

VITAMIN D DEFICIENCY - ISSUES AND RECOMMENDATIONS

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ABSTRACT

Vitamin D deficiency has become a common problem for many individuals not only in Australia, but it is also a worldwide health problem as it is accumulatively linked to a variety of diseases across all age groups and diverse biological and environmental determinants. In developed and developing countries, vitamin D deficiency situation is likely different due to social norm and behavioural determinants rather than the shortage of health service support. In the light of this paper, the situation of vitamin D deficiency in high-risk groups as well as certain reasons for the occurrent situation in developed countries in which the paper explore and collect data from an example of Australia.

I. INTRODUCTION

Vitamin D is a remarkably element for mineral metabolism, skeletal health, bone development, and muscle function. While the major determinant of the vitamin D level in human body relies on the skin absorption with direct sunlight, the less amount of vitamin D can still be supplied through dairy. Vitamin D deficiency is defined as the fall of serum 25-OHD concentration of ≤ 25 nmol/L and insufficiency as 26-50 nmol/L.

Vitamin D deficiency has become a common problem for many individuals not only in Australia, but it is also a worldwide health problem as it is accumulatively linked

to a variety of diseases across all age groups and diverse biological and environmental determinants. There are three levels of key evidence for the association of vitamin D deficiency and diseases. The strongest evidence supports that having insufficient concentration of vitamin D has been proven to have significant association with bone diseases like rickets, low bone mass and osteoporosis, muscle weakness, falls and fractures. Among those who had insufficient vitamin D level, there were 84.29% female and 88.9% male aged 50 years and above had low bone mass with the p-value <0.01 as well as 85% osteoporosis and 14% of elderly group had hip fractures and significant reoccurrence of rickets in children. Second level of key evidence stands with the relationship between insulin resistance and the deficiency.

Less consisting evidence supports that vitamin D deficiency can be considered as a risk factor for autoimmune diseases, cancers, and ability to combat infections. People who had vitamin D deficiency were more likely to catch upper tract respiratory infections (URTI) by 1.36 times higher than those who with normal vitamin D level and 5 times higher if asthma and obstructive pulmonary disease were taken into account.

II. METHOD

The approach of vitamin D deficiency situation and their rising issues and recommendations experienced from developed nations is conducted with literature review as the first step to collect

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Date of receipt: 12/8/2024

Date of scientific judgment: 16/9/2024

Reviewed date: 14/10/2024

evidence regarding the subjected situation. We take an example of Australia to collect data based on keywords such as vitamin D deficiency prevalence, vitamin D deficiency situation, in developed and growing countries, the relationship between vitamin D deficiency and bone health, vitamin D deficiency in high-risk groups, recommendations for vitamin D deficiency prevention. Then the results will be sorted by years of paper publications. The most current and close to keywords, the more likely the data will be selected. Then we choose data from these selected papers and categorized them into groups so that data will be explored and proven to discuss and conclude. The resource of data was Google Scholar and PubMed as well as other Open Access Journals.

III. DISCUSSION

1. Is Vitamin D deficiency an Australian Public Health issue?

The prevalence of vitamin D deficiency may vary in different studies but must be higher than previous thought. In general, the majority of Australian adults had insufficient level of vitamin D in 2011-2012 and 23% adults had vitamin D deficiency and it was estimated that there were more than 4 million adults compared to 15% in the previous studies. Additionally, the recent reports have addressed that younger adults aged between 18-39 are more likely to be vitamin D deficiency than the elderly.

Critically, vitamin D test rates increased sharply from 40.6 tests per 100,000 people in 2000 to 3472.2 tests in 2011 that resulted to a significant growth in health expenditure by 94.6 million within 1 decade in Australia. Among this, the overall health costs were reported to be 39% higher in vitamin D

deficiency group with the significant increase in service utilization. The occurrence of increasing number of vitamin D deficiency in working-age population indicates a burden on economics, health expenditure, life lost and quality of life in Australia.

2. Vitamin D deficiency in high-risk groups

The greatest high-risk groups are stated among those with limited sun exposure. It typically occurs to nearly 80% of darker skin inhabitants or who get their skin covered for medical, cultural or religion purposes, and elderly because vitamin D synthesis is reduced due to lack of melanin, covering clothing, and lack of substrate 7-dehydrocholesterol, respectively. Particularly, those who wear veils are 21.7 times higher getting vitamin D deficiency than those who wear normal clothes. Reasonably, white-collar workers are 1.5 times more at threat of having low level of vitamin D than blue-collar workers. In addition, the rates of deficiency are 2.6 times lower in summer compared to winter across states which would make seasonal variations more critical than latitude.

