MELBOURNE PLANNING SCHEME AMENDMENT C278

Expert witness statement Sunlight and Health

Professor Caryl Nowson

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2 INTRODUCTION, QUALIFICATIONS AND EXPERTISE

I hold the position of Emeritus Professor within the School of Exercise and Nutrition Sciences, Deakin University. I completed a BSc, majoring in nutrition (1979), obtained a PhD in physiology in 1990 and I have post graduate qualifications in dietetics (Dip Nut & Diet 1980), education (Dip Ed 1985) and evaluation (Dip Eval 1994). I held the Deakin Chair of Nutrition and Ageing from 2006 until 2019, after which I was awarded the honorary position of Emeritus Professor. I have published more than 220 scientific peer reviewed papers, and 8 book chapters. I have led and collaborated on numerous successful research projects over the last 30 years receiving funding from government and industry sources totalling in excess of $20M. I have led and contributed to a number of intervention studies (food based and supplement-based studies) that have evaluated the impact of increased protein, vitamin D and calcium on risk factors for falls and fractures in older people in the community and in residential care.

2.1 Summary Expertise relating to vitamin D

I have been an active researcher in the area of vitamin D since 1998 and I am currently one of the chief investigators of a National Health and Medical Research Council grant: Investigating dietary vitamin D in the Australian population. I am a nationally and internationally recognised expert on vitamin D as evidenced by more than 30 peer reviewed authored publications relating to vitamin D and national and international invitations to speak on the topic of vitamin D. As member of the scientific committee of Osteoporosis Australia I led, as first author, the key position paper/consensus document: Vitamin D and health in adults in Australia and New Zealand: a position statement, published in the Medical Journal of Australia.[1] I was also a major contributing author to the companion position paper: Vitamin D and health in pregnancy, infants, children and adolescents in Australia and New Zealand: a position statement published in the Medical Journal of Australia.[2] These publications set the policy for vitamin D testing and treatment in Australia. These papers have become the standard reference guidelines for determination of vitamin deficiency in Australia. I also contributed to a previous position paper on vitamin D: Vitamin D and adult bone health in Australia and New Zealand: a position statement.[3] (See Appendix A: Curriculum vitae)

3 FORMAL INSTRUCTIONS

I**nstructions pertaining to** MELBOURNE PLANNING SCHEME AMENDMENT C278

Instruction specified in letter dated 27th February 2020, received from Legal Counsel for City of Melbourne. I was instructed to:

- Familiarise myself with the Amendment, and relevant submissions.
- State whether I am supportive of the Amendment.
- Prepare a report setting out my expert opinion in relation to heath science prepared in accordance with the relevant requirements of Planning Panels Victoria's guidelines for expert evidence.
- Attend the Panel Hearing to present my evidence.

4 FACTS/MATTERS RELIED UPON

My report is based on an evidence-based review which includes key peer reviewed publications, published in established scientific journals. The key publications referred to in this report includes research and some relevant publications where I am the lead or a secondary author as well as documented peer-reviewed evidence from national and international expert scientists in their field.

5 SUMMARY OF OPINION/SUPPORT FOR PROPOSED AMENDMENT

The main source of vitamin D is sunlight. Exposure of skin to sunlight accounts for more than 80% of the body's level of circulating vitamin D[1] in the Australian population. As Melbourne/Victoria is situated further from the equator than other states (except Tasmania) where the ultraviolet light is less abundant, a significant proportion of Melbourne's population are at greater risk of developing vitamin D deficiency compared to most other Australian capital cities. It is fundamental that the population be provided with an environment that maximises incidental exposure to sunlight to assist the population in maintaining adequate vitamin D status, particularly during winter, spring, autumn. On average 49% of Victorians have vitamin D insufficiency in winter. There is overwhelming evidence that adequate vitamin D status is fundamental for good health, particularly prevention of falls and fractures, maintaining healthy bones and muscle, assisting in fighting viruses/infections, controlling diabetes and may exert a protective effect against developing cancer. There is also emerging evidence that regular short intervals of sun exposure may be protective against some types of melanoma. Furthermore, there is evidence that adequate sunlight exposure has additional health benefits, independent of vitamin D, such as increasing hormones in the body which produce a feeling of well-being and improved mental health similar to exercise.

I support the proposed Amendment C278 (mandatory winter sun protection in all parks outside the Central City and the increases in the hours of protection from 11am to 2pm (3 hrs) at the Spring and Autumn Equinox to 10am to 3pm at the Winter Solstice (5hours) with some exceptions). This amendment if implemented would facilitate Melbourne's population's access to sunlight and is likely to assist people in maintaining adequate vitamin D status particularly during Spring, Autumn and Winter.

