in each of the four seasons, averaged across the year, Fig. 1C) – one way ANOVA, P = 0.003. Post hoc analysis showed a significant difference between 2009 and each year from 2011 onwards ($P < 0.05$ for 2011–2014 and $P < 0.01$ for 2015). In 2009, 58.4% of patients had 25-OHD deficiency compared to 24.4% in 2015.

Discussion

This study confirms that even in a sub-tropical climate in Queensland, Australia, there is a clear seasonality of hip fracture. Compared to summer, autumn and spring, the incidence of hip fracture was 34% higher during the winter. This was associated with an increased rate of 25-OHD deficiency in the winter compared to the summer months. However, despite the overall prevalence of 25-OHD deficiency reducing among the patients with hip fracture over time, the annual number of hip fractures presenting to our institution did not significantly change.

These data are consistent with studies carried out in other regions of Australia and internationally. A large Australian study investigating seasonality and fractures demonstrated seasonal periodicity of 25-OHD, PTH, bone resorption and fractures in a population based in Geelong, Victoria, situated at latitude 38 to 39°South.[4] Worldwide, a higher incidence of hip fractures has been demonstrated during winter in temperate climates.[8,9] Hip fracture and low 25-OHD has been evaluated in sub-tropical and tropical climates in a limited number of studies. 25-OHD deficiency was found to be common in patients with hip

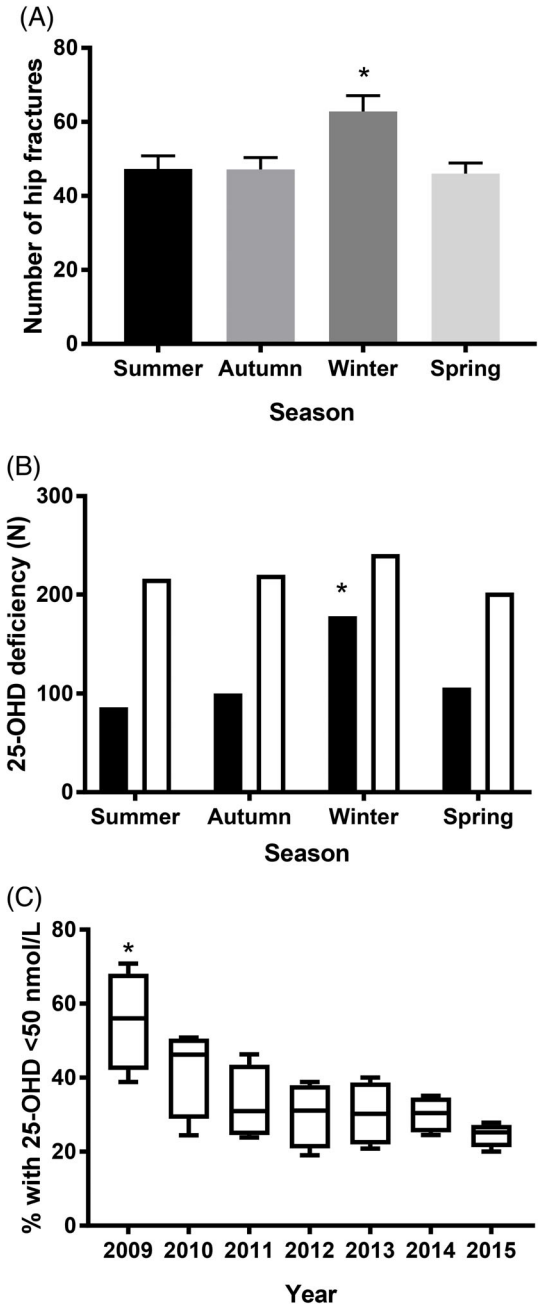

Figure 1 (A) Mean (±standard error of mean) number of fractures occurring in each season across 7 years from 2009 to 2015 inclusive. One way analysis of variance (ANOVA), P = 0.003; *post-hoc analysis, $P < 0.05$ compared to each other season. (B) Number of hip fracture patients with serum 25-hydroxyvitamin D (25-OHD) <50 nmol/L (■) and ≥50 nmol/L (▭) according to season of presentation. χ^2: P = 0.0004, *Fisher exact test comparing winter to summer – odds ratio of 25-OHD deficiency 1.86 (95% confidence interval 1.35–2.56), P = 0.0001. (C) Annual trend in per cent of hip fracture patients with 25-OHD deficiency (mean of the four seasons; box – interquartile range; whiskers – minimum/maximum). One way ANOVA, P = 0.003. *2009 significantly higher than each other year beyond 2010: $P < 0.05$ for 2011–2014 and $P < 0.01$ for 2015.

