# Consensus Statement
# on Vitamin D and Sun Exposure in New Zealand

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Te Kāhui Matepukupuku o Aotearoa

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# Consensus Statement
# on Vitamin D and Sun Exposure in New Zealand

## Advice for use with the general population excluding pregnancy and infancy

This consensus statement updates and replaces the Cancer Society's *Position Statement: The risks and benefits of sun exposure in New Zealand* (2008). The information provided here applies to the general population and is not designed to replace specific advice to individuals given by a medical practitioner. A separate statement will be developed for vitamin D and sun exposure in pregnancy and infancy.

## Why a new consensus statement?

A recent survey of 1083 New Zealand general practitioners (GPs) on the advice they give about sun exposure and vitamin D found that almost 90 percent were concerned that their patients may not be getting enough vitamin D. There was overwhelming agreement among the respondents that clinical guidelines on vitamin D deficiency would be useful.[1]

In addition, a 2010 Massey University survey of mothers with young children and health practitioners found that both groups are confused and concerned about vitamin D and sun exposure messages, and about what they should be advising or doing.[2] A consensus statement will help both the health practitioners and key agencies to provide consistent messages.

Finally, the release of the US Institute of Medicine's (2011) consensus report, together with the United Kingdom *Consensus Vitamin D Position Statement* (2010) and other international statements on vitamin D recently, has added impetus to the need to review New Zealand advice on vitamin D.

In June 2011 the Ministry of Health, Cancer Society and Accident Compensation Corporation (ACC) convened a meeting of experts and key agencies to develop a consensus statement for vitamin D and sun exposure in New Zealand. The discussion was informed by a review of the recent literature (prepared by the Ministry of Health), together with recent international position statements. The aim was to develop a New Zealand consensus statement aligned with international best practice but tailored to the New Zealand environment.

## Summary of the consensus statement

The following summary captures the main points of the consensus statement.

### Health benefits of vitamin D

- Vitamin D maintains calcium and phosphate homeostasis, and optimises bone health and muscle function. Low levels are linked to bone conditions such as rickets in children and osteoporosis and osteomalacia in adults.
- There is evidence of an association between low vitamin D levels and non-skeletal health outcomes such as colorectal cancer, cardiovascular disease and all-cause mortality. However, because there is no convincing evidence from intervention trials, there is no basis for incorporating these results into public policy at present.

1 Anthony Reeder, Otago University, personal communication, 14 June 2011.
2 Pamela von Hurst, Massey University, personal communication, 14 June 2011.

- There is consistent evidence of a protective effect of vitamin D, with or without calcium, for falls in older people in residential care. More research is needed on the effect of vitamin D alone as an intervention to reduce falls and fractures in other population groups.
- The recommendations provided in this statement assume an adequate intake of calcium is maintained.

## 25-hydroxyvitamin D blood levels

- 25-hydroxyvitamin D is the major circulating form of vitamin D in the blood.
- In general, asymptomatic, at-risk people should be prescribed supplements without testing for 25-hydroxyvitamin D.
- There is consensus that 25-hydroxyvitamin D levels below 25 nmol/L are 'deficient'.
- It is not possible to determine an optimal status level, but aiming for a 25-hydroxyvitamin D level of 50 nmol/L or over seems prudent.
- Although no safe upper level of 25-hydroxyvitamin D has been identified, treatment to levels above 125 nmol/L is not recommended.

