SCIENCE & MEDICINE

VITAMIN D GUIDELINES 2017

EXECUTIVE SUMMARY

These guidelines have been assembled by an ECB Medical Panel comprising appointed Chief Medical Officers of the English Cricket Board and certain 1st class counties. Within this group we have been able to call upon specialist knowledge from Professor Cathy Speed and been able to refer to similar guidelines published by clinicians of sister sporting organisations such as the English Institute of Sport (Newton, 2013).

Members of the advisory committee were: Dr Jon Houghton, Prof Bill Ribbans, Dr Tham Wedatilake, Dr Nick Peirce, Chris Rosimus.

In addition, recent government recommendations have resulted in a significant reinforcement of the necessity to consider vitamin D checks and supplementation across the whole population. The key development to note is for maintenance dosing for cricketers remaining in the UK over the winter period.

Already cricketers centrally contracted to the ECB and a number of 1st class counties screen serum Vitamin D levels albeit often on an ad hoc basis. It is hoped that going forward these findings will be part of each player's medical profile and will allow long-term monitoring and analysis of the effect of maintaining adequate Vitamin D levels on various aspects of the player's health.

VITAMIN D SCREENING PROTOCOL

WHEN TO SCREEN

Each player should have a baseline screening to determine their potential for deficiency. If they achieve a high value, then further screening may not be necessary. However, there are seasonal variations and as such the gold standard care would involve repeated annual screenings at one or both of the following times:

A. Prior to Winter season in September

B. Prior to summer season/end of winter season in March

If annual screening cannot be achieved then players should be screened, at one of the time points above, in their first year of professional cricket and and where feasible every 3 years.

The ideal range for bone health is 75-125 nmols/l and this is assumed for other health parameters.

HOW TO SCREEN

1. Serum 25Hydroxyvitamin D should be measured
2. Given inter-laboratory variation, the same laboratory should be used for each screening period.
3. The laboratory should be registered with DEQAS (www.deqas.org) and should follow NIST standards (www.nist/gov)

INTERPRETATION OF RESULTS

NMOL/L	STATUS
75-175	NORMAL
35-75	INSUFFICIENT
<35	DEFICIENT

PROTOCOL

<35 NMOL/L

Replenishment doses of Pro D3* (cholecalciferol-VitaminD3) as;

i) **50,000 IU per week for 6 weeks**
ii) **25,000 IU twice weekly for 6 weeks**

- Consider medical causes of vitamin D deficiency
- Recheck vitamin D levels & bone profile on completion of 6 week loading course
- Repeat loading doses until replete (>75 nmol/l)
- Discuss with specialist if repeated dosing ineffective

35-75 NMOL/L

Replenishment doses of ProD3 as;

i) **50,000 IU weekly for 3 weeks or**
ii) **25,000 IU twice weekly for 3 weeks**

- Recheck Vitamin D levels only on completion of 3 week loading dose
- Repeat loading doses until replete (>75nmol/l)

>75 NMOL/L

- Use standard dietary sources of Vitamin D between May – August
- Use standard dietary sources of Vitamin D between September – April if touring overseas in countries with high levels of sunlight
- Use maintenance doses of Pro D3 between September – April if remaining in UK or risk factors such as ethnicity, recurrent illness/ infection, fatigue, UPS, recurrent injury;

i) **1,000 IU daily or**
ii) **20,000 IU monthly**

RESULT DOCUMENTATION

- Screening results should be seen and actioned on by the respective CMO
- Results should be entered on profiler/(ECB injury records system)
- Results should be available for ECB audit purposes

QUALITY ASSURANCE

If following the advice of these guidelines, vitamin D supplements should be obtained from the sources recommended in vitamin D supplementation protocol (figure 1).

Healthspan Elite and Synergy Biologics as both ProD3 and ProD3 sport 4k have been HFL tested for the absence of WADA prohibited substances.

