



Prescription of vitamin D among Swiss pediatricians

Maristella Santi¹ · Marco Janner¹ · Giacomo D. Simonetti² · Sebastiano A. G. Lava³ 

Received: 15 April 2019 / Revised: 15 May 2019 / Accepted: 16 May 2019 / Published online: 27 May 2019
© Springer-Verlag GmbH Germany, part of Springer Nature 2019

Abstract

The traditional recommendation that Swiss children receive vitamin D during the first year of life was recently extended to the second and third year of life and during winter for older children. The aim of the study was to identify how Swiss pediatricians prescribe vitamin D. Between December 2016 and March 2017, 795 (52%) of 1530 invited Swiss board-certified pediatricians answered a closed-ended questionnaire. Respondents routinely prescribe vitamin D supplements in infants ≤ 1 year of age, but infrequently in children ≥ 3 years of age. Only a minority of them prescribe vitamin D in children with conditions that predispose to poor vitamin D status. Oily vitamin D preparations are the most popular and are usually prescribed in a once-a-day regimen. In situations like intake of drugs interfering with vitamin D metabolism, intestinal malabsorption, and diabetes mellitus, Swiss pediatricians often seek the advice of a subspecialist. In cases with clinical suspicion of poor vitamin D status, the diagnosis is confirmed by the determination of 25-hydroxyvitamin D.

Conclusion: Few pediatricians prescribe a vitamin D supplementation in children ≥ 3 years of age. Collaboration between policymakers and health care professionals is required to fill the gap between guidelines and clinical practice.

What is Known:

- In Switzerland, vitamin D supplementation is recommended during the first, second, and third year of life as well as during winter for older children.
- Both alcoholic and oily preparations are currently available.

What is New:

- Swiss pediatricians routinely prescribe vitamin D in infants ≤ 1 year of age, but infrequently in children ≥ 3 years of age.
- Oily vitamin D preparations are the most popular and are usually prescribed in a once-a-day regimen.

Keywords Vitamin D · Supplementation · Guidelines · Adherence · Survey

Introduction

Vitamin D status is often poor among children worldwide [1, 9, 14]. Thus, approximately 5 years ago, the Swiss Federal Office of Public Health extended the traditional recommendation that infants receive a vitamin D supplementation during

the first year of life. Nowadays, vitamin D is recommended in infants (400 IU once a day during the first year of life) also for the second and third year of life (600 IU once a day) as well as during winter time for older children (600 IU once a day) [14]. Furthermore, in addition to the traditional alcoholic preparation, several oily vitamin D₃ preparations are now commercially available [14].

The aim of the present study was to identify how Swiss pediatricians currently prescribe vitamin D supplementation.

Communicated by Mario Bianchetti

✉ Sebastiano A. G. Lava
webmaster@sebastianolava.ch

¹ Department of Pediatrics, University Children's Hospital of Bern, Inselspital, Bern, Switzerland

² Pediatric Institute of Southern Switzerland, Ospedale San Giovanni, Bellinzona, Università della Svizzera Italiana, Lugano, Switzerland

³ Pediatric Cardiology Unit, Department of Pediatrics, Lausanne University Hospital and University of Lausanne, 1011 Lausanne, Switzerland

Methods

In December 2016, the 1530 (62% females) members of the Swiss Society of Pediatrics received an electronic mail containing a link to a closed-ended questionnaire on vitamin D practice characteristics. In March 2017, a reminder was sent to encourage participation.

In addition to demographic data, the questionnaire (Table 1) addressed the prescription of vitamin D in several pediatric ages (questions 1–3) and in peculiar conditions (questions 4–6, 9–11), the selected dosing interval (question 7), the possible existence of parental concerns related to the use of vitamin D (question 8), the vitamin D preparations (question 12), and the determination of 25-hydroxyvitamin D (question 13).