[1] Circulating vitamin D is assessed through measurement of serum 25-hydroxyvitamin D (25OHD)

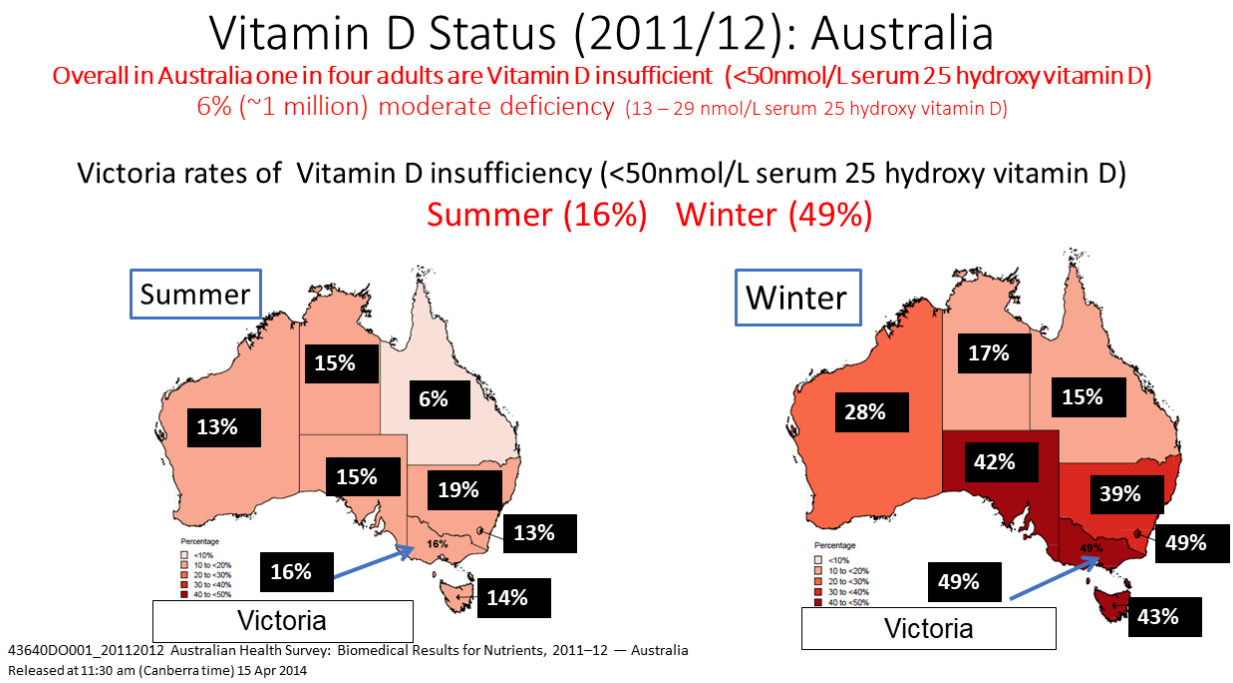
6 REPORT

6.1 Vitamin D insufficiency in Australia and Victoria

Inadequate vitamin D status has emerged as a significant public health issue in Australia and New Zealand with an estimated quarter of all adults across Australia having inadequate vitamin D status (serum 25-hydroxyvitamin D (25OHD <50(nmol/L)[2] (Figure 1.)[4]. The situation is most severe in those areas further from the equator, particularly Victoria and Tasmania. Many people living and working in Melbourne have marginal levels of vitamin D and the number of those developing vitamin D deficiency increases during winter, such that almost half the population in Victoria suffers from vitamin D insufficiency (Figure 1).

6.1.1 **Figure 1.** Rates of vitamin D insufficiency by State in Australia

The major source of vitamin D comes from the sun through the action of ultraviolet light on the skin. Less vitamin D is synthesised in winter, therefore serum vitamin D[3] levels are lower in winter[5] and more people have serum vitamin D levels falling into the deficiency range. Differences are seen across geographical areas, with more people experiencing vitamin D insufficiency levels in the southern states and vitamin D insufficiency more common in major cities (27%) than in inner regional (16%), outer regional (13%) and remote areas (9%).



[2] Vitamin D status (adequate, insufficient and/or deficient) is assessed by a blood test which measures serum 25-hydroxyvitamin D (abbreviated to 25OHD). A serum level of 25OHD greater than 50 nano mole per litre (abbreviated to nmol/L) indicates adequate vitamin D status. Serum 25OHD levels <30nmol/L indicate deficiency, and 25OHD levels between 30 and 50nmol/L indicate mild deficiency or insufficiency. It is common for researchers to group all those with serum 25OHD levels <50nmol/L together under the umbrella term insufficient illustrated in Figure 1 (Australian Health Survey).

[3] Serum vitamin D denotes serum 25-hydroxyvitamin D (25OHD)

6.2 Measurement of vitamin D status

The generic term 'vitamin D' is generally applied to two molecules (cholecalciferol and ergocalciferol). Cholecalciferol (vitamin D3) is formed through the action of ultraviolet (UV)[4] light (290-315 nanometre (nm)[5]) on 7-dehydrocholesterol in the skin. Vitamin D can also be ingested in the dietary forms of cholecalciferol, vitamin D3 (present in the fat of animals) and in the form of ergosterol, vitamin D2 produced by irradiation of yeast and fungi. The frequency of exposure of bare skin to sunlight is the major determinant of vitamin D status, as most adults are unlikely to obtain more than 5-10% of their vitamin D requirement from dietary sources. Both forms of vitamin D (that derived from sunlight and diet) are transported to the liver and metabolised to 25-hydroxyvitamin D(25OHD). The blood test used to assess vitamin D status measures 25OHD in the serum and therefore captures both vitamin D generated in the body through sunlight exposure plus the amount consumed through diet and/or supplements.