If unable to obtain these however, normal sources from pharmacies or health shops are available. However, these are routinely lower doses in line with previous recommended daily allowance, and are not routinely batch tested. Therefore, if considering their use, they should be checked against Global Dro (http://www.globaldro.com/home/index) to ensure the ingredients are permissible within cricket.

DIETARY INTAKE

Most foods contain little vitamin D with a few exceptions such as, fatty fish, egg yolks and cheese (Janice Thompson, 2014). As a result, our primary source of vitamin D intake is from fortified foods such as milk, cereals and yogurt (Janice Thompson, 2014).

While dietary intake cannot supplement sufficiently to cover deficiencies there are some important sources of dietary supplementation that should be promoted in the normal population as well as within cricketers. These sources are summarised in figure 2.

FIGURE 1

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VITAMIN D SUPPLEMENTATION PROTOCOL

STATUS	SERUM LEVELS	SUPPLEMENTATION	DURATION
NORMAL	>75 NMOL/L	1000 IU PER DAY	WINTER MONTHS
INSUFFICIENT	35-75 NMOL/L	25,000 IU 2 X PER WEEK	3 WEEKS
DEFICIENT	<35 NMOL/L	25,000 IU 2 X PER WEEK	6 WEEKS

STATUS	SUPPLEMENTATION	DURATION
STRESS FRACTURE	25,000 IU 2 X PER WEEK	THREE MONTHS

PREFERRED SUPPLIERS

INFORMED-SPORT.com

HEALTHSPAN ELITE

1000 IU & 4000 IU

http://www.healthspan.co.uk/elite/elite-high-strength-vitamin-d3

http://www.healthspan.co.uk/elite/vitamin-d3-4000iu

SYNERGY BIOLOGICS

1000 IU, 2500 IU,
10,000 IU & 20,000 IU

http://www.prod3.co.uk

INCREASING VITAMIN D LEVELS

FIGURE 2

Bone is a living organism that requires high quality nutrition to ensure optimum bone heath. If you present with low vitamin D levels, the following nutrition advice will help you restore your vitamin D status.

EAT FOODS RICH IN VITAMIN D

DAILY

1-2 X PER WEEK

ANYTIME

DID YOU KNOW?

- 1 pint of milk provides your daily calcium requirement.
- Along with vitamin D, calcium is essential for bone health.
- Aim to drink at least 1 pint of milk per day.

- Alcohol & smoking can significantly reduce calcium and vitamin D absorption.
- Smoking significantly increases the risk of nonunion of fractures.
- 0.5 - 1.5 units of alcohol per day has been shown to reduce bone density.

STRESS FRACTURES & VITAMIN D

Research has linked vitamin D deficiency to stress and insufficiency fractures, as well as the decrease in muscle recovery, function and athletic performance (Fishman, 2016). This is due to the relationship between vitamin D deficiency and loss of bone mass, leading to a disease called Osteomalacia, 'soft bones', making an individual more prone to stress fractures. Players with inadequate levels of vitamin D and with higher risk for stress fractures should be educated on the benefits of supplementation, particularly if increased exercise is planned during winter months when vitamin D stores are at their lowest (McCabe, 2012). A Protocol for cricketers with stress reactions/ fractures can be found in figure 1, which should be followed.

All individuals with a stress fracture should be routinely checked for Vitamin D status, together with a full bone health screen where possible.

In the event of a cricketer having a stress reaction/fracture:

A. Routinely check vitamin-d level together with a full bone health screen
B. Supplement with an aim of Vitamin-D level >100nmol/l - ***25,000 IU 2x per week***
C. Re-check vitamin D in 6 weeks and continue to supplement until the Vitamin-D level >100nmol/l

TOXICITY

The risk of an individual experiencing vitamin D toxicity is a lot lower than vitamin D deficiency (Nutrition,2016). This is because you cannot gain a toxic dose from sunlight exposure, as cutaneous vitamin D synthesis is regulated so that excessive production cannot occur (Nutrition, 2016). However, vitamin D intakes have been shown to have toxic effects which can lead to hypercalcemia, the deposition of calcium in soft tissues (Nutrition, 2016). Symptoms of hypercalcemia include weakness, mental confusion and increase in bone loss, all of which will have negative effect on a cricketer's performance. As a result, these guidelines recommend annual screenings so that when a normal vitamin D status is reached (>75NMOL/L) supplementation is adapted to a maintenance dose to ensure toxicity levels are not reached (see figure 1).