The inquiry, which was not commercially sponsored, had been developed by 2 authors (MS, SAGL) following published recommendations for survey research [3–5, 19]. An initial version, designed in 2015, was tested among 15 pediatricians and eventually adjusted. Professional native translators specialized in medicine translated the final questionnaire from Italian into French and German using the forward–backward method [3–5, 19]. It was also checked that the time needed to complete the questionnaire would be ≤ 5 min. All responses were anonymous, and no identifier could be used to

Table 1 Questionnaire about vitamin D practice characteristics

1. Do you prescribe a vitamin D supplementation in children ≤ 1 year of age?*
2. Do you prescribe a vitamin D supplementation during the second and third year of life?*
3. Do you prescribe a vitamin D supplementation during winter months in children older than 3 years of age?*
4. Do you adjust the vitamin D supplementation in children with reduced cutaneous vitamin D synthesis such as dark skin pigmentation, long-sleeved clothing habits, and frequent use of sunscreen?*
5. Do you adjust the vitamin D supplementation in children with excessive body weight?*
6. Do you adjust the vitamin D supplementation in children with frequent respiratory tract infections?*
- 7–9. Do you adjust the vitamin D supplementation in children taking drugs interfering with vitamin D metabolism (e.g. antiepileptics, antivirals, corticosteroids) and children with intestinal malabsorption (e.g. Crohn's disease, ulcerative colitis, cystic fibrosis) or diabetes mellitus? Possible answers: a. I prescribe b. I do not prescribe c. I ask the corresponding subspecialist.
10. Do you prescribe a vitamin D supplementation at longer intervals than once daily, i.e. once weekly or monthly?*
11. Do you encounter parents with concerns related to vitamin D supplementation?*
12. Which of the following vitamin D₃ preparations do you most often prescribe as first choice? Possible answers: a. Vi-De 3® alcoholic drops (100 IU/drop), Wild AG, Basel, Switzerland; b. Vitamin D3 Streuli® (400 IU/0.1 ml), Streuli Pharma AG, 8730 Uznach, Switzerland. c. Vitamin D3 oil Wild® (500 IU/drop), Wild AG, Basel, Switzerland; d. Oleovit D3 (400 IU/drop), Fresenius Kabi AG, Bad Homburg, Germany; e. Oily EveryD₃ Aurora® (200 IU/push) or Activea® (600 IU/drop), Labatec-Pharma AG, Geneva, Switzerland.
13. Do you assess circulating 25-hydroxyvitamin D level in children with clinical suspicion of poor vitamin D status? Possible answers: a. I measure 25-hydroxyvitamin D level and subsequently prescribe vitamin D; b. I prescribe vitamin D without assessing 25-hydroxyvitamin D level.

*Possible answers: a. rarely (<25% of children); b. sometimes (25–49%); c. often (50–74%); d. almost always (75–100%)

trace the participants. The study data were automatically transferred into a centralized database.

Participant characteristics were analyzed by descriptive statistics. Ordered categorical variables were assigned a numerical score and subsequently analyzed using a nonparametric analysis of variance for repeated measures [6, 8]. The Mann–Whitney–Wilcoxon rank sum test for two independent samples and the Fisher exact test were also used, as appropriate [8]. Statistical significance was assigned at $P < 0.05$.

Results

Seven hundred ninety-five (52%) out of 1530 invited pediatricians answered the survey (Table 2). Age and gender were not statistically different between participants and the entire population of Swiss pediatricians. Each question was answered by ≥ 767 (96%) pediatricians.

Ninety-seven percent ($N = 769$) of participants almost always prescribe vitamin D in newborns and infants ≤ 12 months of age (Fig. 1), whereas the prescription is significantly lower for children 2 to 3 years of age (72%, $N = 572$; $P < 0.0001$) and especially for children > 3 years of age (3.2%, $N = 25$; $P < 0.0001$).

Most respondents (Fig. 2) only occasionally adjust the supplementation in children with reduced cutaneous vitamin D synthesis, excessive body weight, and frequent respiratory tract infections. The majority of the respondents (66%) prescribe vitamin D in a once-a-day regimen. On the other side, most families (79%) rarely show concerns about vitamin D supplementation, as perceived by the responding pediatricians.

