Rapid Response

Evidence synthesis: Efficacy of vitamin D supplementation for care home residents

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**HIS Evidence Conclusions**

All UK guidelines and the Scientific Advisory Committee on Nutrition recommend vitamin D supplementation all year round in people > 65 years and those with restricted time outdoors to support musculoskeletal health.\(^1\)\(^-\)\(^3\) The UK recommended dose is 400 IU/day. This is lower than that recommended by other countries (≥800 IU/day).\(^4\)

UK guidelines recommend that health and social care professionals have access to vitamin D supplements for at risk groups and that local authorities should consider providing free vitamin D supplements to at risk groups.

Investigations of the uptake of guidance for vitamin D supplementation advocate education of those caring for at risk groups to increase adherence to recommendations for vitamin D supplementation.\(^5\)\(^6\)\(^19\)

Findings from primary studies published in 2019 and 2021 found no benefit from vitamin D supplementation for prevention of falls\(^7\), bone mineral density\(^8\) or depression and physical limitations/functioning.\(^9\) One study reported an improvement in cognitive function in patients with Alzheimer’s disease.\(^10\)

There is an ongoing discussion regarding whether the responsibility for ensuring adequate vitamin D supplementation in long-term care facilities is a medical or a public health issue.\(^6\)

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**1. What were we asked to look at?**

The Scottish Government SLWG on Vitamin D for care home residents requested a review of the evidence on the health benefits of vitamin D supplementation for care home residents. In 2016 the Scientific Advisory Committee on Nutrition (SACN) recommended vitamin D intake of 10 micrograms (mcgs) (400 IU) per day for the UK population aged 1 year and above to protect musculoskeletal health.\(^2\) In spring and summer most people source enough vitamin D through skin exposure to UVB sunlight and a healthy balanced diet. In autumn and winter there is increased reliance on dietary sources of vitamin D making it difficult to reach the recommended dose. In addition to protecting musculoskeletal health, vitamin D supplementation may provide other health benefits e.g. cardiovascular health, immunity, neurological conditions and respiratory infections.\(^5\)

The Scottish Government recommends that groups at higher risk of vitamin D deficiency take a daily supplement.\(^11\) This includes pregnant and breastfeeding women, children under 5 years old, people who have low or no exposure to the sun and people from minority ethnic groups with dark skin such as people of African, African-Caribbean and South Asian origin.

Care home residents are a group that could have little or no exposure to the sun and may benefit from vitamin D supplements. It is not known how many care home residents in Scotland take vitamin D supplements. Current advice is that decisions are taken on an individual basis. The provision of vitamin D for frail older people is debated in the literature. While it is recognised that
care home residents may lack vitamin D, the provision of supplements has also been shown to add little value especially in this population.

In November 2020, the Scottish Government wrote to people who were shielding due to the COVID-19 pandemic and offered 4 months supply of vitamin D to support health and wellbeing during the winter months. 40% of the shielding cohort took the offer (37% aged 70-79 years and 24% of 80-99 year olds). Uptake of vitamin D by care home residents who were shielding was thought to be low.

The Chief Medical Officer and the Chief Pharmaceutical Officer convened a SLWG to consider whether or not it is beneficial to provide vitamin D supplementation to all care home residents and if recommendations should differ depending on resident characteristics such as age. The SLWG was also asked to make recommendations on options for the way in which care home residents who need vitamin D should access it, taking into account the evidence, costs and individual needs of residents.

2. Overview of the evidence

The following sources were used as the main secondary evidence for this rapid review:

- NICE guidance - Vitamin D: supplement use in specific population groups [Public health guideline PH56]¹ 2014 updated in August 2017 following publication of the Scientific Advisory Committee on Nutrition (SACN) vitamin D and health report 2016.
- NICE COVID-19 rapid guideline (NG187) ¹²
- SACN - Vitamin D and health report 2016²
- Royal Osteoporosis Society. Vitamin D and Bone Health 2018³
- Cochrane review of Interventions for preventing falls in older people in care facilities and hospitals – updated to August 2017¹³
- Bolland, Grey, Avenell¹⁴ Effects of vitamin D supplementation on musculoskeletal health: a systematic review, meta-analysis, and trial sequential analysis
- Reid, Bolland¹⁵ narrative review
- Chakhtoura et al¹⁶ Critical appraisal of evidence and overview of guidelines

A literature search was performed from 2016 to present to identify relevant, more recent studies within the primary literature.