In the event of a Vitamin D result: >175 nmol/l

1. Discontinue any vitamin D and calcium supplements
2. Screen for symptoms of hypercalcaemia (e.g abdominal pain, nausea, dehydration, polyuria, constipation, kidney stones) - If present seek immediate medical attention
3. Check bone profile, renal function – If any problems with renal function or calcium level seek immediate medical attention
4. Re-check Vitamin D in 4 weeks- if persistently elevated seek medical advice

GENDER & ETHNICITY RISK FACTORS

There is no evidence to suggest that vitamin D levels should vary between males and females, and therefore they should follow the same supplementation protocol. However, research shows that there is a relationship between ethnicity and Vitamin D. Studies of human skin have revealed that there is no significant difference in the number of melanocytes in different skin types (Astner, 2003). However, the differences in skin colour are based on the rate at which melanosome organelles produce mature melanin, the pigment that gives human skin its colour (Astner, 2003).

Doctor Fitzpatrick (2003) therefore created the Fitzpatrick skin scale, made up of six different phenotypes, to explain their reaction to sun exposure, and therefore vitamin D. Phototype 1 is an individual that burns easily, never tans, and unexposed skin is found to be ivory white. The other extreme, phototype 6, is an individual that never burns and becomes an intense brown colour with exposure, and their unexposed skin colour is that of a dark brown or black (Astner, 2003). As a result, those with phototype one skin are likely to synthesise higher amounts of vitamin D when compared to those individuals with phototype 6 skin types (Astner, 2003).

Table 1 clearly shows this relationship within an English population (Nutrition, 2016). As a result, those players within the ethnic groups at higher risk of vitamin D deficiency should be more vigorously screened and monitored with an emphasis on the negative effects of deficiency and proactive supplementation.

Health Survey for England 2010					
Serum 25-hydroxyvit D (nmol/l)	**Ethnic Group**				
	White	***Mixed***	***Asian***	***Black***	***Other***
Mean	45.8	(31)	20.5	27.7	(22.4)
Median	43	(24)	15	23	(18)
% below 25 nmol/l	21	(52)	74.8	54.2	(63.9)
Bases (unweighed)	3.548	(25)	135	72	(36)

Table 1: Serum levels by ethnicity within an English population (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/537616/SACN_Vitamin_D_and_Health_report.pdf)

TESTING FOR VITAMIN D

Although there are some companies promoting pin prick testing, at the time of writing of these guidelines, the authors are not aware of the accuracy or validity of these devices. It is recommended, for the time being, that blood testing through established pathology services is undertaken and where possible repeat tests are undertaken through the same institutions. Variations do occur between labs and indeed testing methodology.

BACKGROUND

Vitamin D is obtained primarily from the conversion of its precursors following the action of sunlight, specifically ultraviolet B (UVB) irradiation upon cutaneous tissue, see figure 3. Dietary sources supplement this source but are rarely adequate by themselves due to the causes of a deficiency being multifactorial. In general, the UV index needs to be at a level of 3 or above for significant synthesis of Vitamin D and for a population living at high latitudes. Research shows that despite continuous training peak performance occurs in late summer months when sun exposure is maximal, declining to a low point in winter months (M.Angeline, 2013). For instance, in the United Kingdom, the "Vitamin D winter" may last for six months during which an individual's Vitamin D levels are determined largely by synthesis during the preceding warmer months unless supplemented by dietary additives.