## Sun exposure

- Unprotected UV exposure to the sun or indoor tanning devices is a known risk factor for the development of skin cancer.
- With sufficient exposure to ultraviolet B (UVB) from sunlight, a healthy person should be able to synthesise all of their vitamin D requirements in their skin. However, there is no scientifically validated, safe threshold level of UV exposure that allows for maximal vitamin D synthesis without increasing skin cancer risk.
- Advice on sun exposure requires balancing the risk of skin damage and skin cancer against the risk of vitamin D deficiency.
- For the general population, some sun exposure is recommended for vitamin D synthesis.
- For older adults who are mobile and living independently, the same sun safety messages apply as for the general population. Physical activity outdoors should be encouraged.
- Physical activity is associated with increased vitamin D levels. Being active while outside may enable more skin to be exposed, increase vitamin D production and reduce the length of time required for vitamin D synthesis.
- Between September and April sun protection is recommended (shade, clothing coverage and a hat that shades the face and neck, sunscreen, sunglasses), especially between 10 am and 4 pm. A daily walk or some other form of outdoor physical activity in the early morning or late afternoon is recommended.
- Between May and August some sun exposure is important. A daily walk or another form of outdoor physical activity in the hours around noon, with face, arms and hands exposed, is recommended.
- People with a history of skin cancer, skin damage from the sun, or who are taking medicines that affect photosensitivity should use sun protection (shade, clothing coverage and a sun-protective hat, sunscreen, sunglasses) all year round.
- Sun protection should also be used throughout the year when at high altitudes or near highly reflective surfaces such as snow or water.
- Use of sun beds and solaria is not recommended because they are associated with increased risk of early-onset melanoma. The risk increases with greater use and an earlier age at first use.
- For vitamin D synthesis, exposure must be to direct sunlight as UVB does not pass through glass.
- The daily Sun Protection Alert (www.sunsmart.org.nz/) outlines the times of day when the Ultraviolet Index is over 3. NIWA provides more detailed information on fluctuations in UVR throughout the day: www.niwa.co.nz/our-services/online-services/uv-and-ozone/todays-uv-index

## At-risk groups

- The following three groups are at a particularly **high** risk of vitamin D deficiency and negative health outcomes, and may require vitamin D supplementation:
    1. people with naturally very dark skin – this includes many people from Africa, the Indian subcontinent and the Middle East, especially if they are covered by veils and full-body-coverage clothing
    2. people who completely avoid sun exposure because they have had skin cancer, skin damage from the sun or are on photosensitising medications
    3. people with low mobility, who are frail or who are housebound either in residential care or living in the community, including people who are bed-ridden or chair-bound: adverse musculoskeletal outcomes include musculoskeletal pain and osteomalacia.
- People who live in the cooler, southern regions **and** spend little time outdoors in the middle of the day between May and August (with mostly only their face and hands exposed) may be at risk of vitamin D deficiency and may wish to consider vitamin D supplementation during those months.
- People who have liver or kidney disease, or are on certain medications that affect vitamin D levels may also be at risk of vitamin D deficiency.

## Supplementation

- For the bulk of the population with no specific medical issues or risk factors for vitamin D deficiency (as identified above), supplementation is not necessary and not recommended. There is no conclusive evidence that supplementing with vitamin D is beneficial for the general population.
- At-risk groups (as identified above) may benefit from vitamin D supplementation. The standard (PHARMAC-subsidised) tablet prescribed in New Zealand is a single 1.25 mg (50,000 international units, IU) tablet of cholecalciferol per month. For severe deficiency, an individualised treatment programme may be required initially.
- There are a number of contraindications and precautions for vitamin D supplements. Supplementation is generally not recommended when hypercalcaemia, hypervitaminosis D or renal osteodystrophy with hyperphosphatemia is present. Care should be taken when considering supplementation in the presence of atherosclerosis or cardiac function impairment, hypersensitivity to vitamin D, renal function impairment, or sarcoidosis.

# Introduction

## Chemistry

Vitamin D is a fat-soluble vitamin that functions as a hormone. It can be stored in the body. The term 'vitamin D' actually encompasses two molecules:

- cholecalciferol (vitamin $D_3$), which is formed in the skin through the action of ultraviolet (UV) light on 7-dehydrocholesterol to produce cholecalciferol
- ergocalciferol (vitamin $D_2$), which is produced by UV irradiation of the plant steroid ergosterol.

Vitamin $D_3$ and $D_2$ are transported to the liver and metabolised to 25-hydroxyvitamin D (25-OHD), the major circulating form. Further hydroxylation occurs in the kidney to form the highly biologically active 1,25-dihydroxyvitamin D, often abbreviated to $1,25(OH)_2D$. This compound promotes:

- absorption of calcium and phosphate from the small intestine
- extracellular calcium homeostasis, directly and through its interaction with parathyroid hormone
- mineralisation of the skeleton (Armstrong 2004).

Vitamin D receptors are present in the nucleus of many tissues that are not involved in the regulation of calcium and phosphate metabolism, but vitamin D's function in these tissues and the physiological consequences are not clearly understood (Institute of Medicine 2011).

## Sources

There are three main sources of vitamin D.

