HHS Public Access
Author manuscript
South Med J. Author manuscript; available in PMC 2015 December 15.

Published in final edited form as:
South Med J. 2014 April ; 107(4): 214–217. doi:10.1097/SMJ.0000000000000085.

Surge in US Outpatient Vitamin D Deficiency Diagnoses: National Ambulatory Medical Care Survey Analysis

Karen E. Huang, MS, **Brandy-Joe Milliron, PhD**, **Scott A. Davis, MA**, and **Steven R. Feldman, MD, PhD**

Departments of Dermatology and Social Sciences and Health Policy, Center for Dermatology Research, Wake Forest School of Medicine; Winston-Salem, North Carolina

Abstract

Objectives—In light of the growing medical interest in the potential consequences of vitamin D deficiency, it is important that clinicians are informed about the varying factors that may complicate the assessment of vitamin D status and the diagnosis of deficiency. To better understand the frequency of vitamin D deficiency diagnoses in the ambulatory setting over time, the objective of this investigation was to examine unspecific, general, and bone-related vitamin D deficiency diagnoses between 2007 and 2010 and to determine whether the rate of diagnoses differed by patient age and sex.

Methods—We used data from the National Ambulatory Medical Care Survey and the National Hospital Ambulatory Medical Care Survey to assess the rate of vitamin D deficiency diagnoses provided between 2007 and 2010 during outpatient visits with nonfederally employed physicians in offices and hospitals. Two hundred ninety-two unweighted patient visit records were included. Trends in vitamin D deficiency diagnosis over time, diagnosis of bone disease associated with a vitamin D deficiency diagnosis, and patient age and sex were reported.

Results—The number of diagnoses for vitamin D deficiency rapidly increased from 2007 to 2010. More than 97% of diagnoses were for unspecific vitamin D deficiency; 9.6% of vitamin D deficiency visits also resulted in a diagnosis of osteoporosis or bone fracture.

Conclusions—Although the rate of diagnoses for vitamin D deficiency increased between 2007 and 2010, many diagnoses rendered were for nonspecific disease; therefore, vitamin D deficiency screening may have been ordered for preventive care purposes rather than as a diagnostic aid.

Keywords

vitamin D deficiency; survey; outpatient visits; ambulatory care

---

Osteomalacia in adults and rickets in children are the typical manifestations of clinical severe vitamin D deficiency.[1] Suggesting a greater public health concern than previously reported, clinicians and researchers, however, are more frequently investigating the relation between vitamin D deficiency and health outcomes such as cardiovascular disease, type 2

Reprint requests to: Karen E. Huang, Department of Dermatology, Center for Dermatology Research, Wake Forest School of Medicine Medical Center Blvd, Winston-Salem, NC 27157-1071. kehuang@wakehealth.edu.

The other authors have no financial relationships to disclose and no conflicts of interest to report.

diabetes mellitus, fertility, and bone development.[2–5] Because much of this research is ongoing, the evidence linking vitamin D with benefits for nonskeletal outcomes has been inconsistent.[6]

Healthcare providers have reported confusion regarding the correct methods of testing target populations at high risk and clinically relevant definitions of vitamin D deficiency.[7–9] Although the 2011 Institute of Medicine (IOM) guidelines for vitamin D and calcium emphasize the importance of vitamin D in skeletal health and those and the guidelines published by the Endocrine Society agree that there is no need to screen the general population routinely, there is still disagreement between the two expert panels. The IOM emphasizes that 97.5% of the population are ensured bone health when levels of serum 25-hydroxyvitamin D (25[OH]D) are ≥ 20 ng/mL and defines vitamin D deficiency as <16 ng/mL.[6] The Endocrine Society defines vitamin D levels as sufficient at >30 ng/mL, insufficient between 21 and 29 ng/mL, and deficient at 20 ng/mL.[10]

It also is important that healthcare providers are aware of the variety of assay techniques available for the measurement of serum 25(OH)D concentrations. Liquid chromatography-tandem mass spectrometry is considered the gold standard[11], but a variety of other assay kits are available, including the DiaSorin automated immunoassay test (DiaSorin, Saluggia, Italy), the IDS radioimmunoassay (IDS Ltd, Tyne and Wear, UK) and enzyme immunoassay, and automated protein binding assays. Compared with the gold standard, other tests can produce variable results and in some cases, systematically undermeasure serum 25(OH)D levels.[11,12]

Despite this controversy, research is ongoing and there is hope that this confusion will be eliminated as additional data better defining adequate vitamin D levels and health-related outcomes are reported. To help fill this gap in the research, data describing the trends in diagnosis of vitamin D deficiency are needed. Using a large annual nationally representative survey of outpatient department and office-based physicians, the objective of this investigation was to examine unspecific, general, and bone-related vitamin D deficiency diagnoses between 2007 and 2010 and to determine whether the rate of diagnoses differed by patient age and sex.