Blood levels defining Vitamin D normality and insufficiency are not standardised amongst various international medical organisations. The Institute of Medicine (IOM,2011) and National Osteoporosis Society (NOS,2013) set levels of insufficiency at <50nmol/L whereas the Endocrine Society sets <75nmol/L as its level of insufficiency (Holick,2011). However, recent DOH guidelines and awareness within sport, including the EIS guidelines, have contributed to the ECB providing the target concentration identified in the protocols above.

When considering the consequences of hypovitaminosis D in sport in relation to prevention and recovery from injury and/or surgery, low levels may potentially impair bone healing. Brinker (2007) reported that 68% of 37 patients investigated for unexplained fracture non-unions were Vitamin D deficient. Low vitamin D independently predict an increased risk of stress fracture (Lappe 2008, Ruohola 2006). Similar problems may be experienced following soft-tissue injury and surgical recovery. Research shows that two thirds of sports service patients undergoing ACL reconstruction are deficient in vitamin D (M.Angeline, 2013). Furthermore, Barker (2011) reported rehabilitation delays following ACL surgery in patients with Vitamin D levels <75 nmol/L.

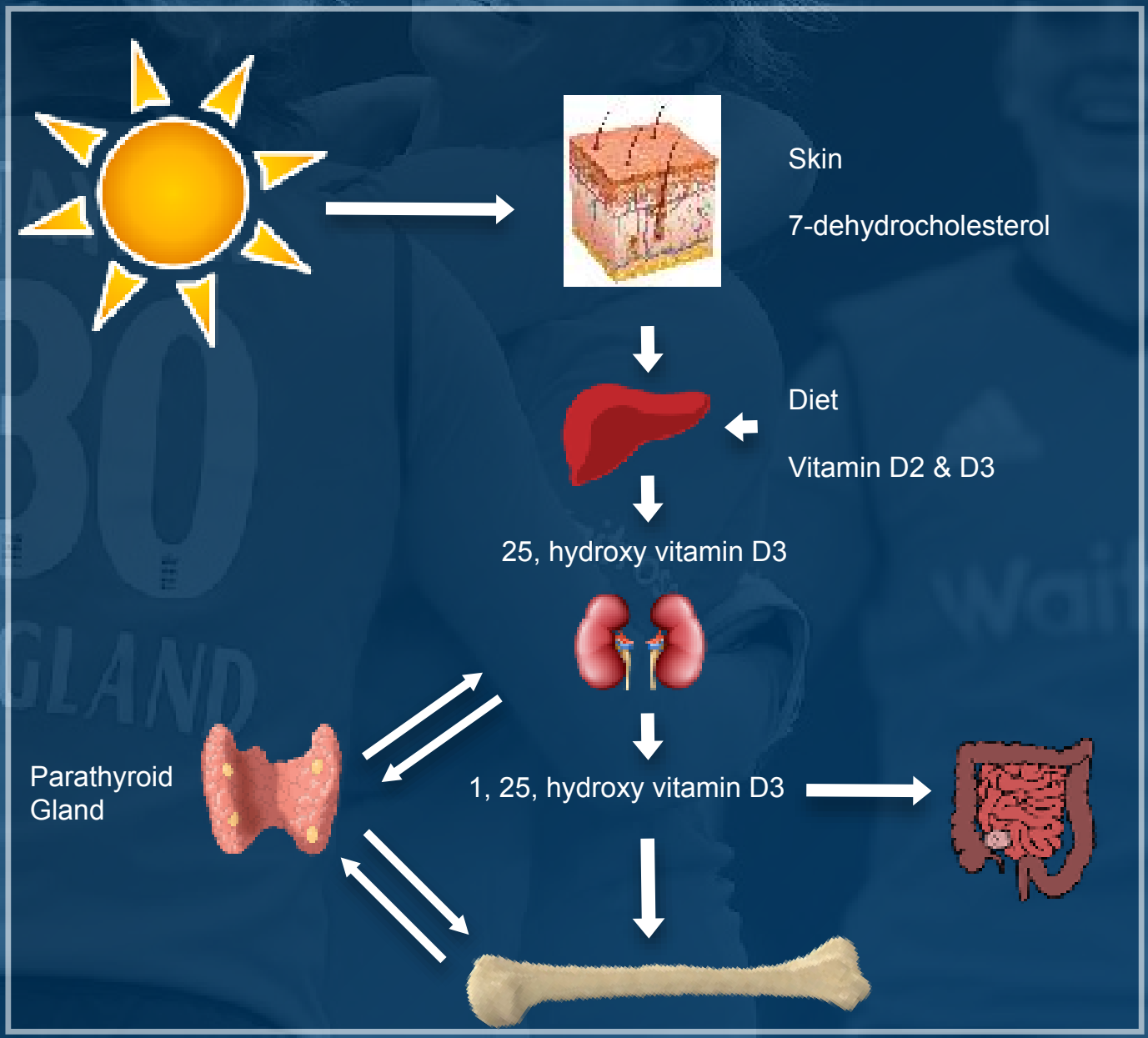

Figure 3: Vitamin D Metabolism Pathway (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/537616/SACN_Vitamin_D_and_Health_report.pdf)

Vitamin D is essential for calcium homeostasis and bone formation principally through its action on promoting calcium absorption in the gut. The consequences of inadequate levels are clearly established leading to secondary hyperparathyroidism and inadequate bone mineralisation. In extreme examples, it can cause rickets in children and Osteomalacia in