6.3 Generation of vitamin D through Sun Exposure

I endorse the following passage which I authored from the position statement Vitamin D and health in adults in Australia and New Zealand: a position statement. Med J Aust. 2012;196(11):686-687. "For most humans the main source of vitamin D is through skin exposure to sunlight. The minimal erythemal dose (MED) of UV is the amount of UV exposure that just causes faint redness of the skin (erythema). At low wavelengths, in the UVB range, the action spectrum for production of erythema is similar to that for production of vitamin D, though erythema, but not vitamin D, can be produced by higher wavelength UVA. This limits the usefulness of MED as an index of vitamin D dose.[6] Nevertheless, there is experimental data indicating that exposure of around 15% of the body surface (arms and hands or equivalent) to 1/3 of a MED will result in the production of approximately 1000 international units (IU) (25 micrograms (µg)) of vitamin D. If this exposure is achieved on most days this should be appropriate to maintain vitamin D levels in the body.[6,7] The amount of sun exposure to produce 1/3 of a MED depends on a number of factors outlined in Box 1.

Less vitamin D is synthesized in winter, particularly at latitudes further from the equator. There is minimal transmission of the relevant UV wavelengths through normal window glass. Although sunscreens markedly reduce transmission in the UVB range (wavelengths 290-320nm), they are often inadequately applied and may have little impact on vitamin D status.[8] Lack of any skin exposure to sunlight is a more common problem (either through confinement indoors or clothing), but given the high incidence of skin cancer in Australasia, sunscreens and other avoidance measures should be adhered to if exposures are likely to be prolonged and there is a risk of skin damage. Short UV exposures (a few minutes) may be more efficient at producing vitamin D, since prolonged exposure to UV results in the production of sterols which have little effect on mineral metabolism.[9]

[4] Ultraviolet light abbreviated to UV
[5] Nano metre abbreviated to nm

6.3.1 **Box 1.** Sun exposure times (minutes) for 1/3 Minimal Erythemal Dose (Estimated amount required to ensure vitamin D sufficiency in those with type I or II (sensitive skin))

(Extract from: Vitamin D and Health in Adults in Australia and New Zealand: a position statement [1]

Sun exposure times in minutes [A] at 10am or 2pm[B] (summer) or noon (winter) for people with moderately fair skin,[C] which would result in approximately 1/3 MED: 15% of the body surface (arms and hands or equivalent).[D]

Region/Time of year		December-January – 10am or 2pm[B]	July-August - noon
Northern:	Cairns	6-7	7
	Townsville	5-7	7
Central:	Brisbane	6-7	11
	Perth	5-6	15
Southern:	Sydney	6-8	16
	Adelaide	5-7	19
	Melbourne	6-8	25
	Hobart	7-9	29

A. Based on 1 MED = 200 J/m^2 effective or 2 Standard Erythemal Doses for people with type I or II (sensitive skin). Data for Australian cities [10], using measured averages of MED/hr over 2 months listed, for a minimum of 5 years in the period 1996-2003, except for Hobart, based on data from 1 year. Times for New Zealand calculated from UV data averaged over 2 years provided by the National Institute of Water and Atmospheric Research (NIWA). Current data substantially unchanged from that period (Geis, P, personal communication, 18.10.2010).

B. 11am or 3pm during daylight saving.

C. Exposure times for people with highly pigmented skin would be 3-6 times greater [8,9]

D. MED is not an index for vitamin D dose, except when there are high levels of UVB – see text

In summer, adequate vitamin D levels are likely to be maintained by a walk with arms exposed for 6-7 minutes mid- morning or mid-afternoon, on most days, if possible. In winter, the task is more difficult, but depending on where in Australasia people live, walking outside at lunchtime from 7- 30 minutes, with as much bare skin exposed as feasible, most days, is likely to be helpful (Box 1). People with darker skin are likely to need 3-6 times longer sun exposure."[8]

Short bursts of sunlight exposure on skin are effective in generating vitamin D production and prolonged exposure does not result in the production of any more vitamin D. Once pre-vitamin D3 (a chemical precursor of vitamin D3) has been formed, synthesis of pre-vitamin D3 ceases and inert over-irradiation products are formed in its place. [11]

6.4 Groups at greatest risk of developing vitamin D deficiency

I endorse with the following passage which I authored from the position statement Vitamin D and health in adults in Australia and New Zealand: a position statement. Med J Aust. 2012;196(11):686-687. "Although the elderly are an at-risk group for developing vitamin D deficiency, having less substrate (7-dehydrocholesterol in the skin), and lower production rates of vitamin D with high level of UV exposure,[12] older people synthesise

similar amounts of vitamin D to younger people at normal levels of UV exposure.[13] A major reason for vitamin D deficiency in older people is limited sun exposure.[14] Vitamin D synthesis is reduced in those who have dark skin due to the presence of melanin which absorbs UV.[8] Vitamin D synthesis is reduced by clothing.[8,15,16] People who wear covering clothing for cultural or religious reasons are a particular at-risk group and the sun avoidance behaviour of fair-skinned people increases their risk of vitamin D deficiency. [17,18] Reduced sun exposure is also likely to contribute to increased risk of vitamin D deficiency in chronically ill individuals and those confined indoors (Box 2.)