UK guidelines and guidance

NICE guideline PH56¹ recommends a daily supplement of 10 mcgs (400 IU) for all adults over the age of 65 and those who are housebound or confined indoors for long periods. NICE guideline PH56 is not specific to care home residents, however the majority of care home residents are in this age group and many are frail and spend more time indoors.

Recommendations include increasing population awareness about vitamin D; ensuring a consistent multiagency approach to improve the vitamin D status of the population by targeting specific population groups and the health, social care and other providers who work with them and ensuring mechanisms are in place to increase the availability and uptake of supplements; local authorities should ensure wide availability of supplements and consider providing these free to specific
population groups; computerised health and social care systems should prompt health professionals who should recommend vitamin D supplements during routine appointments and record use among the specific populations groups.

Within this guideline no evidence was identified for interventions aimed at increasing the uptake of vitamin D supplements among people aged 65 or older. The economic model found that it is cost saving to give everyone in the group a daily vitamin D supplement, rather than testing all and supplementing only those who have a vitamin D deficiency.

In 2016, SACN published a report on vitamin D and health, that considered evidence published up to March 2016, presented as summaries in position papers by working group members. SACN advice on vitamin D is based on protection of musculoskeletal health, as evidence on non-musculoskeletal outcomes was considered insufficient to inform recommendations.

SACN report that annualised mean plasma 25(OH)D concentrations (measurement of vitamin D) in the general UK population range between 40 – 70 nmol/L, falling to 30 nmol/L in institutionalised adults. Nearly 40% of institutionalised adults showed concentrations of < 25 nmol/L. SACN recommend that serum 25(OH)D concentrations should not fall below 25 nmol/L, the level considered ‘population protective’, at any time of the year.

To achieve this throughout the year, SACN recommend a Reference Nutritional Intake (RNI) of 10 mcgs (400 IU) for the general UK population. The RNI refers to vitamin D intake from all dietary sources; natural food; fortified food and supplements. In a change to their previous advice, groups at increased risk of serum 25(OH)D concentrations < 25 nmol/L do not require a separate RNI. SACN recommended that RNI are applicable throughout the year for at risk groups (including institutionalised adults and those aged over 65 years) and that consideration is given to strategies to achieve the recommended RNI which is difficult to achieve from natural food sources alone.

The Royal Osteoporosis Society published an updated clinical guideline in 2018 on the management of vitamin D and bone health. The guideline incorporated evidence included in SACN and the Institute of Medicine (IOM) report published in 2010 as well as evidence published subsequently. This guideline proposed vitamin D thresholds should be adopted by UK clinicians in respect of bone health as follows; plasma 25(OH)D < 25 nmol/L is deficient; plasma 25(OH)D of 25-50 nmol/L may be inadequate in some people and plasma 25(OH)D >50 nmol/L is sufficient for almost the whole population. The guideline reiterated the need to provide vitamin D supplements to adults > 65 years and those who are housebound or confined indoors for long periods of time and are classed as at risk of vitamin D deficiency.

Routine testing of serum vitamin D levels is not recommended for this population. Oral vitamin D₃ is the preparation of choice. Doses equivalent to 800-2000 IU daily, given either daily or intermittently at higher doses.

The NICE COVID rapid guideline NG187, published in December 2020, includes NICE and SACN evidence reviews that considered vitamin D use in the context of COVID-19.
The guideline includes a recommendation to encourage people to follow UK government advice on taking a vitamin D supplement in accordance with NICE PH56 guidance (as above).

NG187 recommends that vitamin D supplements are not offered to people solely to prevent or treat COVID-19, except as part of a clinical trial.

Secondary evidence

A Cochrane systematic review \(^{13}\) included evidence from a diverse range of interventions, including vitamin D supplementation, up to August 2017 to address the question

‘How effective are interventions designed to reduce falls in older people in care facilities and hospitals?’

Primary outcomes included the number of falls (per unit of person time that falls were monitored) or the number of participants sustaining at least one fall during follow-up. Results from care facilities and hospitals were reported separately.

