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Vitamin D Utilization May Improve Military Performance: A Mini-Review

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ABSTRACT

Studies from different regions of the world show that vitamin D deficiency is a common problem across the globe, even in military personnel. Risk factors of this deficiency includes elderly and female population, higher geographical latitudes, winter season, darker skins, low sunlight exposure, diet, and lack of vitamin D supplementation / fortification, although the deficiency in areas with higher sun exposure also has been documented.
We reviewed some of the clinical trials and observations regarding vitamin D deficiency and supplementation. It has been shown that vitamin D deficiency is associated with more acute respiratory tract infections and acute pharyngitis resulting in more days off from training, more bone stress fractures, poor physical performance, and increased risk for suicide.
Clinical trials that utilized supplemental vitamin D shows decreased incidence of stress fractures in female navy recruits, lower incidence of influenza A and lower risk of acute respiratory tract infections, and improved bone density during initial military training, although one systematic review found conflicting data in supplementation with vitamin D for the prevention of acute respiratory infection.
These data opens a window for supplementation with vitamin D in populated military bases to decrease rate of respiratory infection and to minimize stress fractures for better performances; doses used for these purposes ranges from 300 to 1200 IU per day. Further clinical trials of vitamin D supplementation or dietary fortification for these military purposes should be conducted to determine the optimum dose and duration.

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Introduction

Vitamin D_3 also known as cholecalciferol is a fat soluble vitamin which plays many physiologic roles such as skeletal, cardiovascular, immune function, reproductive, mental, cognitive, and metabolic health, and even it affects life expectancy (1-10). Studies from different regions of the world shows that vitamin D deficiency is a common problem across the globe (11-16). Risk factors of this deficiency includes elderly and female population, higher geographical latitudes, winter season, darker skins, low sunlight exposure, diet, smoking, and lack of vitamin D supplementation /fortification, although the deficiency in areas with higher sun exposure also has been documented (4, 10-12, 17). The optimum serum levels for vitamin D_3 considered to be 30 ng/ml (18). Daily consumption of 800 IU vitamin D_3 may bring 97% of the adult population to level of at least 20 ng/ml and

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Table 1. List of the reviewed studies.

Study category	Author(s)	Reference #
Vitamin D status	Bailey BA et al., Andersen NE et al., Lutz LJ et al., Holick MF et al., Mithal A et al., Binkley N et al., Heshmat R et al.,	23 19 20 14 11 12 13
Diabetes	Munger KL et al.,	45
Bone health	Gaffney-stomberg E et al., Lutz LJ et al., Ruohola JP et al., Lappe J et al.,	44 20 3 43
Respiratory system	Maloney SR et al., Laaksi I et al., Laaksi I et al., Science M et al., Camargo CA et al., Urashima M et al., Sabetta JR et al.,	35 37 4 5 15 6 17

about 50% up to the optimum serum levels of 30 ng/ml (18). It has been shown that vitamin D_3 level decreased during military training, and it also have reduced levels in military personnel and veterans (19-23). There are some evidence showing that military family physicians are less likely to supplement vitamin D (24). We reviewed clinical trials and observations regarding vitamin D deficiency and supplementation that could affect military personnel performance.

Sources of Vitamin D

Sunlight exposure and consequently geographical latitude are major determinants for vitamin D3 plasma levels (25, 26). Vitamin D is rare in food but a small number of foods contain vitamin D, including oily fish such as wild-caught salmon, fish oils (ex. cod liver oil), milk and dairy products, and eggs (27-29). In some regions of the world all vitamin D sources are inadequate thus supplementation would be mandatory (29-31).

Studies

We reviewed the literature using Google Scholar search engine with the following key words: vitamin D status, vitamin D supplement, and military. Clinical trials were included in the review. Table 1 shows studies of vitamin D that used in this review.

Acute Respiratory Tract Infections

Respiratory tract infection is a common disease in military camps and up to 18% of recruits become infected during basic training period (32). About 36% of these infections caused by influenza A and B viruses (33).