1. Exposure of the skin to ultraviolet B (UVB) from sunlight is the main source of vitamin D for most people. Vitamin D produced by the skin becomes metabolically active following reactions in the liver and kidney. With sufficient exposure to UVB, a healthy person can synthesise all of their vitamin D requirements in their skin.
2. The food supply also contributes to vitamin D status. Vitamin $D_3$ is found in small quantities in a few foods such as fatty fish (North Sea salmon, herring, tuna and mackerel). Few products are fortified with vitamin D in New Zealand. It would be hard to reach acceptable blood levels of vitamin D through diet alone.
3. Supplementation is available for groups at risk of insufficient levels.

This paper focuses predominantly on getting the right balance between sun exposure as a source of vitamin D, the risks associated with sun exposure, and supplementation.

# Current situation

## Vitamin D levels in New Zealand

An analysis of vitamin D data taken from the 2008/09 New Zealand Adult Nutrition Survey (15 years and older) (Ministry of Health, 2012) showed that 5 percent of people were deficient (less than 25 nmol/L). A further 27 percent had levels between 25 and 50 nmol/L.

There were strong seasonal differences in vitamin D levels: people across New Zealand were much more likely to be deficient in vitamin D in late winter and early spring (August to October). The trend was most marked in the South Island (excluding Nelson Marlborough DHB) where 18 percent were deficient between August and October.

Further work is required to enable comparison with 1997 National Nutrition Survey and 2002 National Children's Nutrition Survey vitamin D data, as different methods were used for analysis of blood samples (Ministry of Health 2012).

### Use of supplementation in New Zealand

Vitamin D tablets approved by Medsafe (a unit within the Ministry of Health responsible for regulation of medicines) are recommended when considering vitamin D supplementation for those who are vitamin D deficient. Other preparations containing vitamin D, which have not been approved by Medsafe, are able to be sold as dietary supplements but these are not recommended as they have not been evaluated for quality, safety and efficacy. The standard (PHARMAC-subsidised) tablet prescribed in New Zealand is one 1.25mg (50,000 IU) tablet of cholecalciferol per month.[3]

The number of people in New Zealand prescribed 1.25 mg (50,000 IU) vitamin $D_3$ (cholecalciferol) has increased steadily, from 84,090 in 2007 to 174,440 in 2010. This represents a total of 464,896 scripts filled in 2010.[4]

Based on Ministry of Health estimates of district health board (DHB) population data, Auckland (7.3 percent), Otago (6.2 percent) and Canterbury (5.0 percent) had the highest proportion of their population prescribed 1.25 mg (50,000 IU) vitamin $D_3$ in 2010. The regions with the lowest proportion were Tairawhiti (0.7 percent), Whanganui (1.5 percent) and Wairarapa, Nelson Marlborough and MidCentral (all 2.0 percent). The national average is 3.9 percent of the population.

The variability across DHB regions is likely to be due to ethnicity, sun exposure and other risk factors, together with possible variations in prescribing practice by GPs.

ACC, with support from DHBs and primary health organisations, has a falls prevention programme within rest homes in New Zealand that offers all rest-home residents vitamin D tablets. In 2010, 12,078 rest-home residents were receiving a vitamin D tablet (of whom 9387 were receiving 1.25 mg, or 50,000 IU, per month). Therefore, rest-home residents made up 5.4 percent of the total number of people receiving the 1.25 mg tablet in 2010.

## Vitamin D in the diet

### What foods are good sources of vitamin D?

Vitamin $D_3$ is found in small quantities in a few foods such as fatty fish (North Sea salmon, herring and mackerel). Liver, eggs and fortified foods such as margarine and some low-fat dairy products (milk and yoghurt) also contain very small amounts of vitamin D. Adequate intakes of vitamin D are hard to achieve through diet alone.

National Nutrition Survey dietary intake data were analysed for vitamin D in 1992. The main sources of dietary vitamin D intake in 1992 were margarine, fish, eggs and milk (LINZ 1992).

### Nutrient reference values

Nutrient reference values (NRVs) refer to a range of intakes, including an upper level of intake, for essential nutrients such as vitamins (including vitamin D) and minerals. The NRVs are a joint initiative of the Australian Commonwealth Department of Health and Ageing and the New Zealand Ministry of Health (NHMRC 2006). The project to develop the 2006 recommendations was managed by the National Health and Medical Research Council (NHMRC) of Australia.

