EDITORIAL

Vitamin D deficiency in urban Poland: what are the implications?

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In this issue of the *Polish Archives of Internal Medicine* (*Pol Arch Med Wewn*), Pludowski et al[1] presented data from a large-scale cross-sectional study on circulating 25-hydroxyvitamin D [25(OH)D], the established marker of vitamin D status, in Polish adults (n = 5775, women, 77%; age range, 15.6–89.8 years). A convenience sample of Polish volunteers from 22 urban areas was recruited for the study via advertisements in different media. The study was sponsored by a pharmaceutical company that offers vitamin D products. Incentives for participants beyond the free vitamin D status assessment included individual counselling on health properties of vitamin D and on supplementation guidelines. The most striking finding of Pludowski et al[1] was that 16% of the population showed vitamin D deficiency, as defined by 25(OH)D levels below 25 nmol/l (10 ng/ml), which seems alarming given the increased risk of fracture at such levels.[2]

As discussed by the authors, various definitions of vitamin D deficiency and optimal vitamin D status have been proposed and are being used by laboratory medicine companies.[3] This variation leads to enormous differences in the proportions of individuals who are classified as being vitamin D deficient or having inadequate vitamin D status. Defining 25(OH)D adequacy at the levels between 75 nmol/l (30 ng/ml) and 125 nmol/l (50 ng/ml), Pludowski et al[1] stated that only 9.1% of their study population had adequate vitamin D status. However, as outlined by the authors, there is no consensus on health benefits of 25(OH)D levels above 75 nmol/l in the general population, which have been claimed on the basis of findings from observational studies showing inverse associations between 25(OH)D and multiple health outcomes.[3] At the same time, there is broad consensus that vitamin D deficiency is manifest at 25(OH)D levels below 25 nmol/l (a cut-off point used for many years in European countries) or 30 nmol/l (as defined in a comprehensive assessment by the American Institute of Medicine in 2011), in view of the increased risk of impaired bone mineralization.[2-4] Thus, unless ongoing randomized trials[5] provide evidence for reduced risks of major chronic diseases at much higher 25(OH)D levels, the prevalence estimates for 25(OH)D levels below 25 or 30 nmol/l (deficiency) and 50 nmol/l (suboptimal, at risk of deficiency) presented by Pludowski et al[1] should be appreciated as their main findings with respect to public health implications.

For the understanding of the results of Pludowski et al,[1] it is important to consider that a major fraction of circulating 25(OH)D derives from endogenous synthesis of its precursor vitamin D_3 in the human skin under ultraviolet B exposure.[6] The amount of ultraviolet B that reaches the earth's surface strongly depends on the zenith angle of the sun, which is why 25(OH)D undergoes substantial circannual fluctuations in populations residing at higher latitudes such as the Polish one.[6] Intriguingly, representative survey data from Poland's neighboring country Germany have indicated that, on the population level, median 25(OH)D concentrations in September are about twice as high as in March.[7] As Pludowski et al[1] carried out most of their assessments of 25(OH)D levels between February and May, that is, in "vitamin D winter", it can be expected that the prevalence of vitamin D deficiency in the study population on yearly average would have been lower. In line with this notion, we have previously shown that the frequency of 25(OH) D levels below 25 nmol/l in a population based-study from Germany was at 23.4% between January and March, but only at 1.7% between July and September, and 12.5% on yearly average.[8] Such a strong seasonal variation has to be taken into account in vitamin D status testing, as it has not been established whether temporary vitamin D deficiency in late winter and early spring causes bone diseases. While higher incidence rates of fractures and falls in winter have been described in some studies, these may have well depended on

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other factors than vitamin D, for example, weather conditions, worse vision due to less sunlight, lower outdoor activity and concomitant bone loss, or hypothermia.[9-11] Nevertheless, a pan-European consortium has shown only recently that the prevalence of vitamin D deficiency in summer was still one fourth to half as high as in winter in representative population samples from Germany, Ireland, and the United Kingdom.[4] Even though the cut-off point for vitamin D deficiency in this consortium was slightly higher (30 nmol/l) than in the present study (25 nmol/l), it is still likely that vitamin D deficiency is not merely a seasonal phenomenon in parts of the Polish population.