In a cohort study of 198 healthy adults during a 5 month period, the incidence of acute respiratory infection in otherwise healthy adults with different concentrations of vitamin D was determined. Those with higher concentrations of vitamin D (≥38 ng/ml) had a two-fold reduction in the risk of acute respiratory tract infections and a reduction in the percentages of days ill (17).

A systematic review of 39 clinical trials also showed that low vitamin D status increased the risk of both upper and lower respiratory tract infections (34).

In a study of 800 male military personnel between 18-29 years old in Finland, subjects with lower serum vitamin D_3 concentrations (<40 nmol/L) had significantly more days of absence from duty due to respiratory infection.[4] In a small retrospective study of military personnel with pharyngitis association between low serum vitamin D_3 and increased infection was seen (35).

Similarly a study of 65 military patients with respiratory diseases showed that low vitamin D levels are frequently found in patients with these diseases (36).

In a placebo-controlled double-blinded study of 164 young military men (18-28 years old), subjects were randomly received 400 IU vitamin D3 or placebo for 6 months. After 6 months vitamin D3 levels was significantly higher in treatment group, but absent days albeit less but without significant difference. Authors suggested conducting larger trials with higher doses (37).

Stress Fractures

Stress fractures also known as “march fractures” is a common problem in military recruits with incidences of up to 20% (38). It is more frequent in female recruits and is caused by an imbalance between micro-damage and bone remodeling and repair (38, 39). It has been shown that patients with stress fractures had low vitamin D plasma levels (40). There is some evidence showing that higher vitamin D levels may have a direct relationship with greater muscle strength and reduced incidence of injury (41). Bigger muscles are protective against the disease (38).

A systematic review and meta-analysis of 9 observational studies on lower extremity stress fractures (2634 military personnel) showed that the mean serum vitamin D level was lower in stress fracture cases than in controls at the time of entry into basic training (42).

In a study of 5201 female Navy recruits, calcium plus vitamin D or placebo was given for 8 weeks of training. After reporting stress fractures symptoms radiographic study was done to confirm the diagnosis. It has been shown that the intervention group had a 20% lower incidence of stress fractures than the control group (43).

In a randomized, double-blind, placebo-controlled trial of 243 recruits, subjects received calcium plus vitamin D or placebo during a 9 week training course. At the end of the study, subjects who received supplementation had greater bone mineral density than those who received placebo (44).

Type 1 Diabetes

In a 13 year observational prospective, nested case-control study among US young active duty military personnel, 310 cases of type 1 diabetes was identified which compared to 613 matched controls in regards of vitamin D levels. The study showed that over a follow-up of 5.4 years in non- Hispanic white population, those with higher vitamin D levels (≥100 nmol/L) had a 44% lower risk of developing diabetes than those with lower levels (<75 nmol/L). Authors concluded that lower vitamin D levels may predispose non-Hispanic white adults to the development of type 1 diabetes (45).

Conclusion

Studies showed that in military personnel higher vitamin D levels are associated with less respiratory infections, and lower vitamin D levels are associated with more days of absence from military duty, however supplementation with vitamin D did not decreased absence days significantly (4, 17, 36, 37).

Military recruits with stress fractures had lower vitamin D levels, supplementation with calcium plus vitamin D decreased the incidence of stress fractures and increased bone mineral density in this population (40, 42-44).

Military personnel with higher vitamin D levels had a lower risk of developing type 1 diabetes mellitus, although effects of viamin D supplementation in the prevention of this disease still remains unclear (45).

Data from clinical trials open a window for supplementation with vitamin D in populated military bases to decrease rate of respiratory infections, to minimize stress fractures, and for better performances; however optimum serum levels are not identified and may vary within the different indications; doses used for these purposes ranges from 300 to 1200 IU per day (6, 15, 37, 43). Further clinical trials of vitamin D supplementation or dietary fortification for these military purposes should be conducted to determine the optimum dose and duration.

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