adults. There are a number of well-recognised benefits of adequate Vitamin D levels apart from optimising bone health. Vitamin D has a role in our immune systems and reducing infection (Wills, 2008; Urashima, 2010), it can aid reducing inflammation (Nagpal, 2005) and affects our perception of pain (Plotnikoff, 2003). In certain groups, it correlates with muscle strength (Mowe, 1999).

Additionally, Vitamin D deficiencies can produce muscle atrophy, weakness (Prineas, Al-Said) and pain (Plotnikoff) and induce neurological changes that can affect rehabilitation post-injury and in the post-operatively period (Tague). As regards athletic performance there is evidence that boosting Vitamin D levels to 100 nmol/L and above is associated with improved musculoskeletal performance (Close, 2012), due to vitamin D being directly related to muscle strength mass and function (M.Angeline, 2013).

TRENDS WITHIN ENGLISH CRICKET

Despite the preconception that cricket is accompanied by prolonged sun exposure, throughout the year many elite cricketers have vitamin D levels below that of the recommended daily allowance. The main cause of this within an athletic population occurs in those who live and train in the northern hemisphere. Furthermore, this may be due to the fact that they wear protective clothing and sun cream, limiting the amount of sun exposure and UVB rays the body requires to synthesis vitamin D (Janice Thompson, 2014).Therefore, a simple example of cricketer's vitamin D trend levels can be seen in table 3 below. These represent ECB senior men's team serum vitamin D levels taken both winter and summer, despite year round northern and southern hemisphere sunlight exposure. Trends are similar to that of a normal population in the UK, with 1 player being deficient and the majority having inadequate amounts.