6.4.1 Box 2. Adult groups at risk of vitamin D deficiency

(Extract from: Vitamin D and Health in Adults in Australia and New Zealand: a position statement [1]

- Elderly and/or disabled people in low & high level residential care[14], particularly housebound community dwelling, geriatric admissions to hospital
- Dark-skinned people[8], particularly migrants if modest dress is worn[8]
- People with a disability or chronic disease e.g. multiple sclerosis[19]
- Fair skinned people and those at risk of skin cancer who avoid sun exposure[17]
- Obese people[20]
- People working in an enclosed environment e.g. office workers, factory/warehouse workers, occupations such as taxi drivers, night shift workers[4]

6.5 Dietary Sources of vitamin D

Vitamin D_3 is found naturally in small quantities in a few foods such as wild-caught fatty fish (North Sea salmon, herring, mackerel). Liver, eggs and fortified foods such as margarine and fortified low fat milk also contain very small amounts of vitamin D_3. Although accurate comprehensive data on the vitamin D content of Australian foods are not available, it is acknowledged that the vitamin D from dietary sources is insufficient to meet vitamin D requirements, as the average estimated dietary intake for adults is only between 80 -120 IU (2-3 µg)/day.[21]

6.6 Functions of vitamin D

Circulating 25OHD undergoes further hydroxylation in the kidney to form the biologically active 1,25 dihydroxyvitamin D ($1,25(OH)_2D$). This compound promotes absorption of calcium and phosphate from the gut, contributes to extracellular calcium and phosphate homeostasis, facilitates mineralization of the skeleton, and is important for muscle function.[9] In addition, almost every nucleated cell expresses the vitamin D receptor and many tissues have the capacity to make the biologically active $1,25(OH)_2D$, thus vitamin D potentially affects all the major homeostatic systems within the body.

6.7 Health Effects of vitamin D Deficiency

Severe vitamin D deficiency causes impaired bone mineralization, resulting in rickets (in children) and osteomalacia in adults. There have been documented two large case series of 55 and 126 children with vitamin D deficient rickets from Victoria[22] and NSW.[23] Almost all children in both series had ethnocultural risk factors (dark skin, maternal covering clothing). In older people vitamin D deficiency is an independent predictor of increased risk of falls and fracture.[24,25]

All the long-term randomised trials to assess the impact of improving vitamin D status,[6] have utilised vitamin D supplements, as it is not feasible to run trials utilising exposure to sunlight to fix vitamin D deficiencies. There are too many uncontrollable variables, including skin colour, age, time of day, amount of surface area of skin exposed to sunlight, amount of pollution and cloud cover. The vast majority of randomised controlled trials, which have utilised vitamin D supplements to correct vitamin D deficiency have demonstrated clear benefits in terms of reducing rate of falls,[26,27] and fractures.[28-30] Additionally there is some evidence improving vitamin D status with supplements is effective in reducing the incidence of influenza A,[31] and improving blood glucose control in vitamin D deficient populations.[32,33]

Data from cross-sectional and longitudinal studies have also indicated that low levels of serum 25OHD increase susceptibility to a large number of diseases. Vitamin D insufficiency has been linked to many diseases including: autoimmune disorders, rheumatoid arthritis, diabetes Type 1, multiple sclerosis, inflammatory bowel disease, cardiovascular disease (hypertension, congestive heart failure, stroke and myocardial infarction), diabetes Type 2, schizophrenia, cognitive decline, Alzheimer's disease, depression, active tuberculosis, increased susceptibility to infection and cancer (colon, breast).[34,35] Furthermore a recent meta-analysis, utilising data from 52 trials with a total of 75,454 participants found that improving vitamin D status using vitamin D supplements reduced the risk of cancer death by 16%.[36]

There is also some evidence that sun exposure, independent of the vitamin D status may have separate roles in the development of and prevention of disease, particularly brain and nerve function.[37] Evidence suggests that vitamin D deficiency in utero as well as throughout life has serious long-lasting consequences for mental health.[38]

6.8 Dangers of vitamin D supplements

Vitamin D is a fat-soluble vitamin and as such is stored in the body. In contrast to exposure to sunlight which cannot result in vitamin D toxicity due to the body shutting down

[6] Blood tests measure serum levels of 25-hydroxy D. Serum levels of 25OHD greater than 50 nmol/L indicate adequate vitamin D status. Levels <30nmol/L indicate deficiency, and 25OHD levels between 30 and 50nmol/L indicate mild deficiency or insufficiency. It is common for researchers to group all those with serum 25OHD levels <50nmol/L together under the umbrella term insufficient.