The review reported moderate quality evidence from 4 trials (4,512 participants) that compared vitamin D supplementation with usual care or placebo in participants ≥ 65 years living in care facilities. Pooled data indicated that vitamin D supplementation probably reduces the rate of falls (RR 0.72 95% CI 0.55 to 0.95; \(I^2 = 62\%\)), and probably makes little or no difference to the risk of falling (RR 0.92, 95% CI 0.76 to 1.12; \(I^2 = 42\%\)).

Bolland, Grey & Avenell\(^{14}\) conducted a systematic review, random-effects meta-analysis and trial sequential analysis to determine the effect of vitamin D supplementation on fractures, falls and bone density. The review included 81 randomised controlled trials (n=53,537 participants) that reported fracture (n=42 trials), falls (n=37 trials) or bone mineral density (n=41 trials). 69 (85%) of the trials investigated community dwelling populations; 39 (48%) studied vitamin D vs controls; 26 (32%) studied vitamin D with agent vs agent; 16 (20%) high-dose vs low-dose vitamin D. In pooled analyses, vitamin D had no effect on total fracture (36 trials; n=44,790, relative risk 1.00, 95% CI 0.93–1.07), hip fracture (20 trials; n=36,655, 1.11, 0.97–1.26), or falls (37 trials; n=34,144, 0.97, 0.93–1.02). The review concluded that there is little justification for the routine use of vitamin D supplements to maintain or improve musculoskeletal health. In the discussion the authors state ‘The clear exception to this is for the prevention or treatment of the rare conditions of rickets and osteomalacia, which can occur after a prolonged lack of exposure to sunshine that leads to 25OHD concentrations lower than 25 nmol/L.’

In a 2020 review Reid & Bolland\(^{15}\) examined evidence investigating the impact of calcium and vitamin D supplements, either alone or combined to correct deficiency. They concluded that neither should be advocated for widespread use to support musculoskeletal health, however vitamin D supplements are justified in populations with clinical risk factors for vitamin D deficiency, including frail elderly and those with limited exposure to sunshine.
Chakhtoura et al\textsuperscript{16} conducted a review of systematic reviews published between 2012 – 2018 investigating vitamin D supplementation and the rate of or prevention of falls or fracture and a review of guidelines for vitamin D supplementation. The review identified 5 meta-analyses of randomised controlled trials (RCTs) with falls as the primary outcome, 4 with fractures as the primary outcome and 4 on both outcomes. The results indicated that vitamin D and calcium supplementation compared with calcium only or placebo may reduce the risk of falls, but data is inconsistent. Review of 20 worldwide guidelines indicated that less than half (8/20) are evidence-based (SACN guidelines are categorised as evidence-based). Most guidelines considered vitamin D in relation to musculoskeletal health. All guidelines concur that screening of the general population for vitamin D deficiency is not recommended. Recommended doses of vitamin D for the general population ranged from 200-1,000 IU with some recommending higher doses for older people. The European Calcified Tissue Society recommended supplementation of 400-800 IU/day for older institutionalised people. The review concluded that supplementation with vitamin D3 in combination with calcium, administered daily at doses of 800-1000 IU/day in elderly institutionalised individuals is prudent.

**Primary evidence**

Four RCTs investigating vitamin D on falls,\textsuperscript{7} bone health,\textsuperscript{8} cognitive function\textsuperscript{10} and depression/physical function\textsuperscript{9} in older adults, published in 2021 and 2019, were identified.

Appel et al\textsuperscript{7} conducted a two stage RCT. Firstly to find the ‘best dose’ of vitamin D (1,000, 2,000 or 4,000 IU/day) for preventing falls in older community-dwelling adults with elevated fall risk and low serum 25(OH)D levels. After the best dose was identified participants who were randomly assigned to any of the non-control doses received the best dose. The control dose was 200 IU/day. 688 adults enrolled in the trial (mean age 77.2 years standard deviation (SD) 5.4, 56.4% men). The primary outcome was time to first fall or death over 2 years. Results demonstrated no statistically significant difference in the primary outcome between best dose group and control group. Other studies\textsuperscript{14} have suggested that higher doses of vitamin D may increase the risk of falling, however, these authors concluded that this remains unclear.