In the light of recent evidence, behavioural determinants such as smoking, physical activity, taking supplement are also as important as environmental factors. People who have low level of physical activity or inactivity face the risk of being vitamin D deficiency nearly twice than those who conduct physical activity through leisure, work or transport more often at vigorous or moderate level. While people who have committed with some of the health risk factors such as smoking and physical inactivity are 28% and 26% more likely to be vitamin D deficiency than those who do not carry these risk behaviours, there is,

however, no solid evidence for the connection between obese and deficiency.

With this background, vitamin D deficiency can be easily classified not only in a large proportion of the Australian population but also is highly reported in children, adults and elderly. The prevalence of deficiency cases has grown from 15% of Australian population to 23.5% in 2000 and then 58% in 2014 which is nearly 4 times higher. No one is immune from the deficiency epidemic, yet it is unrecognized except when the person is diagnosed with resulted health consequences.

3. Vitamin D deficiency and bone health

Facing the widespread of the deficient vitamin D epidemic in Australia, a strategy was implemented not only in high-risk groups but also a broader population through 4 tiers of prevention. Many studies have proven the crucial association between vitamin D deficiency and burden of skeletal diseases across age groups. Particularly, the rates of falls and hip fractures increased by 42% in the elderly which put a weight to morbidity and health care costs as it was reported that Australia had faced the issue of ageing population with 90% of health expenditure per person in a lifetime was spent on aged care. Moreover, there is evidence of the greater proportion of vitamin D deficiency in children, adolescent and adult compared to older population with a burden of skeletal and non-skeletal disease negatively effecting the young generation.

In the light of the issue, health promotion has been conducted to raise the knowledge of sunlight and vitamin D benefits in the general population. For instance, people are recommended to expose face and upper limbs for 5 to 15 minutes to sunlight in the frequent of 4 to 6 times per week or

alternatively take at least 400IU of vitamin D supplements per day. In the concept of primary prevention, education, sun bath and vitamin D supplements have been applied to the high-risk groups. For instance, sun bath and taking vitamin D supplements are regularly recommended for pregnant women, breastfed infants, toddlers, and adolescent, and even double dose for housebound elderly. Secondary and tertiary preventions have also been effectively applied through screening tests and supplementation treatment which minimizing the misclassification and negative outcomes. As a result, the outcomes are quite promising such as the reduction of 15% and 20% in risk of falls and morbidity in elderly respectively as well as the improvement of 50% in public awareness. In addition, the remarkable cost effectiveness achieves per year of life saved (YoLS) was AU\$8,968 per individual that has partly relieve the weight on health expenditure and life lost cost.

4. Vitamin D deficiency and non-skeletal diseases

In the concept of public health issue, there has been no study reviewing the effectiveness of 3 stages of vitamin D deficiency prevention against non-skeletal diseases in Australia although the causal mechanism of low vitamin D level and the diseases was reported in recent studies. Additionally, the association of insufficient vitamin D status and a number of chronic diseases especially among older adults such as cardiovascular diseases (CVD), microbial infections, some cancers, diabetes, muscle function, and mental illness, yet inconsistent and mixed evidence stands with this connection. The possible reason to solve the dilemma in addressing the causal connection is confounders. For instance, a few studies

with less significance suggesting a protective effect of vitamin D against CVD confounding by many factors such as obesity, sun exposure, physical activity, and nutrition. Similarity with other chronic diseases, mixed and inconsistent results were found in some observational and randomized control trial studies regarding to the possible connections.

According to Manson et al 2012 and other reliable resources, there was a complex mechanisms of vitamin D involved in reducing the risk of mortality due to the non-skeletal illness. Therefore, supplementation is prescribed in patients who admits with any or mix of the mentioned chronic diseases with a greater rates of vitamin D used among 12%, 10% and 18% of patients diagnosed with diabetes, heart disease and osteoporosis compared with 5% of all adults. It was also reported that sufficient vitamin D level would reduce 70% chance of death from colorectal cancer as well as life costs from tuberculosis, upper tract infections, breast, and prostate cancer.

As education and prevention has improved the awareness of public in vitamin D benefits and dramatical consequences of vitamin D deficiency, people who are free of diseases are also more likely to have their vitamin D level check-up and take vitamin D supplements regularly. Consequently, the footprint of intervention has put a remarkable impact not only on high-risk groups but also on the general population with the supported data of 80% Australian population awareness improvement and 25% increase in vitamin D supplementation.

