

Vitamin D Supplementation: We Must Not Fail Our Children!

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Abstract: There is increasing concern that vitamin D deficiency poses a major health problem for children. Deficiency can cause hypocalcemic seizures, growth disturbances, and rickets and may influence diabetes, cardiovascular dysfunction, autoimmune diseases, and attention deficit hyperactivity disorders. Reduced vitamin D levels in children presenting to pediatric orthopedic services are common.

In the United Kingdom, recommendations on vitamin D supplementation are set by the Department of Health (DoH) and the National Institute of Health and Clinical Excellence. These state that all children aged 6 months to 5 years ought to receive 7 to 8.5 μ g of vitamin D daily.

We carried out a survey of 203 parents attending our pediatric and pediatric orthopedic and fracture clinics to evaluate parental awareness of the DoH recommendations on vitamin D supplementation for children and to assess the extent to which children were receiving vitamin D supplements.

About 85.71% of parents were not aware of the recommendations. Only 14.29% stated that they were aware of the benefits of vitamin D for their children and just 17.73% of children were receiving vitamin D supplementation; 17 via formula milk and 18 via multivitamin formulations.

Parents are generally not aware about vitamin D supplementation because of a lack of information with the high rates of reported suboptimal vitamin D levels amongst children not being addressed resulting in increased health risks to our children. Major improvements are needed in the implementation of supplementation at all points of contact between parents and health-care professionals.

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Abbreviations: DoH = Department of Health, SECC = severe early childhood caries, SPF = sun protection factor, UK = United Kingdom, UV = ultraviolet.

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INTRODUCTION

Children require vitamin D at adequate levels for effective bone mineralization and normal bone growth. When vitamin D levels are low there is reduced intestinal calcium and phosphate absorption and increased bone resorption. A decrease in bone integrity and strength may result.^{1,2} Deficiency is defined as serum levels of 25-(OH)D <25 nmol/L. Levels of 25 to 50 is considered insufficient, 50 to 75 adequate, and \geq 75 optimal. Although clinically there is no definite agreement regarding the correlation between vitamin D levels and serum 25-(OH)D,³ Snellman et al have shown that the different assay techniques employed by laboratories can result in as much as a 35% difference in results.⁴ Recent evidence demonstrates that vitamin D insufficiency or deficiency (rickets) is increasing in prevalence in the UK.⁵⁻⁷

The effects of vitamin D are not limited to the musculoskeletal system with the vitamin D receptor being present in nearly all tissues. Therefore, vitamin D may have favorable effects in many organs playing an important role in maintaining general health. It may cause, for example, cardiovascular disease, diabetes, cancer,⁸ autoimmune diseases,⁹ and attention deficit hyperactivity disorders.¹⁰ Deficiency can cause hypocalcemic seizures, tetany, growth disturbances, and rickets.¹¹

In 2003, the DoH recommended for all children aged between 6 months and 5 years to take 7 to 8.5 μ g of vitamin D daily. It was believed that children fed with more than 500 mL of formula milk per day need not to be supplemented with vitamin D drops as the quantities in the formula milks were thought to be sufficient. Despite this advice, vitamin D deficiency in children continued to rise with Ahmed et al demonstrating a doubling in symptomatic cases in Glasgow in 2008 compared with previous years (2002–2008).⁷

On February 2, 2012 the Chief Medical Officers of England, Scotland, Northern Ireland, and Wales sent a letter to all general practitioners, practice nurses, health visitors, and community pharmacists. The letter reminded these health professionals of the recommendations, its importance, and the availability of free supplementation for those families with low income (under the Healthy Start Scheme).¹²

We observed in 2013 that there was a widespread lack of awareness of the DoH recommendation of vitamin D supplementation amongst parents of children between the ages of 6 months and 5 years presenting to our pediatric orthopedic clinics, and that the vast majority of children were not receiving vitamin D supplementation.