In specific chronic clinical situations (Fig. 3, upper panel), like intake of drugs interfering with vitamin D metabolism, intestinal malabsorption, and diabetes mellitus, more than half of respondents prefer to seek the advice of the corresponding subspecialist before starting or adjusting the dose of a vitamin D supplementation. Furthermore (Fig. 3, lower panel), 90% of

Table 2 Characteristics of the 795 study participants

Females:males, N (%)	477 (60):318 (40)
Age	
30–40 years, N (%)	181 (23)
41–50 years, N (%)	286 (36)
51–60 years, N (%)	239 (30)
≥ 61 years, N (%)	89 (11)
Activity	
Private practice, N (%)	695 (87)
Hospital, N (%)	100 (13)
Certification	
Pediatric generalist, N (%)	540 (68)
Pediatric subspecialist, N (%)	255 (32)

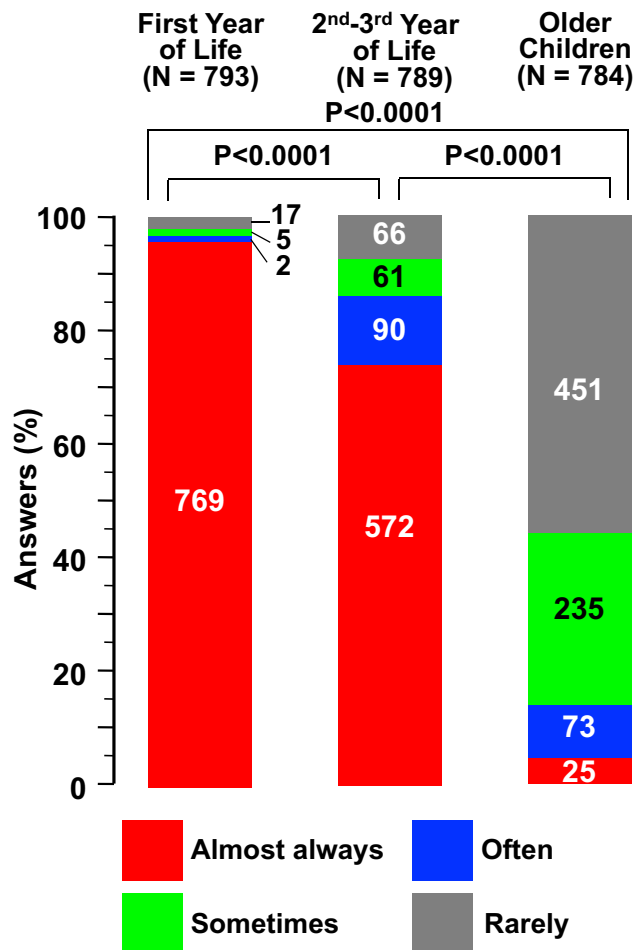


Fig. 1 Prescription of vitamin D in the following pediatric ages: first year of life, second and third year of life, children older than 3 years. Possible answers: in this situation, I prescribe the vitamin D supplementation: rarely (<25% of children); sometimes (25–49%); often (50–74%); almost always (75–100%)

respondents state to prescribe the oily preparations of vitamin D₃ as first choice ($P < 0.0001$).

Finally, in children with suspected poor vitamin D status, 689 (88%) out of 782 respondents state to routinely determine the circulating 25-hydroxyvitamin D level.

Discussion

According to our observations, most Swiss board-certified pediatricians almost always prescribe vitamin D supplements in infants ≤ 3 years of age, while few pediatricians prescribe a vitamin D supplementation in children > 3 years of age. Second, only a minority of them adjust the vitamin D supplementation in children with conditions that predispose to poor vitamin D status. Third, oily vitamin D preparations are much more popular than the alcoholic ones and are usually prescribed in a once-a-day regimen. Fourth, in peculiar situations like intake of drugs interfering with vitamin D metabolism and its