fractures in Singapore which is situated near the equator and classified as a tropical climate.[10] This is also the case with Brazil, a country with a mostly tropical climate[11] and Taiwan, a sub-tropical country, where the hip fracture rate significantly increases during winter.[12]

The Australian Health Survey 2011–2012 found overall high levels of vitamin D insufficiency in winter and spring regardless of the location in Australia and high prevalence of 25-OHD deficiency all year round which peaked in spring.[13] Deficiency of 25-OHD was defined in this study as a level <50 nmol/L at the end of winter.[7] Rates of 25-OHD deficiency were low in summer in all states; however, in winter was high in southern states such as Victoria (49%) and Tasmania (43%) but lower in Queensland (15%).[13] One other study carried out in South-East Queensland showed the lowest mean 25-OHD occurred in July.[14]

Higher latitudes receive sunlight at a lesser intensity compared to equatorial regions, and have greater seasonal variations with respect to daylight hours in the summer and winter.[15] A prospective cohort study of women living in 60 hostels and 89 nursing homes across three states of Australia between 1996 and 1999 found that 25-OHD deficiency was common in many residential care facilities in the country and it was also a predictor for incident falls.[16] Among older community dwelling men in Sydney, the prevalence of 25-OHD insufficiency was highest in winter and spring, and was associated with season, low physical activity, avoidance of sun exposure, current smoking and obesity.[17] For most individuals 25-OHD increases during summer but for some individuals it decreases due to sun avoidance.[6] Deficiency of 25-OHD is common in darker-skin populations living in western countries,[18] including indigenous Australians.[19]

Our observation that the prevalence of vitamin D deficiency among hip fracture patients fell significantly between 2009 and 2015 is likely due to improved recognition and treatment in the community, since clinically significant changes in the 25-OHD assay performance have not been observed. Factors other than 25-OHD deficiency are clearly involved in the seasonal variation in hip fracture in our cohort. However, wet or icy conditions are unlikely to have contributed, since Brisbane has lower rainfall in winter compared to summer, similar sunshine hours and a mean minimum temperature >9°C.[20]

In conclusion, hip fractures are more common in the winter months even in a sub-tropical climate. The prevalence of 25-OHD deficiency in patients presenting with hip fractures during the winter is higher than during the summer, and may be a factor that predisposes to fracture. Identification and treatment of 25-OHD deficiency in at risk groups, particularly the elderly in residential care facilities, along with falls prevention measures remain key practice goals regardless of geographical location.

References

1 Watts J, Abimanyie-Ochom J, Sanders KM. *Osteoporosis Costing all Australians: A New Burden of Disease Analysis – 2012 to 2022*. Glebe: Osteoporosis Australia; 2013.

2 Cenzer IS, Tang V, Boscardin WJ, Smith AK, Ritchie C, Wallhagen MI *et al*. One-year mortality after hip fracture: development and validation of a prognostic index. *J Am Geriatr Soc* 2016; **64**: 1863–8.

3 Lau EM, Gillespie BG, Valenti L, O'Connell D. The seasonality of hip fracture and its relationship with weather conditions in New South Wales. *Aust J Public Health* 1995; **19**: 76–80.

4 Pasco JA, Henry MJ, Kotowicz MA, Sanders KM, Seeman E, Pasco JR *et al*. Seasonal periodicity of serum vitamin D and parathyroid hormone, bone resorption, and fractures: the Geelong osteoporosis study. *J Bone Miner Res* 2004; **19**: 752–8.

5 Boyages S, Bilinski K. Seasonal reduction in vitamin D level persists into spring in NSW Australia: implications for monitoring and replacement therapy. *Clin Endocrinol (Oxf)* 2012; **77**: 515–23.

6 King L, Dear K, Harrison SL, van der Mei I, Brodie AM, Kimlin MG *et al*. Investigating the patterns and determinants of seasonal variation in vitamin D status in Australian adults: the seasonal D cohort study. *BMC Public Health* 2016; **16**: 892–2.

7 Nowson CA, McGrath JJ, Ebeling PR, Haikerwal A, Daly RM, Sanders KM *et al*. Vitamin D and health in adults in Australia and New Zealand: a position statement. *Med J Aust* 2012; **196**: 686–7.

8 Crawford JR, Parker MJ. Seasonal variation of proximal femoral fractures in the United Kingdom. *Injury* 2003; **34**: 223–5.

9 Grønskag AB, Forsmo S, Romundstad P, Langhammer A, Schei B. Incidence and seasonal variation in hip fracture incidence among elderly women in Norway. The HUNT study. *Bone* 2010; **46**: 1294–8.

10 Ramason R, Selvaganapathi N, Ismail NHB, Wong WC, Rajamoney GN, Chong MS. Prevalence of vitamin D deficiency in patients with hip fracture seen in an orthogeriatric service in sunny Singapore. *Geriatr Orthop Surg Rehabil* 2014; **5**: 82–6.