A final aspect of the publication of Pludowski et al[1] that deserves attention is the assay that was used to determine 25(OH)D levels. As stated in the manuscript, there is a substantial variation in 25(OH)D levels measured by different assays. Strikingly, for example, the prevalence of 25(OH)D levels below 30 nmol/l was 25.9% in the above-mentioned representative sample of German adults before but 15.2% after standardization according to the Vitamin D Standardization Program.[4] As Pludowski et al[1] and the German group[4,7] used the same type of immunoassay, for which a recent method comparison has revealed a significant negative average bias of 16.5% (despite excellent concordance with the liquid chromatography-mass spectrometry/mass spectrometry-based reference method),[12] it is likely that the proportions of individuals with vitamin D deficiency and suboptimal 25(OH)D levels were overestimated by Pludowski et al.[1]

Is the statement of Pludowski et al[1] that preventive strategies and educational policies are needed to improve vitamin D status in Poland wrong considering that the measurements of 25(OH)D levels were carried out in "vitamin D winter", using an assay that may provide an overestimated deficiency rate? Their notion of vitamin D deficiency being a public health issue is indeed consistent with recent findings from pan-European vitamin D status monitoring, for which assay standardization was carried out and which pointed to a pandemic of vitamin D deficiency.[4] With regard to the present study from Poland, it is of note that high-risk individuals, for example, institutionalized elderly or patients with major chronic diseases, were probably underrepresented, whereas health-conscious volunteers were overrepresented. Thus, even if actual vitamin D deficiency was less common in their study population than indicated by Pludowski et al,[1] it is possible that substantial parts of the Polish population are vitamin D deficient or at high risk of deficiency.

What are the consequences of the findings from the present Polish study and similar findings from other studies? Targeted sun exposure in months with sufficient ultraviolet B radiation could help maintaining 25(OH)D levels above 25 or 30 nmol/l in winter. In fact, in Germany there are public recommendations for outdoor activity and moderate sun bathing (avoiding sunburns) to improve vitamin D status.[13] While the promotion of more outdoor activity surely deserves support not only regarding vitamin D status, it may seem unlikely though that sun exposure recommendations alone will lead to substantially higher 25(OH)D levels in winter, given the clear decrease of 25(OH)D levels between fall and spring and the high prevalence of vitamin D deficiency in people living at northern latitudes.[1,4] In addition, it can be questioned whether such recommendations are practicable with respect to skin cancer prevention.[4] Attempts to improve vitamin D status through natural dietary sources alone do not appear promising, as fish is the only food that contains higher amounts of vitamin D. A fish-based diet may not suit the food preferences of parts of the Polish population, and recommendations to increase fish consumption have been criticized because of declining fish stocks.[14] Vitamin D fortification of foods that are consumed by a vast majority of the Polish population (eg, bread) could be an effective approach to prevent vitamin D deficiency on the population level, even though groups that are potentially not reached by specific fortification measures require special attention.[15] Notwithstanding that excess vitamin D intake is not probable at moderate food fortification, representative survey data would be required to monitor vitamin D status on the population level. In high-risk groups such as the institutionalized elderly, supplement use may be the best option to improve vitamin D status, considering that health benefits of vitamin D are particularly evident in this part of the population.[3] Such provision of higher doses of supplemental vitamin D may necessitate individual monitoring of vitamin D status and compliance.[15] Overall, a combination of the outlined approaches that is tailored to the preferences and habits of the Polish population might occur more promising than single measures.

Monitoring studies such as the present one by Pludowski et al[1] have helped identifying a public health area that may require action, while less is known about the effectiveness and practicability of vitamin D programs in real-world situations.[15] Thus, the evaluation of efficient and safe instruments to improve vitamin D status on the population level, ideally based on randomized trials in addition to observational studies and simulations, should be a priority in future vitamin D research not only in Poland.

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