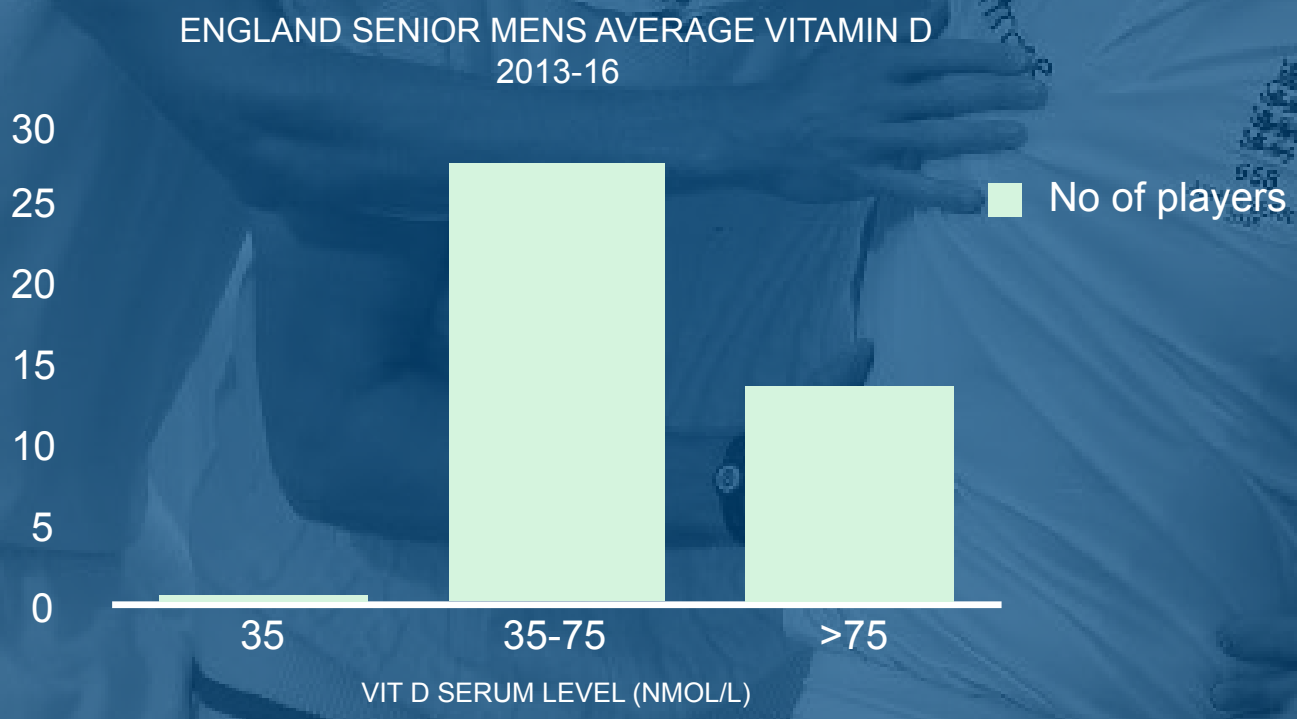

Table 3: A graph to show the average vitamin D status for the England senior men's teams from 2013-2016

GOVERNMENT GUIDELINES

It is recognised that there is a high global prevalence of Vitamin D deficiency with over one billion people worldwide estimated to be affected (Holick,2011). The National Diet and Nutrition Survey demonstrates that up a quarter of the people in the UK have low levels of vitamin D in their blood (Sally C Davies, 2012). This is not the same as having a deficiency but means you are at greater risk of developing a deficiency and its clinical consequences. The young are often affected and Pollock (2012) reported that amongst the United Kingdom 19% of elite athletes had levels below 50 nmol/L and a further 29% between 50-75 nmol/L.

Current guidelines in the United Kingdom were recently updated by the Scientific Advisory Committee on Nutrition (July 2016). The Committee has recommended that everyone over the age of 4 years old should have an RNI (Reference Nutrient Intake) of Vitamin D of 400 iu/day throughout the year.

However, because of the demands of sport, higher levels of Vitamin D supplementation are usually recommended in the athlete, although there are no universally accepted guidelines for screening or the optimal range of levels of circulating Vitamin D to achieve. However, the premise is that in order to optimise recovery and prevention of musculoskeletal injury, as well as promoting other potential benefits, Vitamin D serum levels greater than 75nmol/L (30 ng/mL) should be targeted and can be achieved and maintained via effective use of these guidelines (Shuler, 2012)Sun Exposure (title)

Although a lack of sun exposure of sufficient intensity, duration and area of skin exposure is recognised as a predictor of low vitamin D, there is no place for attempting to raise vitamin D concentrations through it is advised to maintain a excess sun exposure. Therefore a low risk approach for skin cancer through preventing burning, use of sun protection creams and clothing is still advised with the use of vitamin D supplement accordingly.