This observation formed the rationale for our survey. We wanted to establish formally, given the extensive contact that families with a pregnancy or newborn have with health-care professionals, whether or not the recommendation was disseminated to the parents, and whether this resulted in children receiving the supplementation.

We also wanted to know the extent to which parents with young children are aware of the benefits of vitamin D in general, and whether this in any way corresponded to health behaviors.

MATERIALS AND METHODS

Between December 2013 and February 2014, questionnaires were handed out to parents whose children were seen in our pediatric and pediatric orthopedic and fracture clinics and to parents who were themselves seen in fracture clinics whose children were aged between 6 months and 5 years. The questions covered the following objectives.

Primary Objectives

- (1) Assess parental awareness of DoH guidance regarding vitamin D supplementation in children aged 6 months to 5 years.
- (2) Assess the extent to which children are receiving the recommended supplementation, in which form it is given and at which age it was started.

Secondary Objectives

- (1) Assess levels of awareness amongst parents of the health benefits of vitamin D.
- (2) Assess the means via which informed parents have learned of the benefits and guidance.
- (3) Assess awareness of the role of sun in vitamin D levels.
- (4) Use of sun protection factor (SPF).

Questions were formulated in order to answer the primary and secondary objectives of the survey. There were no exclusion criteria.

The study received institutional review board approval (protocol 2060).

RESULTS

By March 2014, 204 responses had been received. Out of all parents/guardians asked whether they would be happy to complete our questionnaire, only 2 declined. One survey was omitted from the data as only 1 question had been answered.

Primary & Secondary Objectives

Primary Objectives

Of the 203 questionnaires returned, 174 (85.71%) parents/guardians stated they had not heard of the DoH guidance regarding vitamin D supplementation. Twenty-nine (14.29%) were aware of the DoH guidance. Of the 29 that were aware, 18 (56.25%) had heard of the guidance from health professionals and 12 (37.5%) quoted the media as a source.

In total, 167 (82.27%) parents/guardians stated that their child did not receive vitamin D supplements. Of the 36 (17.73%) who stated that their child was given supplements, 17 gave it via formula milk and the remainder via vitamin D drops, or multi-vitamin formulations. Those parents who were aware of the DoH guidelines were the same parents who gave their children vitamin D supplementation according to the guidelines.

Secondary Objectives

There was a relatively even split between parental awareness of the benefits of vitamin D for their child: (aware: n = 102, 50.25%, not aware; n = 100, 49.26%) (Table 1). Despite the relatively high levels of awareness of both the importance of vitamin D and that vitamin D is generated by the sun, the significant majority of children (n = 179, 88.18%) were covered with sun creams whilst out in the sun. Just 1 (0.49%) parent stated that they never applied sun cream on their child, with most (n = 121, 58.74%) using SPF 30 to 50. This may represent high levels of awareness of the dangers of sun exposure (Table 2).

A total of 102 responders indicated that they were aware of the health benefits of vitamin D, in the form of 109 responses. Of these 109 responses, a variety of sources were cited, with the media (television, news reports, magazines, and newspapers), health-care professionals, and prior knowledge forming the majority. There was a fairly even split between these: media (n = 27, 24.77%), health professionals (n = 31, 28.44%), and prior knowledge (n = 29, 26.62%). Of the 32 responders that were aware of the DoH guidelines, 56.25% (n = 18) stated health professionals as the source of their knowledge. Health professionals are midwives or health visitors with 1 responder stating their GP. Eight responders stated the Pediatric Orthopedic clinic as the health professionals that had informed them of the DoH guidance, suggesting that they would not have been aware otherwise. This would have reduced the percentage of responders aware of the guidance further.