Methods

Study Design

We used a retrospective study design to estimate the rate of outpatient visits linked with a vitamin D deficiency diagnosis between 2007 and 2010. Data from the National Ambulatory Medical Care Survey (NAMCS) and National Hospital Ambulatory Medical Care Survey (NHAMCS) were used for this analysis. The NAMCS and NHAMCS are conducted by the Centers for Disease Control and Prevention’s National Center for Health Statistics branch. The NAMCS annually surveys outpatient visits to nonfederal-employee physicians who are categorized by the American Medical Association or the American Osteopathic Association as working “office based,” whereas the NHAMCS annually surveys ambulatory visits to nonfederal, short-stay general hospitals. Our study was approved by the institutional review board at our institution.

Data Sources and Samples

NAMCS—The NAMCS includes data from a subset of physicians across 112 sampled geographic areas in the United States. For each selected geographic location, a stratified random sample of physicians is selected from the American Medical Association's and American Osteopathic Association's physician master files. This stage of sampling is stratified by physician specialty. Approximately 1% (3400) of US outpatient physician offices are sampled annually, and visits are reported for a 1-week period of the survey year. The portion of visits sampled during this 1-week period may vary from 100% for small offices to 20% for large offices. On average, two of three sampled physician offices participate in the survey. For each sampled visit, data are collected from the medical records by the physician, physician's staff, or a US Census Bureau representative. Beginning in 2006, the NAMCS included a sampling of community health centers, which typically are located in medically underserved areas and provide services to people who are uninsured or underinsured, earn a low income, or are individuals living in areas with little access to primary health care.[13]

NHAMCS—The NHAMCS annually samples ambulatory visits to nonfederal, short-stay general hospitals. Visits to both emergency and outpatient departments are sampled; however, for the present analysis, only visits to outpatient departments were included. Similar to the NAMCS, the NHAMCS includes hospital visit data from 112 geographic areas. On average, 9% (480) of US hospitals with outpatient departments are sampled annually, and visits are reported for a 4-week period of the survey year.

Outcome Variables

The NAMCS and NHAMCS data include information on the primary reasons for the visit (maximum of three), medications prescribed (maximum of eight), diagnoses made by the physician (maximum of three), procedures performed, and the expected methods of payment.[14–16] Diagnoses and procedures were classified using the *International Classification of Diseases, 9th Revision, Clinical Modifications (ICD-9-CM)*. Most items have nonresponse rates of <5%. The inclusion criteria for the analysis were as follows: NAMCS or NHAMCS visits sampled between 2007 and 2010 linked with a diagnosis of vitamin D deficiency (*ICD-9-CM* 268.0, 268.1, 268.2, and 268.9). Variables included in this analysis were patient sex and age, diagnoses rendered, survey year, and physician specialty type for visits linked with a vitamin D deficiency diagnosis. Because poor bone health is an important outcome of vitamin D deficiency, we also examined the annual per capita rates of visits linked with a diagnosis of osteoporosis (*ICD-9-CM* 733.0) or a bone fracture (*ICD-9-CM* 733.1 or 733.8) that may have been the result of osteoporosis. This secondary analysis of bone disease was restricted to all visits at which patients were 45 years or older because such bone diseases are not common in young individuals.[17]