vitamin D production, a single high dose vitamin D supplement has been found to cause muscle weakness and actually increase the rate of falls in a study conducted in Geelong [39]. The features of vitamin D toxicity are mediated through hypercalcaemia (excessively high levels of blood calcium), and symptoms range from mild, such as thirst and polyuria, to severe, including seizures, coma and even death.[40] There now seems to be a recent increase in the risk of vitamin D toxicity with more people taking vitamin D supplements at inappropriate doses.[41]

6.9 Recognition for the need for sunlight exposure

It is important to balance our risk of adverse effects of too much ultraviolet (UV) exposure with getting enough UV exposure. The amount of time required to be in the sun to make vitamin D will vary according to location, the season and the time of day, the darkness of the skin and the amount of skin exposed to the sun. The UV Index is an indication of the strength of the sun's ultraviolet rays, which can be harmful to people. The ultraviolet index or UV Index is an international standard measurement of the strength of sunburn-producing ultraviolet (UV) radiation at a particular place and time. The UV Index is designed as an open-ended linear scale, directly proportional to the intensity of UV radiation that causes sunburn on human skin. A UV index reading of 3 to 5 means moderate risk of harm from unprotected Sun exposure. When UV levels are 3 or above, most people need just a few minutes of sun exposure, such as walking from the office to get lunch, to get enough vitamin D. When UV levels are below 3, sun protection is not generally required and in Victoria where UV levels fall below 3 for most of the winter season, it is recommended that people spend short periods outdoors being physically active to maintain adequate vitamin D status. These recommendations are in line with the World Health Organisation relating to safe UV exposure (https://www.who.int/UV/intersunprogramme/activities/UV_index/en/).

The current recommendations are: "*Sun protection is not required from May to August in Victoria, unless you are near highly reflective surfaces such as snow, outside for extended periods, or if UV levels reach 3 and above*. Therefore when UV levels are less than 3 there is no recommendation to wear a hat or use sunscreen or limit sun exposure (https://www.sunsmart.com.au/about/media-campaigns/media-releases/2014-media-releases/time-for-victorians-to-shelve-sunscreen-for-winter.html)

The Victorian Health Promotion Foundation and the Cancer Council of Victoria reduced their school requirements for wearing hats in the playground all year round and hats are not required during winter and now recommend sun exposure without sunscreen outside of high UV periods (How Much Sun is Enough).[42]

There is emerging evidence that people regularly exposed to daily sun have a lower risk of getting melanoma and also have a higher survival rate if they do because regular sun exposure protects against burning and reduces risk of melanoma.[43] In contrast many workers spend most of their time inside offices, homes, then plunge into irregular bouts of

excessive sunlight on beach vacations or long weekends. This sudden, intense, intermittent pattern of sun exposure heightens melanoma risk.[44,45]

6.10 Vitamin D and coronavirus/COVID-19 disease

The world is currently experiencing an unprecedented pandemic driven by the upper respiratory tract infection due to coronavirus/COVID-19 disease. Researchers and public health agencies, in addition to developing effective treatments and vaccines are seeking to identify lifestyle factors that can assist in reducing the burden of disease and mortality from COVID-19. Many people, particularly those living in northern latitudes: UK, Northern Europe, Canada, northern parts of the USA, northern India and China have poor vitamin D status, especially in winter or if confined indoors. These regions of the world are among those which have experienced the greatest number of cases of COVID-19, predominantly during the winter months. The importance of maintaining adequate vitamin D status in these countries is reflected in their government health recommendations which advise taking a vitamin D supplement over winter or if confined indoors to assist in maintaining an adequate immune response. [46]

A large cross-sectional study of the US population reported that upper respiratory infections were higher in those with lower vitamin D status. This was particularly evident in those with asthma and chronic obstructive pulmonary disease. [47] Lower vitamin D status is associated with acute respiratory tract infections. [48] A recent metanalysis using data from 361,934 participants showed that vitamin D deficiency or insufficiency was associated with an increased risk of developing COVID-19 and that COVID-19-positive individuals had lower vitamin D levels than COVID-19-negative individuals.[49]

Over the previous winter(2020), those living in Melbourne experienced one of the longest and harshest lockdowns in the world, confining them indoors for most of the day. Many, particularly those living in apartments would have had severely limited access to sunlight, when both time outside and distance from home during winter was restricted. This is likely to have negatively impacted on their vitamin D status, increasing the likelihood of developing vitamin D deficiency. Many people living in Melbourne utilised parks for exercise during lockdown and those parks that facilitated exposure to winter sunlight are likely to have reduced the risk of developing vitamin D deficiency. Given that adequate vitamin D status is required to mount a robust immune response to viruses including COVID-19, and that short burst of exposure to sunlight can improve vitamin D status, it is important that sufficient open spaces with access to sunlight throughout the day are available, particularly in winter for those living and working in urbanised environments.