TABLE 1. Means via which aware parents have been informed about vitamin D supplementation

If YES (<i>Have you, as the parent or guardian, heard about the UK DoH guidelines regarding vitamin D supplements</i>), please tell us where you heard about the vitamin D guidelines:		Media		Health professionals		Word of mouth		n				
		n	%	n	%	n	%					
		12	37.5	18	56.25	2	6.25	32				
If YES (<i>are you, as the parent/guardian, aware of vitamin D health benefits for your child?</i>), please tell us how you have been informed of vitamin D health benefits:		Not answered		Media		Health professionals		Prior knowledge/ education		Self-led research		n
		n	%	n	%	n	%	n	%	n	%	
		7	6.42	27	24.77	31	28.44	29	26.61	15	13.76	109

DoH = Department of Health.

TABLE 2. Awareness of Health Benefits of Vitamin D and Health Behaviors Relating to Sun Exposure

Are you, as the parent/guardian, aware of the health benefits of vitamin D for your child?		Not answered		Yes		No		n
		n	%	n	%	n	%	203
		1	0.49	102	50.25	100	49.26	
Are you aware vitamin D is generated from the sun?		Not answered		Yes		No		n
		n	%	n	%	n	%	203
		1	0.49	184	90.64	18	8.87	
Do you cover your child with sun cream when out in the sun?		Not answered		Yes		No		n
		n	%	n	%	n	%	203
		10	4.92	179	88.18	14	6.90	
If YES, what factor do you use?		1–14		15–29		30–50		Complete sun block
		n	%	n	%	n	%	n
		1	0.49	16	7.77	121	58.74	36
		Nver apply sun cream to my child		My child wears long clothes to cover up		I try to have my child stay out of the sun		206 (3 parents ticked 2 options)
		n	%	n	%	n	%	
		1	0.49	8	3.89	23	11.17	

Those parents who had “prior knowledge” recorded general knowledge, college, books, and websites as their sources.

DISCUSSION

There is an increasing number of studies indicating that large numbers of children and adults have inadequate vitamin D levels. Over a 3-year period, Davies et al¹ investigated 187 children attending a pediatric orthopedic clinic for vitamin D deficiency of which 32% had an insufficiency and 8% a deficiency. Foley et al¹³ reported on 115 children presenting to a pediatric orthopedic clinic in 1 year who had their vitamin D levels measured. In total, 103 (88%) had suboptimum vitamin D levels but only 3 had radiological rickets. It was concluded that the association between low vitamin D levels and radiological or biochemical rickets had poor positive predictive values but that suboptimal vitamin D levels were common in children presenting with vague limb or back pain, suggesting ‘growing pain’ might reflect deficiency. Schilling et al reported that vitamin D insufficiency was common in young children with fractures but was not more common than in healthy children.¹⁴

In 2010, Bogunovic et al¹⁵ measured vitamin D levels of 723 adults scheduled for orthopedic surgery at the Hospital for Special Surgery in New York. About 43% had insufficient and 40% deficient levels, with the highest levels of deficiency seen in patients in the trauma service, where 66% had insufficient levels and 52% deficient levels. In 2011, Maier et al¹⁶ found a high rate of vitamin D insufficiency and deficiency in 1119 adult patients who presented to their orthopedic unit in Germany in 1 year. In 2012, Clarke and Page⁶ postulated that vitamin D levels are extremely important in ensuring successful postoperative recovery in children undergoing orthopedic surgery.

Schroth et al¹⁷ measured vitamin D levels in 144 children (mean age 40.8 months) before dental surgery for severe early childhood caries (SECC) and in 122 caries-free controls

between 2009 and 2011. Significantly more children with SECC had suboptimal vitamin D levels compared with caries-free children. They also had significantly lower mean calcium and mean albumin levels as well as higher mean parathyroid hormone levels indicating that these children were likely malnourished. It was concluded that vitamin D supplementation for children may decrease the prevalence of SECC.

Recent evidence regarding the demographics of vitamin D deficiency in children is mixed. Clarke et al have shown that those most at risk in the UK are white obese children,⁶ and that there is no correlation between vitamin D status and social deprivation.¹ In contrast to Clarke et al, Houghton et al¹⁸ have suggested that there may be a correlation between higher levels of education in parents and guardians and increased levels of vitamin D deficiency in New Zealand. This was attributed to a tendency to apply sun screen or cover children in the sun.