In this RCT, doses of 2,000 and 4,000 IU/day were stopped and 1,000 IU/day was declared the best dose, partly because of safety concerns. This was a departure from the protocol.

Aspray et al\textsuperscript{8} examined the effect of vitamin D supplementation on bone mineral density (BMD) in older adults. 379 adults ≥70 years (48% women; mean age 75 years) were randomly allocated to 1 of 3 doses of oral vitamin D$_3$ [12,000 IU, 24,000 IU or 48,000 IU] given once a month for 1 year. Doses were selected to correspond with different international guidelines; lowest doses equated with SACN RNI of 400 IU/day, second dose with IOM recommended dietary allowance (RDA) of 800 IU/day and the highest doses was twice IOM RDA but well below the tolerable upper intake level defined by the IOM. 343 (91%) participants completed the study at 12 months. Results demonstrated no significant difference between arms for change in BMD at either total hip or femoral neck sites. There was significant difference in plasma 25(OH)D for comparison of the lowest dose with either of the higher doses. Adverse events, including fall frequency were unrelated to dose. The authors concluded that the lowest dose, equivalent to 400 IU/day (consistent with
current UK guidelines), was sufficient to eliminate vitamin D deficiency in 97% of the study population. They also suggested that all three doses may have attenuated an anticipated decrease in BMD of 0.6% over the study period, however there was no placebo comparator in this study.

This was a well conducted RCT with double blinding, however the study population was recruited from GP practices and was likely to be community dwelling.

Jia et al\textsuperscript{10} conducted a randomised double-blind placebo-controlled trial to evaluate whether vitamin D supplementation could delay clinical progression in patients with Alzheimer’s disease. 210 patients were randomly allocated to received either two capsules containing 800 IU/day of vitamin D (n=105) or identical capsules containing a placebo using starch granules (n=105). Study duration was 12 months. All participants were cognitively assessed using a standardised neuropsychological assessment (Wechsler Adult Intelligence Scale-Revised (WAIS-RC)) by trained physicians at baseline, 6 months and 12 months. Biomarkers were also assessed. Repeated measures analysis of variance showed significant effects over 12 months in full scale IQ in the intervention group compared with the control group (p<0.001) taking into account baseline biomarker concentrations. Information test showed marked increments in intervention group (+30.73%), while the control group had a decline trend (p<0.001). Arithmetic score showed substantial percentage decreases in both groups (p<0.001), and was lesser in the intervention group (-35.87%) compared with the control group (-42.09%); there was an interaction between time effect and group effect (p=0.027). In addition, the vocabulary, digit span, block design and picture arrangement also showed similar changes in the two groups, and the intervention group showed higher cognitive test score than in the control group. However, comprehension, similarities, digit symbol, picture completion and object assembly only showed substantial percentage decreases in time effects in the two groups (p<0.001).

This was a well conducted RCT with computer generated randomisation and double blinding. Only 1 participant (control group) dropped out allowing intention to treat statistical analysis of data. At baseline both groups were similar in demography, body mass index and family history and had similar concentration of serum 25(OH)D. Study sample calculation was not provided and although participants were enrolled in a hospital there is no information regarding place of residence.

de Koning et al\textsuperscript{9} conducted a placebo-controlled RCT to investigate the effect of vitamin D supplementation on depressive symptoms, functional limitation and physical performance in high-risk older people with low vitamin D status. 155 community dwelling adults aged 60-80 years with depressive symptoms and more than one functional limitation (difficulty with walking, climbing stairs or dressing unaided) and a serum 25(OH)D concentration between 15 and 50 nmol/L in winter and 15 and 70 nmol/L in summer were randomised to receive either 1,200 IU vitamin D\textsubscript{3} (n=77) or identical tablets without vitamin D (n=78). Study duration was 12 months. Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression CES-D scale. A score of ≥16 is indicative of clinically relevant depressive symptoms. Functional limitations were assessed using the Longitudinal Aging Study Amsterdam (LASA) Functional Limitations questionnaire. Physical performance was assessed using a modified version of the Short Physical Performance Battery (SPPB). Serum 25(OH)D concentrations were measured at baseline and after 6 months. 151 of the 155 participants were included in the intention to treat analysis. After 6 months the mean (SD) 25(OH)D concentration in the intervention group was 85(16) nmol/L compared with 43(18) nmol/L in
the placebo group. There were no significant differences in depressive symptoms, physical performance or severity of functional limitations between the groups over 12 months. The authors conclude that supplementation with vitamin D cannot be recommended for the prevention of depression and poor physical function.