6.11 Additional benefits of sun exposure (independent of vitamin D)

There is an emerging body of research indicating that exposure to sunlight-derived wavelengths including ultraviolet, blue, red, infrared and near infrared result in favourable metabolic and anti-inflammatory effects. In animal models, red and near infrared wavelengths appear to have beneficial effects on a number of diseases including allergy, cancer, cardiovascular disease, diabetes, eye diseases, pain, blood pressure, depression and wound healing. It has been hypothesised that exposure to natural sources of these wavelengths could have a wide variety of positive health effects.[50]

A recent review revealed that almost all epidemiological studies suggest that chronic (not intermittent) sun exposure is associated with a reduced risk of colorectal-, breast-, prostate cancer and non-Hodgkin's lymphoma.[51] In separate analyses Increased sunlight exposure has been associated with reduced risk of colorectal cancer, breast cancer, multiple sclerosis, hypertension, cardiovascular disease, metabolic syndrome and type 2 diabetes, non-alcoholic fatty liver disease, depression, myopia and macular degeneration. [38,52]

Sunlight deprivation has been associated with depression. In the winter this can cause, for those who are susceptible, seasonal affective disorder (SAD).[53] People have a feeling of well-being when exposed to sunlight which has been found to be related to the production of increase serum beta-endorphin levels. Beta-endorphin, a neurohormone is also released in the human body by exercise, producing a feeling of well-being similar to the feeling of well-being induced by sun exposure. In addition to this, the prevailing amount of sunlight affects brain serotonergic activity and underlies mood seasonality and seasonal affective disorder.[54] Deficiencies in serotonin and brain serotonergic activity have been linked to sudden infant death syndrome, seasonal affective disorder, depression, schizophrenia, Alzheimer disease and migraine headaches. [43,52]

In summary there is a substantial body of evidence that regular short intervals of exposure to sunlight improve health and prevent against common diseases, although the exact mechanisms of action have yet to be elucidated.

6.13 References

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7 DECLARATION STATEMENT

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.

Professor Caryl Nowson

8 APPENDIX A: CURRICULUM VITAE: with specific reference to vitamin D

8.1 Contact Details

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8.2 ACADEMIC QUALIFICATIONS

1994 **Diploma of Evaluation**, University of Melbourne
1990 **Doctor of Philosophy (Physiology)**, University of Melbourne
1985 **Diploma of Education**, University of Melbourne
1980 **Diploma of Nutrition & Dietetics**, University of Sydney
1979 **Bachelor of Science (Nutrition)**, Deakin University

8.3 Current Position

Emeritus Professor 2019 – current
Institute of Physical Activity and Nutrition
School of Exercise and Nutrition Sciences, Deakin University

8.3.1 Peer Recognition

I received the prestigious Fellow of Nutrition Society of Australia (NSA) award in 2016 in recognition of my outstanding contribution to nutrition research, having previously received NSA Medal (2010), bestowed upon Australian scientists with an outstanding track record in the field of animal or human nutrition.

8.4 NATIONAL AND INTERNATIONALLY RECOGNISED EXPERTISE ON VITAMIN D

In 2001 I completed a review on: Vitamin D status of Australians: impact of changes to mandatory fortification with vitamin D for the Australian and New Zealand Food Authority. A summary of which was published in the Medical Journal of Australia.[55] Subsequent to this I provided an expert review for the NH&MRC committee setting the new Recommended Dietary intakes for vitamin D. (2006). I was one of the chief investigators on a large NH&MRC trial of vitamin D supplementation trial, conducted in residential aged care that demonstrated a 30% reduction in in rate of falls and a trend for a similar reduction in fracture.[30]

As member of the scientific committee of Osteoporosis Australia I led, as first author, the key position paper/consensus document: Vitamin D and health in adults in Australia and

New Zealand: a position statement published in the Medical Journal of Australia.[1] I was also a major contributing author to the companion position paper: Vitamin D and health in pregnancy, infants, children and adolescents in Australia and New Zealand: a position statement published in the Medical Journal of Australia.[2] These publications set the policy for vitamin D testing and treatment in Australia. These papers have become the standard reference guidelines for determination of vitamin deficiency in Australia. I also contributed to a previous position paper on vitamin D: Vitamin D and adult bone health in Australia and New Zealand: a position statement.[3]

I have publicised the issue of vitamin D insufficiency in Australia through a number presentations and was the instigator and primary program organizer of joint conference: ILSI SEAR Australasia and the Australian Academy of Science National Committee for Nutrition: "Should Australia and New Zealand allow more Vitamin D into the food supply? (June 2012). This initiative generated significant debate and publicity and resulted in multiple media reporting (17 pages of media hits: TV, radio and print articles) including: Channel 9 Sydney TV Today, Channel 9 Sydney TV morning news, Channel 9 Sydney TV afternoon news, ABC Science online, Top news online, Australia to discuss fortification of milk. This initiative has contributed to the action by the Food Standards Aust. NZ to undertake a food modelling exercise to assess the impact of changing the food regulations to allow the fortification of breakfast cereals with vitamin D in Australia, which was previously prohibited.

