THE ROLE OF VITAMIN D IN OLDER ADULTS

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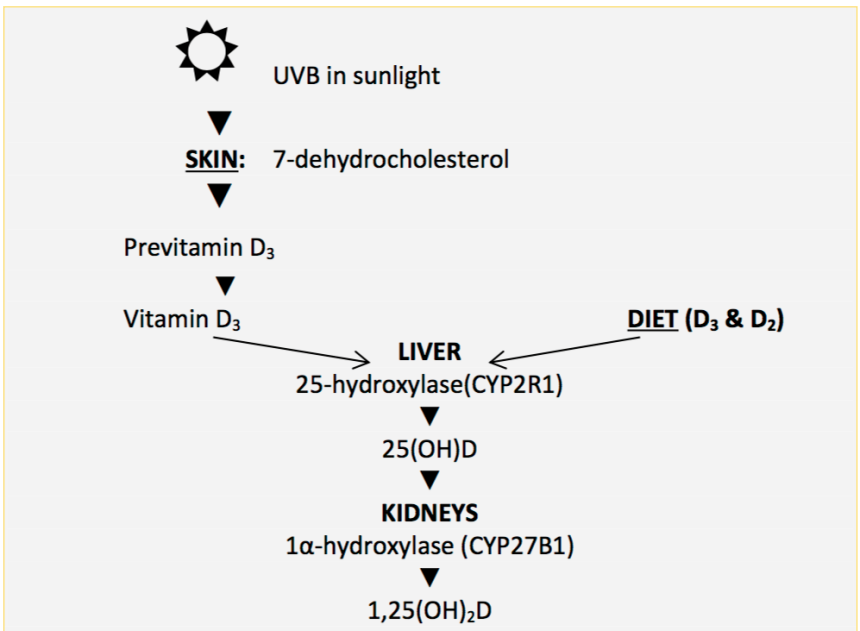
Vitamin D is essential to our health, especially in relation to bone health. Older adults (generally defined as adults 65 years and older) have been identified as an 'at risk' group for vitamin D deficiency, but what are the current evidence-based recommendations for this population in terms of vitamin D?

Vitamin D plays a vital role in preventing rickets in children and osteomalacia in children and adults by promoting calcium absorption, bone growth and bone remodelling; it also maintains serum calcium and phosphate concentrations to support healthy bone mineralization.[1,2] Vitamin D is also involved in: cell growth, genetic coding and functioning, neuromuscular functioning, immune functioning and reducing inflammation.[3] There has been some inconclusive evidence which suggests an association between low vitamin D levels and diseases such as osteoporosis, diabetes, cardiovascular disease, tuberculosis, multiple sclerosis, preeclampsia and cancer.[4]

SOURCES OF VITAMIN D

There are two main forms of vitamin D: vitamin D3 (cholecalciferol) and vitamin

Figure 1: Vitamin D metabolism pathway



Source: SACN 2015 Draft Vitamin D and Health report, www.gov.uk/government/uploads/system/uploads/attachment_data/file/447402/Draft_SACN_Vitamin_D_and_Health_Report.pdf

Table 1: Dietary sources of vitamin D

Food	Mean vitamin D content (µg/ 100g)
Fish	
Herring (grilled)	16.1
Salmon (farmed, grilled)	7.8
Salmon (farmed, steamed)	9.3
Salmon (pink, canned in brine, drained)	13.6
Salmon (cold & hot smoked)	8.9-11
Mackeral (grilled)	8.5
Mackeral (smoked)	8.2
Sardines (grilled)	5.1
Sardines (canned in brine, drained)	3.3
Tuna (baked)	3.1
Tuna (canned in brine, drained)	1.1
Eggs	
Eggs (whole, boiled)	3.2
Eggs (yolk, boiled)	12.6
Meat	
Beef (rump steak, fried)	0.7
Fortified foods	
Bran flakes	4.6
Cornflakes	4.7
Rice cereal	4.6
Fat spreads (reduced fat 62-75% polyunsaturated)	7.5

Taken from The Composition of Foods, 7th edition (Finglas et al, 2015)

Source: SACN 2015 Draft Vitamin D and Health report: www.gov.uk/government/uploads/system/uploads/attachment_data/file/447402/Draft_SACN_Vitamin_D_and_Health_Report.pdf