5. Raising controversies

In the contrast of effectiveness, there has been some critical public concerns such as over-testing and over-diagnosis as well as

rising trend of unnecessary taking vitamin D supplements. As people are more aware of the benefits of vitamin D and resulted diseases from the deficiency, they intend to take supplements more often that consequently leading to inappropriate supplementation and risk of toxicity. According to Bilinski and Talbot in 2014, health cost for plain vitamin D supplements was 32.4 million per year, plus the unmeasurable side effects of vitamin D overdose. Moreover, the unnecessary screening tests has increased by 59% each year for the past decade and 58% of those who take the test has been ordered unnecessary repeated tests with uncertainty of health improvement. Certainly, people questioned the correlation of the increase in screening test and vitamin D deficiency improvement. In the concept of health economics, these concerns are reasonable and possibly go along with the Australian current pressure on health expenditure.

Another public argument is about the benefit of sunlight exposure due to a number of recent data revealing the side effects of sun bath towards skin cancer and gene mutations. Questions and doubts have been raised against advantages and severe drawbacks of ultraviolet light which is known to be risk factor of multiple gene change and skin cancers. Furthermore, guidelines to sunlight exposure recommendation for pregnant women, toddlers and adults are complexed and unclear.

Interestingly, the insistence of vitamin D deficiency epidemic in Australia has been doubted by many professionals. To avoid misclassification, the cutoff point of deficient vitamin D was changed to ≤ 50 nmol/L which directly raise the prevalence of the deficiency

in Australia 5 times higher across age groups, genders, and ethnics as well as indirectly put a weight on screening tests and supplement recommendation. Nevertheless, conclusions from a 2011 consensus conference even proposed to raise the 25OHD sufficient level to above 75nmol/L which then would include more people from the healthy population in the insufficient vitamin D status group as well as elevating the rates of testing and supplement recommendation. Again, the argument is worth to be considered at a population level because it would influence the trend of financial flow and public perception.

IV. CONCLUSION

This is unarguable how significant the vitamin D deficiency prevention in Australia has achieved over the last 3 decades. However, there are certain issues and limitation which considerably have been put on recent public concerns and arguments.

Firstly, in terms of public concern about the side effect of sunlight exposure, specific guidelines for different sub-groups such as pregnant women, elderly, toddlers, and adolescent are recommended. Accordingly, the efficiency of absorbing vitamin D through sunlight exposure also varies to season, latitude, and working conditions including white-collar and blue-collar workers, winter and spring, closer or further to the equator. Therefore, there should be further observational and experimental studies about the difference of sunlight effect and vitamin D deficiency in various subgroups and then systematic review to develop a national approved guideline with specific recommendation of sunlight exposure duration and frequency for each target population to ensure greatest

effectiveness and safety for Australian population.

Secondly, regarding to unnecessary screening tests, a guideline of screening test recommendation should be scientifically reviewed and constructed to warrant that each patient deserves to have appropriate and only necessary ordered tests. Recently, there has been uncertain that either the second test should follow by 8 weeks or 3 months after the first screening test as well as limitation of 3 or more tests per person per year. Because of this, clinicians are confused and influenced by capitation and supply-induced-demand in the concept of health economics in which doctors are more likely to over or under prescribe and order tests depending on their income desirability and Medicare restrain. Therefore, the health authorisations should apply a guideline for screening tests to warrant the welfare and safety of patients and control economic factors effecting on doctors.

Thirdly, although vitamin D supplements are recommended for deficiency treatment, but not only high-risk patients but also free-of-disease individuals take vitamin D supplementation regularly with or without screening tests and doctor prescription. As suggestion, further research in toxicology and health related outcomes of over-dosed vitamin D concentration should be conducted to effectively construct vitamin D supplementation guidelines for individual sub-groups and to monitor the control and supply demand policy relating to vitamin D product.

At last, public awareness has not been equally and efficiently provided to all ethnic populations. The knowledge of vitamin D deficiency as well as sunlight and vitamin D benefits dramatically vary and relatively related to latitude, educational level, ethnics.

Specifically, 80 % of Australian population are alerted with vitamin D benefits but 78% of them hardly able to name the deficiency's consequences. In similarity to Asian, Mediterranean ethnic population in Australia, their trend of having low knowledge, attitude and practice toward sunlight benefits because of cultural and religious reasons, as a result, their risk of being vitamin D deficiency is higher than Australian and British populations. There is also a gap between providing health promotion and implementing screening and treatment prevention among Aboriginal and Torres Strait Islander population as the prevalence of vitamin D deficiency is higher and more severe in these groups than non-aboriginals. For these reasons, to fill the gap and reach over the equality between ethnic populations, the efforts from not only Australian government and authorities but also from non-profit organisations, international associations are required to build a healthier and safer environment for public in the concepts of ethics, welfare, health, and effective economic investment.

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