This was a well conducted double blinded RCT. Treatment allocation was assigned randomly by an independent pharmacist. At baseline, both groups were similar. Power calculation was conducted to inform sample size. Participants were community dwelling, however many had low serum 25(OH)D at baseline.

Studies investigating strategies to increase use of vitamin D supplementation in long-term care (LTC) homes,5,19 to determine the efficacy of a standardised oral vitamin D dosing regimen in nursing home residents,20 to explore micronutrient food fortification strategies21 and to understand the determinants of current practice and perceived responsibility for the vitamin D status of residents6 were found.

Kennedy et al19 conducted a descriptive study to examine prescribing of vitamin D, calcium and osteoporosis medications in 10 LTC homes (2,098 residents) at the outset of the Ontario Osteoporosis Strategy in 2007 (an action plan targeted at improving osteoporosis prevention that included knowledge translation activities) and in 166 LTC homes (21,699 residents) in 2012 to compare prescribing rates. In 2007, mean, weighted facility prescribing rates were 25.4% (range 7 to 55%) of residents taking vitamin D ≥800 IU/day; and in 2012 this increased to 63.6% (range 23 to 95%). Between 2007 and 2012 prescribing rates increased by 38.2%. The authors concluded that efforts to translate research evidence into practice and policy are important and wide-scale activities in LTC homes are successful in improving vitamin D prescribing rates.

This was a descriptive before and after study therefore results could not assess causality of the change in prescribing practice.

Walker et al5 conducted a non-randomised wedge cluster study with 41 residential aged care facilities in Australia, the vitamin D implementation (ViDAus) study. The study aim was to support the uptake of best practice in relation to recommendations for vitamin D supplementation. It was hypothesised that by employing implementation strategies such as education, conducting audits, and facilitating system change to improve the timely identification of residents, an increase in the use of vitamin D supplements (≥800 IU/day) by residents could be achieved. The intervention lasted 12 months. A statistically significant increase in mean percentage of adequate vitamin D supplementation was seen overall during the study from 55% at baseline to 58.8% at 12 months and 59.6% at 18 months. This change was not considered clinically significant. No significant between group differences were observed. The goal of 25% increase was not achieved – this may have been due to high use of supplements at baseline. The authors concluded that widespread improvements will be achieved when a consistent national message is delivered to overcome existing contradictions in prescribing guidance.

Toren-Wielema et al20 conducted a cross-sectional observational study to determine if a standardised oral vitamin D dosing regimen of a single loading dose of 200,000 IU followed by a
A maintenance dose of 100,000 IU every 13 weeks would achieve and maintain a serum 25(OH)D concentration of 75-220 nmol/L (defined as a safe vitamin D trough level (VDTL)). The study cited evidence that showed daily doses of 800 IU failed to raise serum 25(OH)D levels to >75 nmol/L in the majority of nursing home residents. 156 (16% of the total number of residents) were included (71% female; median age 85 years, range 56-99 years). Results showed that 58% of the residents obtained a VDTL 75-220 nmol/L (at least 85% required for treatment outcome to be regarded as efficacious). The authors concluded the regimen was not efficacious.

In this study data collection was retrospective and the study population was chosen by elderly care physicians. The small sample of 16% may not have been representative of the total population. Blood samples were not drawn at baseline and were taken within 10 days prior to the next maintenance dose which could explain the wide range in observed VDTLs.

Lam et al\(^2\) conducted a scoping review to explore evidence on micronutrient food fortification strategies for older adults living in residential care. Four studies considered fortification with vitamin D and calcium together. Food vehicles included cheese, yogurt and buns. Doses were 100-5,000 IU vitamin D and 302 – 800 mg calcium per day. Study lengths were 6-8 weeks. In three of the four studies trialled formulations were below RDA for both vitamin D and calcium. All reported an increase in 25(OH)D. The authors concluded that food fortification could be efficacious in this group, however more research is required.