SUN EXPOSURE

Although a lack of sun exposure of sufficient intensity, duration and area of skin exposure is recognised as a predictor of low vitamin D, there is no place for attempting to raise vitamin D concentrations through it is advised to maintain a excess sun exposure. Therefore a low risk approach for skin cancer through preventing burning, use of sun protection creams and clothing is still advised with the use of vitamin D supplement accordingly.Summary

SUMMARY

There is increasing evidence that baseline serum vitamin D concentrations should be higher than previously advised for a number of health parameters and not just performance, as has been suspected in sportsmen and women for some time. Despite a supposed high exposure to sun through the outdoor environment enjoyed in the game, England cricketers often have a level recognised as insufficient. Furthermore, the winter months may well require supplementation from October to March for those remaining in the UK. These guidelines are designed to provide guidance but appropriate medical expertise should be used to overseas the results and actions.

REFERENCES

Al-Said, Y. a, Al-Rached, H. S., Al-Qahtani, H. a, & Jan, M. M. S. (2009). Severe proximal myopathy with remarkable recovery after vitamin D treatment. The Canadian Journal of Neurological Sciences. Le Journal Canadien Des Sciences Neurologiques, 36(3), 336–9.

Angeline, M. E., Gee, A. O., Shindle, M., Warren, R. F., & Rodeo, S. a. (2013). The effects of vitamin D deficiency in athletes. The American Journal of Sports Medicine, 41(2), 461–4. https://doi.org/10.1177/0363546513475787

Astner, S., 2003. Skin Phototypes. The Journal of Investagavtive Dermatology . http://www.jidonline.org/article/S0022-202X(15)30638-2/pdf

Barker, T., Martins, T. B., Hill, H. R., Kjeldsberg, C. R., Trawick, R. H., Weaver, L. K., & Traber, M. G. (2011). Low Vitamin D Impairs Strength Recovery After Anterior Cruciate Ligament Surgery. Journal of Evidence-Based Complementary & Alternative Medicine, 16(0), 201–209. http://doi.org/10.1177/2156587211413768

Close G et al. The effects of Vitamin D3 supplementation on serum total 25[OH]D concentration and physical performance: a randomised dose-response study. Br J Sports Med 2013. 47(11):692-696.

Fishman, M. P., Lombardo, S. J., & Kharrazi, F. D. (2016). Vitamin D Deficiency Among Professional Basketball Players. Orthopaedic Journal of Sports Medicine, 4(7), 2325967116655742. http://doi.org/10.1177/2325967116655742

Francis, R., Aspray, T., Fraser, W., Gittoes, N., Javaid, K., Macdonald, H., & Patel, S. (2013). Vitamin D and Bone Health: A Practical Clinical Guideline for Patient Management. National Osteoporosis Society.

Holick, M. F. (2007). Vitamin D deficiency. The New England Journal of Medicine, 357(3), 266–281. http://doi.org/10.1056/NEJMra070553

Holick, M. F., Binkley, N. C., Bischoff-Ferrari, H. a, Gordon, C. M., Hanley, D. a, Heaney, R. P., … Weaver, C. M. (2011). Evaluation, treatment, and prevention of vitamin D deficiency: an Endocrine Society clinical practice guideline. The Journal of Clinical Endocrinology and Metabolism, 96(7), 1911–30. http://doi.org/10.1210/jc.2011-0385

IOM, I. of M. (US). (2011). Dietary reference intakes for calcium and vitamin d. IOM (Vol. 130).

Janice Thompson, M. M. L. V., 2014. The Science of Nutrition Third Edition. Harlow, Essex: Pearson Education Limited.