Statistical Analysis

Analyses were performed using SAS version 9.2 (SAS Institute, Cary, NC). To account for the complex clustered sampling designs, SAS PROC SVYS was used. Survey weights, which are the product of sampling fractions from each stage of the sampling, were applied with SAS PROC SVYS to provide unbiased national estimates of visits to ambulatory sites. The National Center for Health Statistics provides these weights after adjusting for survey nonresponse. The estimated number of visits linked with a vitamin D deficiency diagnosis overall and by *ICD-9-CM* subcategories were reported. Per capita visit rates were calculated by dividing the number of visits linked with a diagnosis by the estimated population size. Population sizes were extracted from the US Census Bureau's 2010 estimates of the number of noninstitutionalized civilians. *t* Tests were used to compare visit rates per 100,000 population among age and sex subgroups. The proportion of vitamin D deficiency visits associated with a diagnosis of osteoporosis or a bone fracture was reported. Patients' age and sex were characterized. Physician specialist subcategories are collected only the NAMCS; therefore, the distributions of vitamin D deficiency visits by specialty were reported for outpatient office data only. As complementary data, the rate of visits associated with a diagnosis of osteoporosis or bone fracture per 100,000 population for people 45 years old or older were reported. Summary statistics were reported as mean/proportion/total (95% confidence interval [CI]).

Results

There were 292 unweighted records associated with a diagnosis of vitamin D deficiency. An estimated 7.5 million (95% CI 4.9–10.2 million) outpatient visits were linked with a diagnosis of vitamin D deficiency in the United States between 2007 and 2010. Approximately 97.2% (7.3 million visits) of diagnoses were for unspecified vitamin D deficiency (*ICD-9-CM* 268.9) and 2.8% (0.2 million visits) were for vitamin D deficiency–related osteomalacia (*ICD-9-CM* 268.2) and general vitamin D deficiency (*ICD-9-CM* 268.0). Before 2008, the annual rates of vitamin D deficiency diagnoses were too low to meet the NAMCS' criteria for reporting data (≥ 30 unweighted records). For 2008–2010, the visit rates associated with a vitamin D deficiency diagnosis per 100,000 population were 383 (95% CI 139–627) in 2008, 783 (95% CI 123–1444) in 2009, and 1177 (95% CI 705–1649) in 2010. Approximately 9.6% (95% CI 3.4–15.7) of the visits were reported as having a diagnosis of osteoporosis or bone fracture.

The mean patient age was 56.9 years (95% CI 53.8–60.0 years) and was not significantly different by sex. Female patients were 2.6 times more likely to be diagnosed as having vitamin D deficiency compared with male patients ($P = 0.001$) and individuals 65 years old or older were also 2.9 times more likely to be diagnosed compared with individuals younger than 65 ($P = 0.003$; Table). Among visits to outpatient offices (NAMCS data) for which physician specialty was recorded, 81% were diagnosed by a primary care provider (general and family practitioners, internists, and pediatricians). The remaining 19% of visits were to assorted specialists.

In the entire 2007–2010 NAMCS and NHAMCS outpatient datasets, the visit rates per 100,000 population for visits associated with a diagnosis of osteoporosis or a bone fracture among patients 45 years or older were 17,670 (95% CI 14,410–20,920) in 2007, 23,690 (95% CI 19,780–27,590) in 2008, 32,440 (95% CI 26,210–38,670) in 2009, and 22,550 (95% CI 17,870–27,230) in 2010.

Discussion

Although the increase in diagnoses of vitamin D deficiencies beginning in 2007 may be attributed to several factors, the most compelling factors are the 2007 change in the guidelines that physicians use to define vitamin D deficiency and the increase in publicity about and awareness of vitamin D deficiency screening. In addition, both physician and patient awareness of the known and potential consequences of vitamin D deficiency has grown because of a substantial increase in both academic and general media periodicals concerning vitamin D deficiency.[18] An increase in diagnoses among adults for bone disease also occurred from 2007 to 2009. The concurrent increase in visits for osteoporosis and vitamin D deficiency may be in part the result of more surveillance by physicians.[9] The increase also may be attributed to the aging US population, which could result in patients being at risk for developing osteoporosis.[19]

Being older than 65 years or female was associated with a higher rate of visits linked with a vitamin D deficiency diagnosis. Although being older in age and being female are associated with an increased risk of osteoporosis,[20–24] there were no statistical differences in the prevalence of vitamin D deficiency between the two age groups or between the sexes. Consequently, diagnoses were possibly rendered as preventive measures for these two subgroups.

The NAMCS and outpatient department portion of the NHAMCS datasets are nationally representative and generalizable to the outpatient setting. The reliability of information provided in the NAMCS database is bolstered in that diagnoses and measures are recorded by physicians or their appointed designees.