D2 (ergocalciferol). Vitamin D3 is synthesized from the action of ultraviolet B (UVB) rays with our skin; this is our main source of vitamin D and the reason it is often referred to as 'The Sunshine Vitamin'. Vitamin D3 is also found in some dietary animal sources, such as oily fish, egg yolks and red meat. Vitamin D2 is found in plants and is formed via the action of UVB with the plant sterol ergosterol.[4,5]

The main circulating form of vitamin D is 25-hydroxyvitamin D [25(OH)D] which is produced in the liver.[4] Conversion then occurs in the kidneys and the biologically active form of vitamin is produced, which is called calcitriol or 1,25-dihydroxyvitamin D [1,25$(OH)_2$D].[4]

Vitamin D is added to certain foods such as fortified margarines and breakfast cereals (see Table 1) and can also be obtained from supplements, either in tablet form or from certain types of oral nutritional supplements (e.g. Ensure Plus Advance, Fortisip Extra, Nutriplen Protein etc).

VITAMIN D REQUIREMENTS FOR ADULTS 65 YEARS AND OLDER

Previously, the Committee on Medical Aspects of Food and Nutrition Policy (COMA 1991/1998) only set dietary reference values for vitamin D for 'at risk' groups, such as pregnant women, breastfeeding women and adults over 65 years. However, based on evidence related to musculoskeletal health, the updated recommendations by the Scientific Advisory Panel on Nutrition (SACN) set the reference nutrient intake (RNI) for vitamin D at 10ug per day, as a 'population protective' level for the UK general population aged four and above; which includes those deemed 'at risk'.[4] SACN also defined serum levels of vitamin D (25(OH) D) as deficient when lower than 25nmol/L and sufficient when ranging from 50 to 125nmol/L.[4] As vitamin D is fat soluble, excess intakes are stored in our body tissues. A guidance safe upper level for vitamin D of 25ug/day was set based on the risk of vitamin D toxicity which has been

Table 2: Serum 25(OH)D levels found in adults, (adapted from NDNS data)[7]

Population group	% with serum 25(OH)D below 25nmol/L (mean serum concentration)
19-64 years old 65 years and older	22.8% (45.4nmol/L) 21.0% (44.5nmol/L)
Men 19-64 years old Men 65 years and older	24.0% (43.5nmol/L) 16.9% (47.0nmol/L)
Women 19-64 years old Women 65 years and older	21.7% (47.3nmol/L) 24.1% (42.5nmol/L)
Men living in institutions Women living in institutions	38% (33.7nmol/L) 37% (32.5nmol/L)
19-64 years old from January to March 65 years and older from January to March	39.3% (34.8nmol/L) 29.3% (40.5nmol/L)
19-64 years old from July to September 65 years and older from July to September	8.4% (57.5nmol/L) 3.6% (50.5nmol/L)

Table 3: Mean intakes of vitamin D for UK adults (adapted from NDNS data)[9]

Population group	% mean intake of RNI (mean daily intake in µg)
19-64 years old 65 years and older	28% (2.8µg) 33% (3.3µg)
19-64 years old including supplements 65 years and older including supplements	36% (3.6µg) 51% (5.1µg)
Men living in institutions Men living in institutions including supplements	38% (3.79µg) 39% (3.87µg)
Women living in institutions Women living in institutions including supplements	33% (3.31µg) 34% (3.36µg)

associated with renal damage, cardiovascular damage and hypercalcaemia, which can lead to subsequent bone demineralisation.[4] Although the evidence is less consistent, other reported adverse effects vitamin D toxicity include an increased incidence of falls and fractures, pancreatic and prostatic cancer and all-cause mortality.

VITAMIN D LEVELS IN UK ADULTS 65 YEARS AND OLDER

Many factors effect vitamin D exposure in the UK; for example, there is insufficient UVB light from mid-October to the beginning of April for cutaneous vitamin D synthesis, and minimal synthesis occurs outside of the time frame of 11am to 3pm due to UVB exposure levels.[2,4,6] Other factors can contribute to low serum vitamin D levels, such as sun avoidance, sunscreen use, wearing concealing clothing, genetics, skin pigmentation, latitude, altitude, air pollution and cloud cover.[4]

It has also been suggested that the ability of the skin to produce vitamin D decreases with age; however, it is unclear whether this is related to confounding factors such as minimal sun exposure or possible co-morbidities such as impaired liver or kidney function.[4]

NICE and SACN highlight 'adults 65 years and older' and 'frail and institutionalised people as specific 'at risk' categories for vitamin D deficiency.[2,4]