The American Academy of Pediatrics recommends that children younger than 6 months stay out of direct sunlight and apply sunscreen only onto small areas such as the face if protective clothing and shade are not available. Clothing (cotton pants, long-sleeved shirts, and hats) preferably with a tight weave should cover the body, be cool and comfortable. For older children, sun exposure between 10.00 AM and 4.00 PM, when UV light rays are the strongest, should be limited and sun glasses with 99% UV protection should be worn. Sunscreen should be used for sun protection, not as a reason to stay in the sun longer. Broad-spectrum sunscreen which screens out UV-A and UV-B with an SPF of at least 15 (up to SPF 50) should be used. Sunscreens with the ingredient oxybenzone should be avoided because of concerns about mild hormonal properties. For sensitive areas, such as nose, cheeks, tops of ears, and shoulders, a sunscreen with zinc oxide or titanium dioxide should be used. The screen needs to be applied 15 to 30 minutes before going outdoors so that it can be absorbed into the skin. It should be used any time spend outdoors even on cloudy days because up to 80% of UV rays can get through the clouds. It should be reapplied every 2 hours and after swimming, sweating or drying off with a towel.¹⁹

Research consistently demonstrates that children of Asian ethnicity are over-represented in samples of children with insufficiency or deficiency.^{2,5-7}

Our local area has higher than average employment and socioeconomic status (with just 1 area being below the national average).²⁰ It also has a younger population when compared with national statistics (attributed to the presence of 2 universities), and a less ethnically diverse population than the UK with 95.9% of the regional residents being white.

With our area having a large academic population and the population being better off than the national average, we would have expected our parents to be better informed through media and Internet with a high level of awareness about vitamin D supplementation instead of a low rate of 17.73%. This raises the suspicion that there could be an even higher lack of awareness and lower supplementation rate in less well off areas.

Despite the mounting evidence in the literature and the awareness of the UK Department of Health and National Institute for Clinical Excellence of the widespread vitamin D deficiencies and the potential health benefits of vitamin D supplementation, our study shows that the vast majority, 85.71% of our parents were not aware of the recommendations and not aware of the potential benefits of vitamin D. This is by far higher than what has been reported by Alramdhan et al²¹ in the only published study we found on the level of vitamin D supplementation in children. The authors reported that 40% out of 606 mothers interviewed in Saudi Arabia did not give vitamin D supplementation to their children.

In 2010, Pearce and Cheetham²² published in a review article in the *British Medical Journal* stating that bowing of the legs (*genu varum*) is typical for vitamin D deficiency from the age of 6 months not knowing that *genu varum* alignment is normal physiological alignment for children for the first 2 years of life.²³ They further stated that knock knees (*genu valgum*) can also occur and that anterior bowing of the femur is frequent with vitamin D deficiency. However, *genu valgum* is normal physiological alignment by the age of 3 to 4 years and anterior bowing of the femur is normal at any age. Education should be multidisciplinary and include pediatric orthopedic surgeons and pediatricians alike. We as pediatric orthopedic surgeons routinely differentiate between normal variants and pathological limb malalignments and therefore play an important part in health education of parents and must do our part in raising the awareness amongst other health professionals and parents.

Limitations and source of bias: We limited our study to children seen in hospital. Since vitamin D is linked to a variety of diseases, the rate of vitamin D deficiency and lack of vitamin D supplementation might therefore be higher in children attending hospital compared with children without medical problems.

CONCLUSION

We conclude that there is a lack of adequate education of health professionals and parents on the widespread vitamin D deficiencies and benefits of vitamin D supplementation in our population, a failure of implementation of the Department of Health recommendations on vitamin D supplementation, and a lack of a system which assures that the information reaches those at risk and that vitamin D supplementation is taken as recommended.

We recommend repetitive provision of information at points of contact between health professionals and patients and introduction of a check system to assure that supplementation is given.

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