Temporal Trends of Hypovitaminosis D: A Population-Based Study of Cases Under 19 Years of Age

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Background

- Hypovitaminosis D is becoming increasingly common in the western hemisphere, however exact incidence is not known.
- Vitamin D mediates its biological effect through the vitamin D receptor (VDR), which was discovered to be present in a variety of tissues, suggesting potential importance of vitamin D on extra-skeletal systems.
- Particularly, researchers have paid a great deal of attention to the effect of vitamin D on immunologic mechanisms.
- Vitamin D inhibits the pro-inflammatory responses of the adaptive immune system and promotes proliferation of regulatory T cells.
- Thus, vitamin D has been the focus of many studies examining its relationship with allergic diseases.

Aim: To determine the trends in testing and changing incidence of hypovitaminosis D in a population-based cohort.

Methods

Data Source:

- This study used the data resources of the Rochester Epidemiology Project (REP)
- The REP provides the infrastructure for medical research on the approximately 154,000 citizens of Olmsted County as the result of a unique medical records linkage system in Rochester, MN

Study Design:

- A retrospective cohort study design was used
- Using the REP, we identified all 25-hydroxyvitamin D levels drawn during a 16-year period from January 2, 2002 through December 31, 2017 for Olmsted Country residents under 19 years of age
- Using each patient's first total 25-hydroxyvitamin D concentration less than 30.0, a patient was classified as having either vitamin D deficiency (<20 ng/mL) or insufficiency (20.1-30.0 ng/mL)
- Baseline characteristics were reviewed for these patients

Results

Patient Characteristics and Incidence Rates

- During 2002-2017, a total of 1987 Olmsted County residents under 19 years of age met the criteria for an incident case of vitamin D deficiency/insufficiency
- Using each patient's first instance with a total concentration of 30.0 ng/mL or lower, 634 (31.9%) patients were classified as having vitamin D deficiency and 1353 (68.1%) were classified as having vitamin D insufficiency. Table 1 summarizes the patient's baseline characteristics at the time of the index date.

Table 1: Baseline characteristics of incidence cases with vitamin D deficiency or insufficiency at time of index date

Characteristic	Vitamin D deficiency (<20ng/mL) (N=634)	Vitamin D insufficiency (20-30 ng/mL) (N=1353)	Total (N=1987)	P-value
Sex, n(%)				<0.001
Male	227 (35.8%)	591 (43.7%)	818 (41.2%)	
Female	407 (64.2%)	762 (56.3%)	1169 (58.8%)	
Race, n(%)				<0.001
White	318 (50.2%)	955 (70.6%)	1273 (64.1%)	
Black or African American	164 (25.9%)	169 (12.5%)	333 (16.8%)	
Asian	55 (8.7%)	86 (6.4%)	141 (7.1%)	
All other races	88 (13.9%)	132 (9.8%)	220 (11.1%)	
Not reported	9 (1.4%)	11 (0.8%)	20 (1.0%)	
Age at index date (yrs), n(%)				<0.001
<1	49 (7.7%)	38 (2.8%)	87 (4.4%)	
1-<5	44 (6.9%)	150 (11.1%)	194 (9.8%)	
5-<19	541 (85.3%)	1165 (86.1%)	1706 (85.9%)	
BMI percentile				<0.001
Normal (<85th percentile)	284 (44.8%)	775 (57.3%)	1059 (53.3%)	
Overweight (85-95th percentile)	73 (11.5%)	164 (12.1%)	237 (11.9%)	
Obese (≥95th percentile)	192 (30.3%)	305 (22.5%)	497 (25.0%)	
Not applicable (patient <2 yrs)	72 (11.4%)	90 (6.7%)	162 (8.2%)	
Not available	13 (2.1%)	19 (1.4%)	32 (1.6%)	
Season at diagnosis, n(%)				<0.001
Spring (Mar-May)	211 (33.3%)	367 (27.1%)	578 (29.1%)	
Summer (Jun-Aug)	98 (15.5%)	270 (20.0%)	368 (18.5%)	
Autumn (Sep-Nov)	116 (18.3%)	341 (25.2%)	457 (23.0%)	
Winter (Dec-Feb)	209 (33.0%)	375 (27.7%)	584 (29.4%)	

Results

- The overall age- and sex-adjusted incidence for vitamin D deficiency or insufficiency was 321.8 (95% CI, 307.7-336.6) per 100,000 person-years
- The incidence for vitamin D deficiency or insufficiency was significantly higher for females compared to males (Table 2)

Table 2:Incidence (per 100,000 person-years) of vitamin D deficiency or insufficiency among residents <19 years of age in Olmsted County, MN during 2002-2017, stratified by age and sex