The UK National Diet and Nutrition Survey (NDNS), which ran from 2008 to 2009 and 2011 to 2012, found evidence of a high risk of vitamin D deficiency across all population groups which was substantially effected by seasonal variation (see Table 2 for adult data).[7] It is interesting to note that this survey did not find a lower serum 25(OH)D concentration in adults 65 years and older compared to adults aged 19-64 years. The NDNS also found that those living in institutions, which are likely to include a large

Table 4: Percentage contribution of food groups to vitamin D intake for UK adults (adapted from NDNS data)[9]

Food group	% Contribution to vitamin D intake	
	19-64 years	65 years and older
Meat and meat products	30%	23%
Fortified fat spreads	19%	19%
Cereals and cereal products (from fortified breakfast cereals and baked goods using eggs and fortified fats as ingredients	13%	13%
Fish and fish dishes (mainly oily fish)	17%	23%
Eggs and egg dishes	13%	13%
Milk and milk products	5%	6%
Vegetables and potatoes	1%	0%

proportion of older adults, had significantly higher levels of vitamin D deficiency than the general population.

VITAMIN D INTAKES IN THE UK ADULTS 65 YEARS AND OLDER

The NDNS reported intakes below the RNI for vitamin D across all adult groups, it also found that adults 65 years and older had higher mean intakes of vitamin D than adults aged 19 to 64, both from food sources alone and food sources in combination with supplements (see Table 3). According to this data, supplements seemed to contribute more to serum vitamin D levels for adults 65 years and older than those aged 19 to 64.[7]

As it is very difficult to achieve the RNI for vitamin D from dietary sources alone, in 2012 the UK Chief Medical Officers advised that, "people aged 65 years and over and people who are not exposed to much sun should take a daily supplement containing 10 micrograms of vitamin D".[8] As a follow on from this, due to evidence that a large proportion of the UK population are at risk of vitamin D deficiency, SACN have recommended that consideration be given to 'strategies for the UK population to achieve the RNI of 10μg/d for those aged four years and older'.[4]

The individual food groups contributing to vitamin D intake were found to be quite similar across all adult age groups; however, 'meat and meat products' contributed a higher intake for adults aged 19 to 64 years than with older adults, but fish and fish dishes contributed a higher intake for adults age 65 years and older (see Table 4).

VITAMIN D AND HEALTH OUTCOMES IN AN ADULTS 65 YEARS AND OLDER

Although the evidence is mixed, SACN report that there appears to be a benefit to vitamin D supplementation in adults over 50 years in relation to falls risk, muscle strength and muscle function. However, there was evidence of an increased falls risk in one randomised control trial when an annual high dose of vitamin D (12,500μg/500,000 IU) was administered.[4]

From the available evidence SACN conclude that low serum vitamin D levels (ranging from 4-20nmol/L) are associated with a higher incidence of osteomalacia in adults of all age groups; which suggests a benefit to vitamin D in this regard.[4] However, this evidence is based on mainly cross sectional studies and case reports.
In adults over 50 years old, current meta-analysis evidence reports a small benefit of vitamin D supplementation in improving femoral neck bone mineral density; however, there was no benefit with bone mineral density in the spine or total hip found.[4]

Overall, vitamin D supplements have not been found to be beneficial in regard to fracture prevention in adults over 50 years; however, the evidence is conflicting and suggests that vitamin D, along with calcium, is more effective than vitamin D alone.[4] SACN also found a possible protective effect of vitamin D supplementation

on all-cause mortality; especially when used in combination with calcium supplementation.[4]

Currently, there is not enough strong evidence to support an association with vitamin D and cancer, CVD, autoimmune diseases, oral health, psychological conditions, infectious diseases, or age-related macular degeneration.

CONCLUSION

Vitamin D plays a clear role in musculoskeletal health; with recent evidence reporting a specific benefit of vitamin D supplementation for older adults helping to reduce falls and the risk of osteomalacia and also improving muscle strength and function.

As previous guidelines only address 'at risk' groups, an updated practical guideline for healthcare professionals to use in relation to advising vitamin D supplementation in adults would be useful for clinical practice; as recent research highlights a high risk of vitamin D deficiency across all adult population groups in the UK.

As vitamin D deficiency can have a big impact on a person's nutritional status and overall quality of life, this should be an important consideration as part of nutritional assessments and management plans. Correcting vitamin D deficiency is likely to become increasingly relevant to dietitians with the introduction of independent prescribing.

References
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