11 Guerra MT, Feron ET, Viana RD, Maboni J, Pastore SI, Castro CC. Elderly with proximal hip fracture present significantly lower levels of 25-hydroxyvitamin D. *Rev Bras Ortop* 2016; **51**: 583–8.

12 Lin HC, Xiraxagar S. Seasonality of hip fractures and estimates of season-attributable effects: a multivariate ARIMA analysis of population-based data. *Osteoporos Int* 2006; **17**: 795–806.

13 Australian Bureau of Statistics. Australian Health Survey: Biomedical Results for Nutrients, 2011–12. [cited 2018 Mar 3]. Available from URL: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/4364.0.55.006Chapter2002011-12

14 McGrath JJ, Kimlin MG, Saha S, Eyles DW, Parisi AV. Vitamin D insufficiency in south-east Queensland. *Med J Aust* 2001; **174**: 150–1.

15 Quaggiotto PTH, Bhanugopan M. Vitamin D deficiency remains prevalent despite increased laboratory testing in New South Wales, Australia. *Singapore Med J* 2014; **55**: 271–80.
16 Flicker L, Mead K, MacInnis RJ, Nowson C, Scherer S, Stein MS *et al*. Serum vitamin D and falls in older women in residential care in Australia. *J Am Geriatr Soc* 2003; **51**: 1533–8.
17 Hirani V, Cumming RG, Blyth FM, Naganathan V, Le Couteur DG, Handelsman DJ *et al*. Vitamin D status among older community dwelling men living in a sunny country and associations with lifestyle factors: the Concord Health and Ageing in Men Project, Sydney, Australia. *J Nutr Health Aging* 2013; **17**: 587–93.
18 Martin CA, Gowda U, Renzaho AMN. Meta-analysis: the prevalence of vitamin D deficiency among dark-skinned populations according to their stage of migration and region of birth: a meta-analysis. *Nutrition* 2016; **32**: 21–32.
19 Maple-Brown LJ, Hughes JT, Lu ZX, Jeyaraman K, Lawton P, Jones GR *et al*. Serum vitamin D levels, diabetes and cardio-metabolic risk factors in Aboriginal and Torres Strait Islander Australians. *Diabetol Metab Syndr* 2014; **6**: 78.
20 Australian Government Bureau of Meteorology. Climate Statistics for Australian Locations – Summary Statistics Brisbane Regional Office. [cited 2018 Oct 25]. Available from URL: http://www.bom.gov.au/climate/averages/tables/cw_040214.shtml

doi:10.1111/imj.14389

Oesophageal food bolus obstruction and eosinophilic oesophagitis

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Key words
eosinophilic, food, bolus.

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Received 19 August 2018; accepted 13 January 2019.

Abstract

Eosinophilic oesophagitis (EoE) is now a well-recognised cause of dysphagia and food bolus obstruction (FBO). The diagnosis requires histologic confirmation, and the yield is greatest when at least 4 to 6 oesophageal biopsies are taken from different sites. Previous case reports of FBO have demonstrated a low biopsy rate, and as such cases of EoE may have been missed. In this review, the medical records of 123 patients aged 18 years or older, who had presented with FBO over a 2 year period, were reviewed. EoE was the most common diagnosis, and was found in 81.3% of patients with FBO aged 40 years or less. 45.5% of patients with FBO were biopsied, and of those, 33.9% were confirmed to have had at least 4 biopsies. EoE is a common cause of FBO and requires appropriate oesophageal sampling to confirm the diagnosis. Cases of EoE may otherwise be missed.

Oesophageal food bolus obstruction (FBO) is a common gastrointestinal emergency, usually necessitating urgent gastroscopy. Eosinophilic oesophagitis (EoE) is an increasingly recognised cause of upper gastrointestinal symptoms, and its role in causing dysphagia and FBO in both children and adults is now well established.[1,2] In fact, case series of FBO in other centres have shown that EoE is the most common cause of this problem.[3,4]

The prevalence of EoE has been increasing since its first description in the early 1990s. Plausible hypotheses for this include the hygiene hypothesis (as seen in asthmatics) as well as exposure to atopic triggers in the form of food and aero-allergens, as well as an increased awareness of the diagnosis amongst endoscopists.[5,6] Despite the increasing recognition of this disorder, however, case series have shown that the number of patients who have oesophageal biopsies taken for FBO is low, which may contribute to missed diagnoses. For example, Philpott *et al*. showed that only 24.5% of patients in their cohort of patients with FBO had biopsies taken.[7] A 2013 review by researchers in Adelaide, Australia, did

Funding: None.
Conflict of interest: None.