A project is currently under way that will inform a future review. This project will consider the key issues with the current NRVs and undertake research to propose possible approaches, examine relevant international work and seek input on suitable options for the review process. The findings will inform the Australian and New Zealand government departments who will decide if and how a review will be undertaken.

**3** As at 13 February 2012, PHARMAC subsidise the Cal-d-Forte brand. Further products may be subsidised in future. See PHARMAC schedule online www.pharmac.govt.nz/Schedule. PHARMAC, personal communication, 2 August 2011.
**4** Pamela von Hurst, Massey University, personal communication, 14 June 2011.

## Health benefits of Vitamin D

Vitamin D maintains calcium and phosphate homeostasis and optimises bone health and muscle function. Low levels are linked with bone conditions such as rickets in children and osteoporosis in adults. Levels of 25-hydroxyvitamin D below 25 nmol/L can be associated with osteomalacia.

There is consistent evidence of a protective effect of vitamin D, with or without calcium, for falls in older people in residential care (Cameron 2010). More research is needed on the effect of vitamin D alone as an intervention to reduce falls and fractures in other population groups (Institute of Medicine 2011).

The discovery of vitamin D receptors located in organ tissues throughout the body has led to research into possible roles beyond bone health. A rapidly growing body of evidence has identified an association between low vitamin D levels and non-skeletal health outcomes such as colorectal cancer, cardiovascular disease, auto-immune conditions and all-cause mortality, but so far there is no evidence of a causal role (Institute of Medicine 2011). In the absence of convincing evidence from intervention trials, there is no basis for their inclusion in public policy at present.

The recommendations provided in this statement assume an adequate intake of calcium is maintained.

## What serum level of vitamin D is adequate?

The level of 25-hydroxyvitamin D, or 25(OH)D, in the blood is an indicator of vitamin D status. However, there is a lack of standardisation of methods used to measure 25 (OH)D status, with different tests producing very different results (Nowak et al 2011).

Some international policy statements on vitamin D have defined an adequate serum 25 (OH)D level as 50 nmol/L and over (Institute of Medicine 2011; American Academy of Dermatology and AAD Association 2010; Henry et al 2010). Other statements, such as the UK consensus statement (2010), do not define a sufficient or optimal level.

There is also variation in the use and definition of the terms 'adequate', 'sufficient' and 'optimal' due to a lack of evidence. Based on the knowledge available, it is not possible to determine an optimal status level, but aiming for a 25 (OH)D level of 50 nmol/L or more seems prudent.

Although there is a clear consensus that levels under about 25 nmol/L are deficient, there is uncertainty over levels between 25 and 50 nmol/L. There is also some evidence of individual genetic variation in vitamin D levels (Wang et al 2010). Using thresholds thus creates arbitrary levels. Clinical treatment should be guided but not dictated by these thresholds: other risk factors need consideration.

There is uncertainty about the upper optimal level because of inter-seasonal variation, assay differences and inconsistent evidence. There is also uncertainty over seasonal variation: it is not known whether people should aim to maintain consistent levels throughout the year, or whether natural seasonal variation in vitamin D levels serves any biological purpose.

There is no agreement internationally on a safe upper limit for 25(OH)D levels, but treatment to levels above 125 nmol/L is not recommended because the long-term safety of such levels is unknown (Institute of Medicine 2011).

## Vitamin D testing

Vitamin D testing is considerably more expensive than vitamin D supplementation. In general, asymptomatic, at-risk people should be prescribed supplements without testing. Routine testing of vitamin D levels is not usually necessary before or after starting vitamin D supplementation. If there is clinical suspicion of severe symptomatic vitamin D deficiency, it is appropriate to investigate with serum calcium, phosphate, alkaline phosphatase and vitamin D levels, plus other tests as indicated.

Vitamin D testing is appropriate for:

- unexplained raised serum alkaline phosphatase, or low calcium or phosphate
- atypical osteoporosis
- unexplained proximal limb pain in older people
- unexplained bone pain, unusual fractures, or other evidence suggesting metabolic bone disease (consider specialist advice for people in this category) (BPAC 2007).

Specialist treatment is recommended for people identified as having metabolic bone disease other than simple vitamin D deficiency. The most appropriate measure of vitamin D status is almost always 25-hydroxyvitamin D.