A limitation of this study is the absence of the criteria used to diagnose vitamin D deficiency. Such measures may vary from serum 25(OH)D concentrations to sun exposure or dietary intake data to other information garnered from patients, all of which can help to confirm the diagnosis. Because of the design of the surveys used, we are not able to directly confirm why there was a surge in diagnoses in recent years. In addition, the small sample size (N = 292) limited our ability to conduct subgroup analyses. Despite the small sample size, these data still illustrate a sharp increase in recent years of diagnosis-linked visits, especially vitamin D deficiency diagnoses not linked with an additional diagnosis for bone disease.

Although vitamin D deficiency can manifest itself in highly visible deformities, in the present analysis, 90% of the diagnoses were not associated with a vitamin D deficiency–related disease (osteoporosis or bone fracture). This finding may suggest that screening for vitamin D deficiency in these patients was used as a preventive measure rather than as a diagnostic aid. We emphasize the importance of providing consistent guidelines, testing procedures, and diagnostic criteria to healthcare providers so that they can make informed decisions when screening patients for vitamin D deficiency. Identifying and screening individuals at risk for vitamin D deficiency is clinically valuable; however, unwarranted, excessive screening may tax the healthcare system unnecessarily.

Acknowledgments

The Center for Dermatology Research is supported by an unrestricted educational grant from Galderma Laboratories. S.R.F. is a consultant and speaker for Galderma, Stiefel/GlaxoSmithKline, Abbott Laboratories, Warner Chilcott, Janssen, Amgen, Photomedex, Genentech, BiogenIdec, and Bristol-Myers Squibb; has received grants from Galderma, Astellas, Abbott Laboratories, Warner Chilcott, Janssen, Amgen, Photomedex, Genentech, BiogenIdec, Coria/Valeant, Pharmaderm, Ortho Pharmaceuticals, Aventis Pharmaceuticals, Roche Dermatology, 3M, Bristol-Myers Squibb, Stiefel/GlaxoSmithKline, Novartis, Medicis, Leo, HanAll Pharmaceuticals, Celgene, Basilea, and Anacor; and has received stock options from Photomedex. B.J.M. is supported by the National Cancer Institute under award number 5 R25 CA122061-05.

References

1. Holick MF. Vitamin D deficiency. N Engl J Med. 2007; 357:266–281. [PubMed: 17634462]
2. Wang TJ, Pencina MJ, Booth SL, et al. Vitamin D deficiency and risk of cardiovascular disease. Circulation. 2008; 117:503–511. [PubMed: 18180395]
3. Husemoen LL, Skaaby T, Thuesen BH, et al. Serum 25(OH)D and incident type 2 diabetes: a cohort study. Eur J Clin Nutr. 2012; 66:1309–1314. [PubMed: 23031851]
4. Moller UK, Streym S, Heickendorff L, et al. Effects of 25OHD concentrations on chances of pregnancy and pregnancy outcomes: a cohort study in healthy Danish women. Eur J Clin Nutr. 2012; 66:862–868. [PubMed: 22378226]
5. Woeckel VJ, Alves RD, Swagemakers SM, et al. 1Alpha,25-(OH)2D3 acts in the early phase of osteoblast differentiation to enhance mineralization via accelerated production of mature matrix vesicles. J Cell Physiol. 2010; 225:593–600. [PubMed: 20506116]
6. Institute of Medicine. Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: The National Academies Press; 2011. p. 260-262.
7. Rosen CJ, Abrams SA, Aloia JF, et al. IOM committee members respond to Endocrine Society vitamin D guideline. J Clin Endocrinol Metab. 2012; 97:1146–1152. [PubMed: 22442278]
8. Rollins, G. [Accessed August 30, 2012] Vitamin D testing–what's the right answer?. http://www.aacc.org/publications/cln/2009/july/Pages/CovStory1July09.aspx
9. Sattar N, Welsh P, Panarelli M, Forouhi NG. Increasing requests for vitamin D measurement: costly, confusing, and without credibility. Lancet. 2012; 379:95–96. [A] [PubMed: 22243814]
10. Holick MF, Binkley NC, Bischoff-Ferrari HA, et al. Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011; 96:1911–1930. [PubMed: 21646368]
11. Lai JK, Lucas RM, Banks E, et al. Variability in vitamin D assays impairs clinical assessment of vitamin D status. Intern Med J. 2012; 42:43–50. [PubMed: 21395958]
12. Roth HJ, Schmidt-Gayk H, Weber H, et al. Accuracy and clinical implications of seven 25-hydroxyvitamin D methods compared with liquid chromatography-tandem mass spectrometry as a reference. Ann Clin Biochem. 2008; 45(Pt 2):153–159. [PubMed: 18325178]
13. Centers for Disease Control and Prevention. [Accessed November 29, 2012] Ambulatory health care data. http://www.cdc.gov/nchs/ahcd.htm
14. Centers for Disease Control and Prevention. [Accessed July 20, 2012] Ambulatory health care data: survey instruments. http://www.cdc.gov/nchs/ahcd/ahcd_survey_instruments.htm#namcs
15. Franks P, Clancy CM, Nutting PA. Defining primary care. Empirical analysis of the National Ambulatory Medical Care Survey. Med Care. 1997; 35:655–668. [PubMed: 9219494]
16. Binns HJ, Lanier D, Pace WD, et al. Describing primary care encounters: the Primary Care Network Survey and the National Ambulatory Medical Care Survey. Ann Fam Med. 2007; 5:39–47. [PubMed: 17261863]
17. Cummings SR, Melton LJ. Epidemiology and outcomes of osteoporotic fractures. Lancet. 2002; 359:1761–1767. [PubMed: 12049882]