This review has several limitations. Study periods were of short duration, doses were below RDA of both vitamin D and calcium and no study compared food fortification with other approaches to supplementation.

Williams & Williams\(^6\) conducted a qualitative study to understand the determinants of current practice and perceived responsibility for the vitamin D status of residents in care homes in two areas of Southern England. Thematic analysis of data from 13 interviews resulted in four themes;

1. Framing of vitamin D supplementation as medicines; participants understood vitamin D to be prescribed on an individual basis and none knew of any care home where vitamin D supplements were given to residents as part of a public health measure.
2. Professional and sector boundaries whereby GPs are perceived as responsible for the vitamin D status of residents and care home managers felt unable to administer over-the-counter vitamin tablets; strong agreement that vitamin D status was the responsibility of the GP. There were cost implications of who would pay. There is also a lack of guidance on how to implement public health advice on vitamin D supplementation.
3. Low awareness of national guidance
4. Ethical and practical issues including resident consent and population versus individual approach and the value of introducing another tablet given the age of residents – some residents are already taking many tablets. This results in vitamin D supplementation requiring prescription by medical professionals and few residents receiving them.

The authors concluded that the medical framing of vitamin D supplements in care homes is a practical barrier to implementation of national guidelines. Using scarce GP time and the NHS prescribing to obtain vitamin D for all residents is a poor use of NHS resources as a one year supply of vitamin D costs £15/person. A shift is needed so that vitamin D is understood as a protective...
nutrient as well as a medicine and a public health as well as a medical responsibility. Costs could be absorbed in nursing home fees or vitamin D supplements could be provided by local authorities.

**Expert opinion**

One expert opinion paper was found.

Chiodin & Gennari\(^{22}\) commented on the Bolland et al\(^{14}\) systematic review and advised that the conclusions should be interpreted with caution due to the heterogeneity of the studies included in the meta-analyses. These authors indicated that the meta-analysis may have been confounded by the majority of participants being community dwelling adults who were not selected for underlying illness and many of the studies were small (52% of RCTs included <200 participants) and of short duration (68% had an overall length of <1 year). The conclusion of this paper was that although the results do not support widespread use of vitamin D supplementation in community-dwelling individuals, vitamin D supplementation is important in people with low serum concentrations of vitamin D, particularly those at high risk of bone loss, falls and fractures.

**Planned and ongoing work (including research projects, evidence reviews and implementation projects)**

Yusuf, S The International Polycap Study 3 (TIPS-3) NCT01646437. Due to report in March 2025.

### 3. Summary and conclusions

All UK guidelines and the Scientific Advisory Committee on Nutrition recommend vitamin D supplementation all year round in people > 65 years and those with restricted time outdoors to support musculoskeletal health.\(^{1-3}\) The UK recommended dose is 400 IU/day, lower than that recommended by other countries (≥800 IU/day).\(^4\) There is also disagreement regarding the minimal desirable serum concentration of 25(OH)D (25 nmol/L to >100nmol/L).\(^4\)

UK guidelines recommend that health and social care professionals are made aware of guidelines and have wide access to vitamin D supplements for at risk groups. Local authorities should consider providing free vitamin D supplements to at risk groups.

Findings from 3 systematic reviews conducted since the SACN report are inconsistent.\(^{13-15}\) Two concluded that vitamin D supplementation probably reduces the risk of falls in elderly people in residential care. One review indicates that supplementation is only justified in at risk groups.

Findings from primary studies published in 2019 and 2021 found no benefit from vitamin D supplementation for prevention of falls, bone mineral density or depression and physical limitations/functioning.\(^9\) One study reported an improvement in full scale IQ in patients with Alzheimer’s disease.\(^{10}\)
Investigations of the uptake of guidance for vitamin D supplementation showed inconsistent results for knowledge transfer, but advocate education of those caring for at risk groups to increase adherence to recommendations for vitamin D supplementation. 5 6

There is an ongoing discussion regarding whether the responsibility for ensuring adequate vitamin D supplementation in long-term care facilities is a medical or public health issue. Supplementation can be achieved by fortified food as well as tablets, however few studies investigating fortified food provided RDA of vitamin D.5 22

References


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