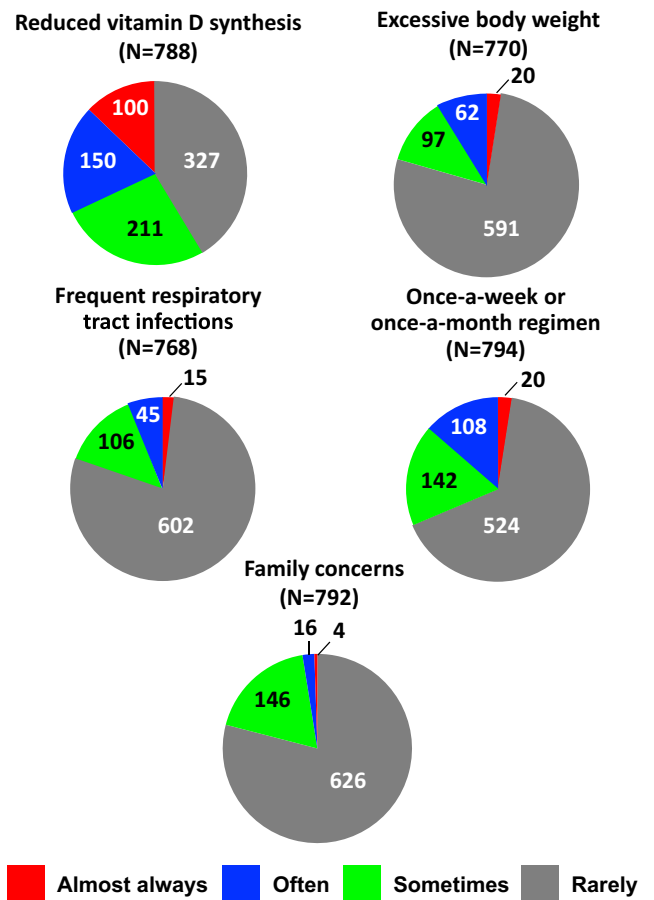


Fig. 2 Adjustment of the vitamin D supplementation in children with reduced cutaneous vitamin D synthesis (such as dark skin pigmentation, long-sleeved clothing habits, and frequent use of sunscreen), in children with excessive body weight, and in children with frequent respiratory tract infections; prescription of vitamin D once-a-week or once-a-month; concerns of families related to the supplementation with vitamin D. Possible answers: in this situation, I adjust the vitamin D supplementation: rarely (<25% of children); sometimes (25–49%); often (50–74%); almost always (75–100%)

functional correlates, intestinal malabsorption, and diabetes mellitus, pediatricians prefer to seek the advice of a subspecialist before starting a vitamin D supplementation or adjusting the dose. Finally, in situations of suspected hypovitaminosis D, circulating 25-hydroxyvitamin D is frequently measured.

The response rate to this inquiry (52%) was satisfactory, superior to that of a recent survey on fever management [13] and similar to that of a survey on immunization practices [17].

Numerous authorities support the prescription of vitamin D supplements not only during the first year of life but also through adolescence and in peculiar clinical situations likely to impair vitamin D metabolism [9, 14]. Under-prescription of therapy is frequent in chronic conditions such as cardiovascular diseases, diabetes mellitus, and obstructive pulmonary diseases [7, 18]. Following barriers might underlay the partially poor adherence of Swiss pediatricians to current recommendations on vitamin D prescription in children: poor awareness,