[A]Original refs 9 and 19 were identical; 19 was deleted and subsequent refs renumbered.

18. Guthrie, C. [Accessed July 30, 2012] Top 10 everything of 2007: top 10 medical breakthroughs. http://www.time.com/time/specials/2007/article/0,28804,1686204_1686252_1690393,00.html
19. Seriolo B, Paolino S, Casabella A, et al. Osteoporosis in the elderly. Aging Clin Exp Res. 2013; 25(Suppl 1):S27–S29. [PubMed: 23963883]
20. Forrest KY, Stuhldreher WL. Prevalence and correlates of vitamin D deficiency in US adults. Nutr Res. 2011; 31:48–54. [PubMed: 21310306]
21. Hui SL, Slemenda CW, Johnston CC Jr. Age and bone mass as predictors of fracture in a prospective study. J Clin Invest. 1988; 81:1804–1809. [PubMed: 3384952]
22. Lapi F, Simonetti M, Michieli R, et al. Assessing 5-year incidence rates and determinants of osteoporotic fractures in primary care. Bone. 2012; 50:85–90. [PubMed: 21985999]
23. Ross PD. Osteoporosis. Frequency, consequences, and risk factors. Arch Intern Med. 1996; 156:1399–411. [PubMed: 8678708]
24. National Institutes of Health Osteoporosis and Related Bone Diseases National Resource Center. [Accessed July 30, 2012] Osteoporosis handout on health. http://www.niams.nih.gov/Health_Info/Bone/Osteoporosis/osteoporosis_hoh.asp. Published 2011

Key Points

- Research on the potential consequences of vitamin D deficiency has rapidly grown.
- Diagnoses of vitamin D deficiency also have increased rapidly, with women and older individuals the most likely to receive this diagnosis.
- The majority of recent diagnoses of vitamin D deficiency have been asymptomatic disease.
- With the surge in asymptomatic vitamin D deficiency diagnoses, physicians often appear to be screening rather than confirming clinical manifestations resulting from the deficiency.

Table

Frequency of patient visits resulting in a vitamin D deficiency diagnosis, by age and sex

	Unweighted NAMCS and NHAMCS records	Estimated visits	Population estimate*	Visit rate per 100,000 population (95% CI)†	*P*
Overall	292	8010	303,630	2600 (1700–3500)	—
Age, y					
≥65	82	2250	38,910	5800 (3200–8400)	0.003
<65	209	5260	264,720	2000 (1200–2800)	
Sex					
Female	213	5490	154,630	3500 (2300–4800)	0.001
Male	78	2030	149,000	1400 (600–2100)	

CI, confidence interval; NAMCS, National Ambulatory Medical Care Survey; NHAMCS, National Hospital Ambulatory Medical Care Survey.

* Population estimates based on 2010 US Census Bureau noninstitutionalized civilian population estimates.

† Visit rates were calculated as total visits divided by population estimates. Rate comparisons were performed using *t* tests.