Measurement of 1, 25-dihydroxyvitamin D is rarely required, as it is very expensive and the results do not provide a good reflection of vitamin D status.

## Sun exposure

### Risks of sun exposure

Unprotected UV exposure, either to the sun or to indoor tanning devices, is a known risk factor for the development of skin cancer (American Academy of Dermatology and AAD Association 2010).

Excessive sun exposure (both UVA and UVB) has been linked to eye diseases (such as some types of cataract), premature ageing of the skin and immune suppression (Lucas et al 2006). Up to 95 percent of the UV radiation reaching the Earth's surface is in the form of UVA rays. UVA rays are 30 to 50 times more prevalent than UVB but less intense.

The intensity of UVA rays remain relatively consistent during all daylight hours throughout the year, and can penetrate clouds and glass. UVB intensity varies throughout the year and time of day. The peak UVB period, and hence the greatest sun exposure risk, is between 10 am and 4 pm from September to April, when the UVB levels are 3 or above on the Ultraviolet Index, which measures ultraviolet radiation. However, UVB rays can burn and damage the skin year-round, especially at high altitudes and on reflective surfaces such as snow or ice, which reflect up to 80 percent of the rays. UVB rays do not significantly penetrate glass.

Exposure to ultraviolet radiation (both UVA and UVB) is the likely cause of over 90 percent of all skin cancer cases in countries with high summer levels, such as Australia and New Zealand (IARC 1992; Armstrong 2004). Skin cancer is the most common cancer in New Zealand, with an estimated 50,000 or more new cases and over 300 deaths each year (O'Dea 2009, 2010; Ministry of Health 2011). New Zealand has the highest reported melanoma incidence rate in the world (Liang et al 2010).

### What is acceptable sun exposure?

Sun exposure is the main source of vitamin D for most people in New Zealand. Exposure to low wavelengths in the UVB range are required for vitamin D production. UVA does not contribute to vitamin D production.

There is no scientifically validated safe threshold level of UV exposure from the sun or indoor tanning devices that allows for maximal vitamin D synthesis without increasing skin cancer risk (American Academy of Dermatology and AAD Association 2010).

There are both beneficial and detrimental effects of human exposure to ultraviolet radiation. A balance is required between avoiding an increase in the risk of skin cancer by excessive sun exposure and achieving enough sun exposure to maintain adequate vitamin D levels.

There is no evidence that current sun behaviour (specifically sunscreen use) is adversely affecting vitamin D status (Marks et al 1995, Nessvi et al 2010).

Sensible sun exposure depends on a range of factors, including season, location, individual characteristics and risk factors for skin cancer. Here are some recommendations to follow for sun exposure.

1. Sunburn should *always* be avoided.

    - Deliberate sun exposure during peak ultraviolet radiation periods between September and April is not recommended because this increases the risk of skin cancer, eye damage and photo ageing. Photo ageing is the premature wrinkling of the skin caused by overexposure to sunlight. According to the World Health Organization, sun protection is required when the Ultraviolet Index is 3 or higher to prevent skin cancer (WHO 2009). However, as more evidence becomes available, sun protection messages will increasingly need to take account of variations between groups and their susceptibility to the dangers and benefits of sun exposure (Lucas et al 2008).
    - Between September and April, sun protection (shade, cover-up clothing and hats, sunscreen, sunglasses) is recommended, *especially* between 10 am and 4 pm.

2. For the general population, some sun exposure is recommended for vitamin D synthesis. Physical activity is associated with increased vitamin D levels (Looker 2007, Chomistek 2011). Possible mechanisms are that being active while outside enables more skin to be exposed (less clothing is required to keep warm), thus increasing the capacity to synthesise vitamin D; increased time exposed to the sun, or a direct effect of physical activity on vitamin D metabolism (Looker 2007).

    - Between September and April, in the early morning or late afternoon, a daily walk or some other form of outdoor physical activity is recommended.
    - Between May and August, sun protection is generally not required unless at high altitudes or near highly reflective surfaces, such as snow or water. During this time some sun exposure, especially in the hours around noon when UVB levels are highest, is advised for vitamin D synthesis. A daily walk or other outdoor activity is recommended at this time.