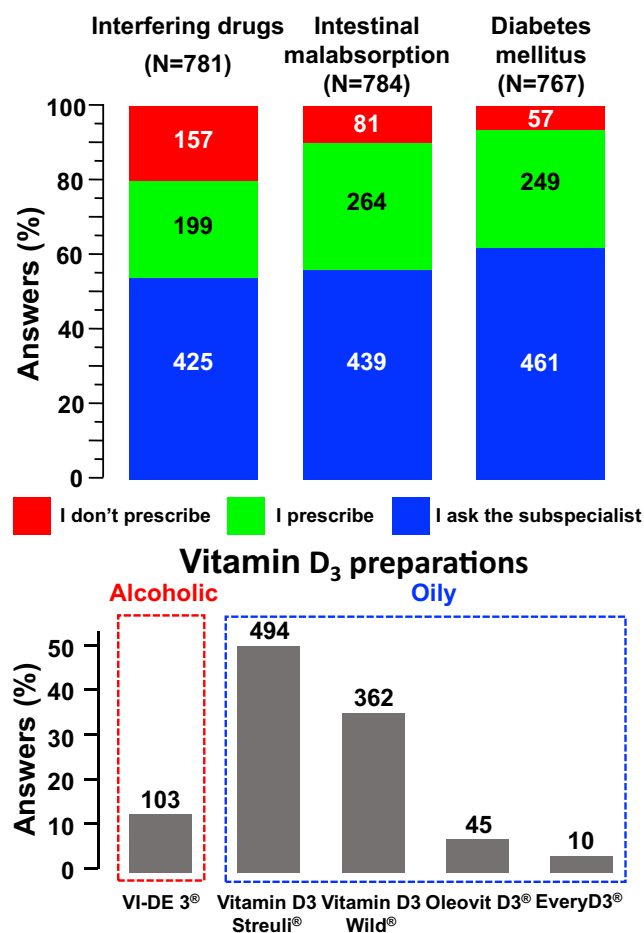


Fig. 3 Upper panel: prescription of a vitamin D supplementation in children taking drugs interfering with vitamin D metabolism, in children with intestinal malabsorption, or in children with diabetes mellitus. Lower panel: most frequently preferred vitamin D₃ preparations

inertia of previous practice (i.e., the difficulty in effectively translating updated knowledge in everyday clinical routine), and lack of agreement [7, 18]. Poor awareness is an unlikely explanation because the current recommendations have been largely widespread in the last years. In fact, according to this survey, the new recommendations were adopted for children in their 2nd and 3rd year of life, but not in children > 3 years of age. Thus, inertia of previous practice and lack of agreement probably play here a more important role. In fact, pediatricians might be hesitant to prescribe currently recommended doses of vitamin D because too much vitamin D may be as harmful as too little [1, 9, 14]. In childhood, however, vitamin D toxicity occurs exclusively after repeated enteral and especially parenteral administration of vitamin D in mega-doses (total dose of 240,000 to 4,500,000 IU) [21].

Supplementation with vitamin D can be achieved equally well with daily, weekly, or monthly dosing frequencies [10]. Unsurprisingly, therefore, nearly one third of the Swiss pediatricians, who traditionally prescribed vitamin D in a daily dose, sometimes or often select a larger dosing interval. Of

note, the Swiss drug compendium does not currently mention this possibility.

Most participants seek the advice of a pediatric subspecialist before starting a supplementation with vitamin D in conditions like intake of drugs interfering with vitamin D metabolism, intestinal malabsorption, and diabetes mellitus. Although this result might suggest that Swiss pediatricians are unsure about the attitude to have in these conditions, we believe that, considering the organization of pediatric residency and pediatric care in Switzerland, it rather highlights the excellent collaboration between general and subspecialist pediatricians in Switzerland [12].

Circulating 25-hydroxyvitamin D, the best indicator of vitamin D status, is nowadays rapidly assessed in many laboratories [2]. Whether the potential benefit of vitamin D status screening in children without specific risk factors or clinical features outweighs its costs is questionable [2].

This nationwide study on pediatricians' attitudes with respect to vitamin D can benefit from an adequate response rate and the involvement of both community and hospital pediatricians. However, this study also has some limitations. First, the questionnaire was pilot-tested for usability but not validated [3–5, 19]. Second, the results are based on self-reports, which might not always reflect the everyday clinical practice [15]. Finally, this study does not allow for the disclosure of the reasons why participants sometimes do not adhere to current Swiss clinical practice guidelines on vitamin D.

Like recognized, translation of new guidelines in everyday clinical routine is challenging. Collaboration between researchers, policymakers, and health care professionals might help to fill the gap between national guidelines and clinical practice in vitamin D prescription [11, 16, 20].

Authors' contributions Study concept, study design, inquiry development: MS, SAGL.

Pilot testing of the instrument: MS, GDS.

Programming and management of the survey website: MS, GDS, SAGL.

Email invitations to the participants: MS.

Statistical analysis: MS, SAGL.

Drafting of the manuscript: MS, MJ, SAGL.

Critical revision of the manuscript: MS, MJ, GDS, SAGL.

Final manuscript: MS, MJ, GDS, SAGL.

Funding This research was supported by the Advisory Board for Research of the Ente Ospedaliero, Canton Ticino (Switzerland), and by the Ettore Balli Foundation.

Compliance with ethical statements

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article, being a survey among health professionals, does not contain any clinical or experimental studies with human participants or animals. Participants received information on the study

and (anonymous) study participation via an invitation email containing a link to the survey's website. Participation in the questionnaire following reading of the email implied consent.