Age group (years)	Females		Males		Both sexes	
	No.	Incidence (95% CI)	No.	Incidence (95% CI)	No.	Incidence (95% CI)
Deficiency or Insufficiency						
<1	40	219.8 (157.0-299.3)	47	248.5 (182.6-330.4)	87	234.4 (187.8-289.1)
1 - < 5	97	138.3 (112.2-168.7)	97	131.6 (106.7-160.6)	194	134.9 (116.6-155.3)
5 - < 19	1032	469.9 (441.7-499.5)	674	293.6 (271.9-316.7)	1706	379.8 (362.0-398.3)
Overall†	1169	388.9 (366.5-411.2)	818	257.9 (240.2-275.6)	1987	321.8 (307.7-336.0)
Deficiency						
<1	28	153.9 (102.2-222.4)	21	111.0 (68.7-169.7)	49	132.0 (97.7-174.5)
1 - < 5	22	31.4 (19.7-47.5)	22	29.9 (18.7-45.2)	44	30.6 (22.2-41.1)
5 - < 19	357	162.6 (146.1-180.3)	184	80.2 (69.0-92.6)	541	120.4 (110.5-131.0)
Overall†	407	135.0 (121.9-148.1)	228	71.3 (62.0-80.6)	634	102.4 (94.4-110.4)
Insufficiency						
<1	12	65.9 (34.1-115.2)	26	137.4 (89.8-201.4)	38	102.4 (72.5-140.5)
1 - < 5	75	106.9 (84.1-134.1)	75	101.8 (80.1-127.6)	150	104.3 (88.3-122.4)
5 - < 19	675	307.4 (284.6-331.4)	490	213.5 (195.0-233.2)	1165	259.4 (244.7-274.7)
Overall†	762	253.8 (235.8-271.9)	591	186.6 (171.5-201.7)	1353	219.4 (207.7-231.1)

†The overall rates are age-and sex-adjusted to the population structure of the IS total population in 2010

Results

Temporal Trends in the Incidence of Vitamin D Deficiency/Insufficiency

Figure 1: Overall biannual incidence rates for <19 years of age in Olmsted County, Minnesota during 2002-2017

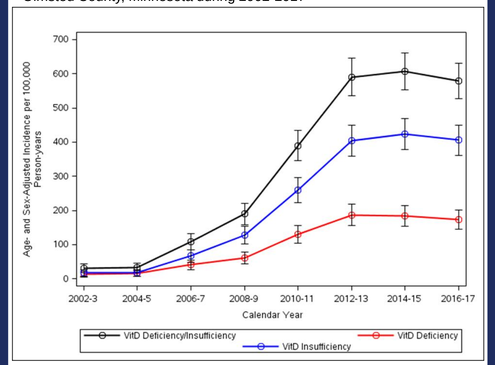

Table 3: Number and proportion of Olmsted County residents under 19 years of age who had "total" vitamin D level reported each calendar year

Calendar year	No. in Olmsted County population <19 years of age†	No. tested‡	No. incident cases*	Percent of Olmsted County population (<19 years of age) tested each year
2002	37554	14	8	0.04%
2003	38083	27	16	0.07%
2004	38226	29	13	0.08%
2005	38614	26	12	0.07%
2006	38998	70	32	0.18%
2007	39306	116	53	0.30%
2008	39592	148	58	0.37%
2009	39568	184	88	0.47%
2010	39765	298	130	0.75%
2011	39912	352	175	0.88%
2012	39901	392	204	0.98%
2013	40161	506	254	1.26%
2014	40461	538	224	1.33%
2015	40436	588	255	1.45%
2016	40658	601	246	1.48%
2017	40819	637	219	1.56%

† Based on the REP enumerated census. ‡ A patient tested more than once during the 2002-2017 time period is counted only once in a single calendar year, but is counted once in each calendar year they are tested. *A patient is counted an incident case in the first calendar year that their total concentration was 30.0 ng/mL or lower.

Discussion

- This represents a comprehensive population-based study on hypovitaminosis D, which provides an estimate of temporal trends in the incidence of vitamin D deficiency/insufficiency at a population level
- This retrospective study found an increase in incident cases of both vitamin D deficiency and insufficiency in Olmsted County, Minnesota, over a 16-year period from 2002 through 2017
  - A higher proportion of the patients with a deficiency were non-white comparted to those with an insufficiency
  - Among the patients 2 years or older at the index date, the prevalence of obesity was significantly higher among those with a vitamin D deficiency compared to those with vitamin D insufficiency
  - Patients with a vitamin D deficiency were more likely to be diagnosed during the winter and spring months compared to those with a vitamin D insufficiency
  - Females had a higher incidence of vitamin D insufficiency or deficiency
- Limitations include the fact that the generalizability of this study is limited largely to white people because the Olmsted County is mainly white. The use of a retrospective study design is subject to several biases, including reviewer bias.
- Future directions include determining prevalence of comorbidities in hypovitaminosis D, with a focus in atopic conditions

References

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