3. Individuals at high risk of skin cancer include those: with a history of skin cancer, who are highly sun sensitive, who have received an organ transplant, or who are taking medicines that increase photosensitivity. These people should discuss their vitamin D requirements with their health practitioner to determine whether dietary supplementation with vitamin D would be a preferable alternative to sun exposure.

4. When the Ultraviolet Index is 3, in those with sensitive skin (eg, fair-skinned people), skin damage occurs after about an hour, but optimal vitamin D can still be produced in a few minutes if at least the face, arms and legs are exposed. Even during winter in southern New Zealand (when the UVI reaches only 1 at midday) there should be sufficient UV radiation available to help maintain vitamin D, though people need to expose larger areas of skin and this may not be practicable in low temperatures.

5. There are two sources of information that provide advice to the public on the Ultraviolet Index. The daily Sun Protection Alert (www.sunsmart.org.nz/) outlines the times of day when the Ultraviolet Index is over 3. A more detailed daily Ultraviolet Index regional forecast service for New Zealand is available on the National Institute for Water and Atmospheric Research (NIWA) website (www.niwa.co.nz/our-services/online-services/uv-and-ozone/forecasts).

6. Sun protection should be used throughout the year when at high altitudes or near highly reflective surfaces, such as snow or water.

7. Use of sunbeds and solaria is not recommended because they are associated with increased risk of early-onset melanoma. The risk increases with greater use and an earlier age at first use (Cust et al 2011).

8. Exposure must be to direct sunlight as UVB does not pass through glass.

9. There is a need for further research to inform advice regarding the amount of sun exposure required to avoid sunburn and/or synthesise vitamin D. The use of the Ultraviolet Index as an educational tool should be maintained and supported in schools so that children grow up understanding ultraviolet radiation in the New Zealand context.

## Who is at risk of vitamin D deficiency?

Exposure to sunlight is the main source of vitamin D for people living in New Zealand, so people who have reduced exposure to sunlight are most at risk of vitamin D deficiency.

Groups at high risk of vitamin D deficiency include:

- older people in both low- and high-level residential care
- older people admitted to hospital
- people with hip fractures
- people with very dark skin, including many people from Africa, the Indian subcontinent and the Middle East, especially if they are covered by veils and full-body-coverage clothing
- people with skin cancers or skin-related conditions, where avoidance of sunlight is required
- people who completely avoid the sun (eg, because they are on photosensitising medication)
- people with malabsorption syndromes
- exclusively breastfed infants of mothers with risk factors for vitamin D deficiency.[5]

Overweight and obesity have been linked to lower serum 25(OH)D concentrations (Institute of Medicine 2011). In New Zealand, people who were obese had a lower mean level of vitamin D than people who were overweight or normal weight (Ministry of Health 2012). Evidence suggests that this is likely to be due to a combination of factors: sequestration of vitamin D into fat, lower use of vitamin D supplements (Picciano et al 2007) and lower levels of physical activity (Looker 2007). Modest weight loss has been shown to increase circulating 25(OH)D levels even with no increase in sun exposure or dietary intake of vitamin D (Institute of Medicine 2011). Supplementation should only be considered if there are other risk factors, such as sun avoidance.

Pacific peoples tend to have lower levels of vitamin D than New Zealand Europeans (Ministry of Health 2012). However, Pacific peoples also have lower fracture rates and a higher bone mineral density than New Zealand Europeans (Rockell et al 2006; Rush et al 2004). New Zealand European hip fracture rates between 2003 and 2005 were approximately 30 percent higher than for Māori, Pacific and Asian peoples (Brown et al 2011). Therefore supplementation for Pacific peoples should only be considered in the presence of other risk factors.

Māori women were more likely to be below the recommended level of vitamin D than non-Māori women, but there was no significant difference in the prevalence of deficiency. There were no significant differences between Māori and non-Māori men (Ministry of Health 2012). As for Pacific peoples, supplementation for Māori women should be considered only in the presence of other risk factors.

Older people are at higher risk of skin cancer. They are more likely to be already immune-suppressed and have thinner skin. Age is the single most important risk factor for melanoma. However, recent evidence shows that sun exposure at any age increases risk of melanoma (MelNet Establishment Committee 2011).