Lappe, J., Cullen, D., Haynatzki, G., Recker, R., Ahlf, R., & Thompson, K. (2008). Calcium and vitamin d supplementation decreases incidence of stress fractures in female navy recruits. Journal of Bone and Mineral Research, 23(5), S.741-749. http://doi.org/10.1016/S0162-0908(08)79003-2

McCabe, M. P., Smyth, M. P., & Richardson, D. R. (2012). Current Concept Review: Vitamin D and Stress Fractures. Foot & Ankle International, 33(6), 526–533. http://doi.org/10.3113/FAI.2012.0526

Mowé, M., Haug, E., & Bøhmer, T. (1999). Low serum calcidiol concentration in older adults with reduced muscular function. Journal of the American Geriatrics Society, 47(2), 220–6. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9988294

Nagpal, S., Na, S., & Rathnachalam, R. (2005). Noncalcemic actions of vitamin D receptor ligands. Endocrine Reviews. http://doi.org/10.1210/er.2004-0002

REFERENCES

Newton J, Lewis N. EIS Position stand on the testing and interpretation of Vitamin D levels and prescription of Vitamin D supplements in Elite Sport. English Institute of Sport. Version 2. Published June 2013.

Plotnikoff, G. A., & Quigley, J. M. (2003). Prevalence of Severe Hypovitaminosis D in Patients With Persistent, Nonspecific Musculoskeletal Pain. Mayo Clin Proc, 78, 1463–1470. http://doi.org/10.4065/78.12.1463

Pollock, N., Dijkstra, P., Chakraverty, R., & Hamilton, B. (2012). Low 25(OH) vitamin D concentrations in international UK track and field athletes. South African Journal of Sports Medicine, 24(2), 55–59. Retrieved from http://www.ajol.info/index.php/sasma/article/view/78022

Prineas JW, Mason As, Henson RA. Myopathy in metabolic bone disease. BMJ 1965;1(5441);1034-1036.

Ruohola, J.-P., Laaksi, I., Ylikomi, T., Haataja, R., Mattila, V. M., Sahi, T., … Pihlajamäki, H. (2006). Association Between Serum 25(OH)D Concentrations and Bone Stress Fractures in Finnish Young Men. Journal of Bone and Mineral Research: The Official Journal of the American Society for Bone and Mineral Research, 21(9), S.1483-1488. http://doi.org/10.1359/jbmr.060607

Sally C Davies, T. J. M. M. H. B., 2012. Gov.uk. [Online]
Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213703/dh_132508.pdf

Scientific Advisory Committee on Nutrition. Vitamin D and Health. UK Government. July 2016. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/537616/SACN_Vitamin_D_and_Health_report.pdf

Shuler, F. D., Wingate, M. K., Moore, G. H., & Giangarra, C. (2012). Sports Health Benefits of Vitamin D. Sports Health, 4(6), S.496-501. http://doi.org/10.1177/1941738112461621

Tague, S. E., Clarke, G. L., Winter, M. K., McCarson, K. E., Wright, D. E., & Smith, P. G. (2011). Vitamin D deficiency promotes skeletal muscle hypersensitivity and sensory hyperinnervation. The Journal of Neuroscience: The Official Journal of the Society for Neuroscience, 31(39), 13728–38. http://doi.org/10.1523/JNEUROSCI.3637-11.2011

Urashima, M., Segawa, T., Okazaki, M., Kurihara, M., Wada, Y., & Ida, H. (2010). Randomized trial of vitamin D supplementation to prevent seasonal influenza A in schoolchildren. American Journal of Clinical Nutrition, 91(5), 1255–1260. http://doi.org/10.3945/ajcn.2009.29094

Vitamin D – Advice on supplements for at risk groups. Circular letter from Department of Health. February 2nd, 2012.

Willis, K. S., Peterson, N. J., & Larson-Meyer, D. E. (2008). Should we be concerned about the vitamin D status of athletes? International Journal of Sport Nutrition and Exercise Metabolism.