8.5 Selected Invited Keynote and Speaker addresses related to vitamin D

1. "Vitamin D: Sun, Food and Supplements" 2nd International Summit on Medical Nutrition Education and Research, Wolfson College, University of Cambridge, UK June 2016
2. "Challenges in meeting vitamin D requirements from dietary sources". Nutrition Society of Australia, Canberra July 2014
3. "Stormy Weather in the Sunny Country: vitamin D deficiency a public health issue" Royal Society of Victoria Sept 2014.
4. Organising Chairperson of the Symposium "Should Australia and New Zealand allow more vitamin D into the food supply?" ISLI, Australia Academy Sciences, June 2012.
5. "Vitamin D current issues and controversies": Allied Health and Medical Professional Development session. Kingston Centre, Melbourne Dec 2010
6. Plenary Presentation. "Salt and Iodine: reluctant partners" Nutrition Society of Australia National Conference, Perth, December 2010
7. "Vitamin D: current intakes and implications for childhood: " Vitamin D in Pregnancy, lactation and childhood conference, Massey University, Auckland Nov 2010.
8. Plenary Presentation: "Calcium, Vitamin D and Salt in reducing hypertension, stroke and osteoporosis." Functional Foods Conference Auckland, Nov 2010
9. "Nutritional factors to reduce risk of Osteoporosis and Fracture" "Living to 100" Centenarians Conference Sydney Nov 2010
10. "Salt and Iodine" Nutrition Society of Australia (Queensland Branch). Brisbane, Aug 2010.

11. "Reducing Risk of Osteoporosis and Fracture" Eastern Metropolitan Region, Department of Health, HACC Big Day Out, Wellness Conference. Melbourne. May 2010.
12. "Vitamin D: current intakes and implications" Dietary fats: the science, the message and advocacy. Dietitians Assoc. Aust. 28th National Conference Melbourne May 2010
13. "Lifestyle preventative strategies to reduce osteoporosis and fracture" Human Nutrition Research, Elsie Widdowson Laboratory, Cambridge Medical Research Council, Cambridge UK 2009.
14. "Dietary calcium, vitamin D status and fracture" Rank forum on vitamin D. University of Surrey, UK 2009.

8.6 Key Professional, Policy Activities

I was deputy chair of the National Committee for Nutrition, Australian Academy of Science (08-15), during which time I initiated and contributed three, one day seminars on key topical issues: iodine fortification of the food supply, salt reduction of the food supply and vitamin D fortification of the food supply.

8.7 Contribution to Peer Review process

I am a member of review panels for over 30 international peer-reviewed journals and regular reviewer for several key funding agencies including: NHMRC Project Grants/Fellowships, National Heart Foundation, Health Research Council NZ, Canadian Institutes of Health Research, Dairy Australia, Brewers' Foundation, Alzheimer's Australia Dementia Grants Program, New Zealand Research Council, and the Danish Medical Research Council.

8.7.1 Other Relevant Professional Activities

Member Editorial board British Medical Journal of Nutrition and Preventive Health (2018-current)
Associate Editor of the Journal of Human Nutrition and Dietetics (UK) (2013 – 2019)
Member Editorial Board of Nutrients (online open access journal) (2009 – 2016)

8.8 AUTHORED PUBLICATIONS RELATED TO VITAMIN D (peer reviewed journals)

1. Miller EG, Nowson CA, Dunstan DW, Kerr DA, Menzies D, Daly RM. Effects of whey protein plus vitamin D supplementation combined with progressive resistance training on glycaemic control, body composition, muscle function and cardiometabolic risk factors in middle-aged and older overweight/obese adults with type 2 diabetes: A 24-week randomized controlled trial. Diabetes Obes Metab. 2020 Dec 23. doi: 10.1111/dom.14299. Epub ahead of print.
2. Foulkes S, Kukuljan S, Nowson CA, Sanders KM, Daly RM. Effects of a multi-modal resistance exercise program and calcium-vitamin D3 fortified milk on blood pressure and blood lipids in middle-aged and older men: secondary analysis of an 18-month