**5** A separate position statement on vitamin D and sun exposure is being developed for pregnancy and infancy.

Although the ability to make vitamin D decreases with age, it is still possible for older people to make enough vitamin D for their needs. The prevalence of vitamin D deficiency in New Zealand does not vary significantly by age group (Ministry of Health 2012). For older adults who are mobile and living independently, the same sun safety messages apply as for the general population, and physical activity outdoors should still be encouraged.

People with low mobility, who are frail or who are housebound (either in residential care or living in the community) are at increased risk of vitamin D deficiency and adverse musculoskeletal outcomes, including musculoskeletal pain and osteomalacia. This group requires treatment (supplementation) and includes people who are bed-ridden or chair-bound.

People with naturally very dark skin have high melanin levels in the skin. Melanin reduces absorption of ultraviolet radiation. Although they rarely or never burn and are better protected from skin cancer, they are at greater risk of vitamin D deficiency. This may have implications for the vitamin D status of African, Indian and Middle Eastern peoples in particular, especially those living in the south of New Zealand.

## Recommendations for supplementation

All international policy statements that were reviewed identified a role for supplementation in maintaining adequate vitamin D levels for individuals at risk of vitamin D deficiency. There is no universally accepted dose or frequency of dose.

Vitamin D levels in New Zealand are known to vary significantly with seasons. What we do not know is what effect this seasonal variation has on long-term bone health.

Caution should be taken with vitamin D supplementation, because vitamin D toxicity can be caused by excessive oral intake through supplementation but not by prolonged exposure of the skin to UV light. Symptoms of vitamin D toxicity (hypervitaminosis D) include dehydration, vomiting, decreased appetite, irritability, constipation, fatigue and muscle weakness.

For the general population with no specific medical issues or risk factors for vitamin D deficiency, supplementation is not necessary and is not recommended. There is little current evidence that supplementing with vitamin D is beneficial for the general population, including healthy older people who are mobile.

In New Zealand it is not cost-effective to undertake widespread blood testing, because the cost of testing is far greater than the cost of treatment. Therefore, it is important to identify those at most risk of vitamin D deficiency by risk factor profile.

At-risk groups, as identified on page 9, may benefit from vitamin D supplementation. The standard (PHARMAC-subsidised) tablet prescribed in New Zealand is one 1.25 mg (50,000 IU) tablet of cholecalciferol per month. These tablets are registered medicines and are available on prescription from a doctor or lead maternity carer.

Other (non-PHARMAC-subsidised) vitamin D tablets are also available. Dietary supplements are not recommended due to variations in dose, the quality of the manufacturing process and co-ingredients (some contain high levels of other vitamins and minerals).

For severe deficiency, an individualised treatment programme may be required initially.

There are a number of contraindications and precautions for vitamin D supplements. Supplementation is generally not recommended when hypercalcaemia, hypervitaminosis D or renal osteodystrophy with hyperphosphatemia is present. Care should be taken when considering supplementation in the presence of atherosclerosis or cardiac function impairment, hypersensitivity to vitamin D, renal function impairment, or sarcoidosis (PSM Healthcare Ltd 2010).

## Emerging New Zealand research

A randomised controlled trial is being undertaken in New Zealand by Auckland University (lead researcher Professor Robert Scragg) evaluating the effect of vitamin D on cardiovascular and respiratory diseases.[6] The study includes an evaluation of the effect of vitamin D on falls and fracture rates in community dwelling adults. The findings of this study are not expected to be known until 2016.

Additional Health Research Council-funded vitamin D research projects include:

- vitamin D deficiency risk and respiratory/allergy diseases in New Zealand 1–4-year-olds (HRC11/655); lead researcher Dr Pamela von Hurst (Massey University, Albany)
- effect of vitamin D supplementation on upper respiratory infections in adults (HRC09/302); lead researcher Professor David Murdoch (University of Otago, Christchurch)
- a randomised placebo-controlled study of vitamin D during pregnancy and infancy (HRC09/215R); lead researcher Associate Professor Cameron Grant (University of Auckland).

In addition to New Zealand research, there is a huge body of international research and interest in the role vitamin D plays in a range of health conditions. It is expected that advice on vitamin D will need to be reviewed and updated if new and more convincing evidence becomes available.

This consensus statement will be updated as new evidence becomes available.

**6** www.ANZCTR.org.au, registration number ACTRN 12611000402943.

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## Further Information

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