References

- Ariyawatkul K, Lersbuasin P (2018) Prevalence of vitamin D deficiency in cord blood of newborns and the association with maternal vitamin D status. *Eur J Pediatr* 177:1541–1545
- Basatemur E, Hunter R, Horsfall L, Sutcliffe A, Rait G (2017) Costs of vitamin D testing and prescribing among children in primary care. *Eur J Pediatr* 176:1405–1409
- Boynton PM (2004) Hands-on guide to questionnaire research - administering, analysing, and reporting your questionnaire. *BMJ* 328:1372–1375
- Boynton PM, Greenhalgh T (2004) Hands-on guide to questionnaire research - selecting, designing, and developing your questionnaire. *BMJ* 328:1312–1315
- Boynton PM, Wood GW, Greenhalgh T (2004) Hands-on guide to questionnaire research - reaching beyond the white middle classes. *BMJ* 328:1433–1436
- Brown GW, Hayden GF (1985) Nonparametric methods. *Clinical applications*. *Clin Pediatr (Phila)* 24:490–498
- Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, Rubin HR (1999) Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA* 282:1458–1465
- Emerson JD, Hosseini H (1984) Analyzing data from ordered categories. *N Engl J Med* 311:442–448
- Grossman Z, Hadjipanayis A, Stiris T, Del Torso S, Mercier JC, Valiulis A, Shamir R (2017) Vitamin D in European children - statement from the European Academy of Paediatrics (EAP). *Eur J Pediatr* 176:829–831
- Ish-Shalom S, Segal E, Salganik T, Raz B, Bromberg IL, Vieth R (2008) Comparison of daily, weekly, and monthly vitamin D3 in ethanol dosing protocols for two months in elderly hip fracture patients. *J Clin Endocrinol Metab* 93:3430–3435
- Jackson R, Feder G (1998) Guidelines for clinical guidelines - a simple, pragmatic strategy for guideline development. *BMJ* 317:427–428
- Jenni OG, Sennhauser FH (2016) Child health care in Switzerland. *J Pediatr* 177S:S203–S212
- Lava SAG, Simonetti GD, Ramelli GP, Tschumi S, Bianchetti MG (2012) Symptomatic management of fever by Swiss board-certified pediatricians: results from a cross-sectional, web-based survey. *Clin Ther* 34:250–256
- Lava SAG, Simonetti GD, Bianchetti AA, Ferrarini A, Bianchetti MG (2013) Prevention of vitamin D insufficiency in Switzerland: a never-ending story. *Int J Pharm* 457:353–356
- Leaf DA, Neighbor WE, Schaad D, Scott CS (1995) A comparison of self-report and chart audit in studying resident physician assessment of cardiac risk factors. *J Gen Intern Med* 10:194–198
- Messerli FH, Hofstetter L, Agabiti-Rosei E, Burnier M, Elliott WJ, Franklin SS, Grodzicki T, Kario K, Kjeldsen SE, Kostis JB, Laurent S, Leenen FH, Lund-Johansen P, Mancia G, Narkiewicz K, Papademetriou V, Parati G, Poulter N, Redon J, Rimoldi SF, Ruilope LM, Schiffrin EL, Schmieder RE, Schwartz AB, Sever P, Sowers JR, Staessen JA, Wang J, Weber M, Williams B, de Leeuw PW (2017) Expertise: no longer a sine qua non for guideline authors. *J Hypertens* 35:1564–1566
- Posfay-Barbe KM, Heininger U, Aebi C, Desgrandchamps D, Vaudaux B, Siegrist CA (2005) How do physicians immunize their own children? Differences among pediatricians and nonpediatricians. *Pediatrics* 116:e623–e633
- Proehl JA, Hoyt KS (2014) Clinical inertia and champions for change. *Adv Emerg Nurs J* 36:207–208
- Rattray J, Jones MC (2007) Essential elements of questionnaire design and development. *J Clin Nurs* 16:234–243
- Umscheid CA (2009) Should guidelines incorporate evidence on patient preferences? *J Gen Intern Med* 24:988–990
- Vogiatzi MG, Jacobson-Dickman E, DeBoer MD, Drugs, and Therapeutics Committee of The Pediatric Endocrine Society (2014) Vitamin D supplementation and risk of toxicity in pediatrics: a review of current literature. *J Clin Endocrinol Metab* 99:1132–1141

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.