factorial design randomised controlled trial. Eur J Nutr. 2020 Jul 14. doi: 10.1007/s00394-020-02325-x. Epub ahead of print.
3. Matthews J, Torres SJ, Milte CM, Hopkins I, Kukuljan S, Nowson CA, Daly RM. Effects of a multicomponent exercise program combined with calcium-vitamin D3-enriched milk on health-related quality of life and depressive symptoms in older men: secondary analysis of a randomized controlled trial. Eur J Nutr. 2020 Apr;59(3):1081-1091. doi: 10.1007/s00394-019-01969-8. Epub 2019 Apr 16.
4. Malacova E, Cheang PR, Dunlop E, Sherriff J, Lucas RM, Daly RM, **Nowson** CA, Black LJ. Prevalence and predictors of vitamin D deficiency in a nationally representative sample of adults participating in the 2011-2013 Australian Health Survey. Br J Nutr. 2019;121(8):894-904.
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6. Daly RM, Miller EG, Dunstan DW, Kerr DA, Solah V, Menzies D, **Nowson** CA. The effects of progressive resistance training combined with a whey-protein drink and vitamin D supplementation on glycaemic control, body composition and cardiometabolic risk factors in older adults with type 2 diabetes: study protocol for a randomized controlled trial. Trials. 2014;15(1):431.
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9. Paxton GA, Teale GR, **Nowson** CA, Mason RS, McGrath JJ, Thompson MJ, Siafarikas A, Rodda CP, Munns CF, Vitamin D and health in pregnancy, infants, children and adolescents in Australia and New Zealand: a position statement. MJA 2013;198(3); 142-3.
10. **Nowson** CA, McGrath JJ, Ebeling PR, Haikerwal A, Daly RM, Sanders KM, Seibel MJ, Mason RS. Vitamin D and health in adults in Australia and New Zealand: a position statement. MJA. 2012 ;196(11):686-7.
11. Winzenberg T, van der Mei I, Mason RS, **Nowson C,** Jones G. Vitamin D and the musculoskeletal health of older adults. Aust Fam Physician. 2012;41(3):92-9.
12. Renzaho A, **Nowson C,** Kaur A, Halliday JA, Fong D, Desilva J. Prevalence of vitamin D insufficiency and risk factors for type 2 diabetes and cardiovascular disease among African migrant and refugee adults in Melbourne: a pilot study. Asia Pac J Clin Nutr 2011;20(3):397-403.
13. Renzaho AM, Halliday JA, **Nowson** C. Vitamin D, obesity, and obesity-related chronic disease among ethnic minorities: a systematic review. Nutrition 2011;27(9):868-79.
14. Ducher G, Kukuljan S, Hill B, Garnham AP, **Nowson** S, Kimlin MG, Cook J. Vitamin D Status and Musculoskeletal Health in Adolescent Male Ballet Dancers. J Dance Med Sci 2011;15(3): 99-107.
15. Peake JM, Kukuljan S, **Nowson** CA, Sanders K, Daly RM. Inflammatory cytokine responses to progressive resistance training and supplementation with fortified milk in men aged 50+ years: an 18-month randomized controlled trial. Eur J Appl Physiol. 2011;107(6):1864-73
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Structure and Strength in Older Men: An 18-Month Factorial Design Randomized Controlled Trial. J Clin Endocrinol Metab. 2011;96(4):955-63.
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20. Daly RM, **Nowson** CA. Long-term effect of calcium-vitamin D3 fortified milk on blood pressure and serum lipid concentrations in healthy older men. Eur J Clin Nutr 2009; 63(8):993-1000
21. Grieger JA, **Nowson** CA. Calcium, folate and vitamin D3 fortified milk improves nutritional status, but not bone mass or turnover in a group of Australian aged care residents. J Nutr Elder 2009;28(3):236-254
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23. Grieger JA, **Nowson** CA, Jarman H, Malon R, Ackland L. Effect of multivitamin on vitamin D status and heel ultrasound bone density in Australian aged care residents. Nutritional Aspects of Osteoporosis, Serona Symposia, USA, edited Burckhardt P, Dawson-Hughes, B, Heaney R. Spinger-Verlag, New York, International Congress Series 1297(2007)109-119.
24. Tang BMP, Eslick GD, **Nowson** C, Smith C, Bensoussan A. Use of calcium or calcium in combination with vitamin D supplementation to prevent fractures and bone loss in people aged 50 years and older: a metanalysis. Lancet 2007;370(9588):657-66.
25. Daly RM, Bass S, **Nowson** C. Long-term effects of calcium-vitamin-D(3)-fortified milk on bone geometry and strength in older men. Bone. 2006;39(4):946-53.
26. **Nowson** CA. Vitamin D Status of Australians (editorial). J Nutr Dietetics 2006:63:194-195.
27. Daly RM, Brown M, Bass A, Kukuljan S, **Nowson** C. Calcium and Vitamin D3 Fortified Milk Reduces Bone Loss at Clinically Relevant Skeletal Sites in Older Men: A 2-year Randomised Controlled Trial. J Bone Min Res 2006;21:397-405.
28. Flicker L, MacInnes RJ, Stein MS, Scherer SC, **Nowson** CA, Thomas J, Lowndes C, Hopper JL, Wark JD. Should older people in residential care receive vitamin D to prevent fall? Results from a randomized trial. J Am Geriatr Soc. 2005; 53:1881-8.
29. Working Group of the Australian and New Zealand Bone and Mineral Society, Endocrine Society of Australia and Osteoporosis Australia. Diamond, Eisman, JA, Mason, RS, **Nowson**, CA, Pasco JA, Sambrook, PN, Wark JD. Vitamin D and adult bone health in Australia and New Zealand: a position statement. MJA 2005; 182 (6):281-285.
30. **Nowson** C, Diamond T, Pasco J, Mason R, Sambrook P, Eisman J.: Vitamin D in Australia. Issues and recommendations. Aust Fam Physician 2004, 33:1-6.

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