ROLE OF VITAMIN D_3 SUPPLEMENT AS AN ERGOGENIC AID FOR BONE AND MUSCLE HEALTH OF POWERLIFTERS FROM PUNJAB, PAKISTAN

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ABSTRACT: *Bone strength and Power production are the key factors for Powerlifting. Much concern is shown towards the improvement, modification and evaluation of the capability of the part of Power lifters and coaches. Vitamin D_3 deficiency directly affects bones and muscles make them weak and consequently the performance. Vitamins have various biochemical utilities, a few, like Vitamin D, have the role like hormone because it regulates metabolism of minerals and control the development of tissue and cell demarcation. The objective of this research was to validate that, increase in serum calcidiol level causes a boost in bones and muscles development, resulting an increase in lifting best total or 1RM of all powerlifting events. There were 40 elite class powerlifting volunteers who were chosen from four different cities of Punjab and their lifting best total of squat, bench press and deadlift along with serum calcidiol level measured at pre test level. Outcome showed that increase in serum calcidiol level is a reason to increase the lifting best total or 1RM of all powerlifting events of power lifting players who were lacking or at par level of serum calcidiol concentration. The effect of vitamin D_3 did show considerable effect on the performance of the elite class weight lifters in all most all types of lifts.*

Key terms: Powerlifting, Calcidiol level, volunteers, Vitamin D

INTRODUCTION

A vitamin is an essential nutrient which is vital for an organism in partial amount [1]. As an organic chemical compound it is manufactured by the body as per requirement and when the situation remains otherwise it is taken as a diet or supplement to make over the deficiency [2]. Vitamins have various biochemical utilities, a few, like Vitamin D, have the role like hormone because it regulates metabolism of mineral and controls the development of tissue and cell demarcation (Like some types of vitamin A): other vitamins act as antioxidants (for example vitamin E and from time to time vitamin C) [3].

Powerlifting is a power sport which comprises of 3 categories at maximum power on 3 lifts in the order of: squat, bench-press and deadlift. Historically Powerlifting developed from a sport recognized as Odd Lifts, its format also consisted of three attempts but it included wider range of events, likewise to strongman contest, ultimately Odd Lifts turned identical to the current three categories [4]. In Powerlifting competitions, lifts can be executed un-equipped or equipped; equipment refers to squat/deadlift suit or briefs or bench shirt or knee rolls/wraps, in a few federations knee rolls are allowed in the equipped forms although not in un-equipped category while in other federations these are permitted in both equipped and un-equipped categories; usage of special footwear, knee sleeves, weight belts and wrist wraps are allowed but these supportive equipments are not permissible when equipped lifting is distinguished from unequipped lifting [4].

Literature Review

Usually vitamin D is a vitamin which is in fact not a vital vitamin needed nutritionally to our body as it can be manufactured in sufficient quantity by nearly all mammals exposed to sunlight (Wolf, 2004) [5]. The two most important types of vitamin D as prohormone are D2 (ergocalciferol) and D3 (cholecalciferol): ergocalciferol are formed through fungi and yeast-resultant ergosterol which changes to ergocalciferol upon revelation to UVB light while vitamin D3 is formed when human skin is exposed to sunlight (UVB light) by changing of 7-dehydrocholesterol to cholecalciferol and it is the most important source for humans [6].

Deficiency of vitamin D3 consequently weakens bone mineralization and impairment of bone that directs softening of the bone [7]. Hypovitaminosis of Vitamin D might be a peril factor for multiple sclerosis [8]. In broad-spectrum, vitamin D's role to trigger the inborn immunity and reduce its adaptibility [9]. Deficiency of Vitamin D has been associated to enlarged danger of viral diseases, together with HIV and influenza [10]. Hazard of tuberculosis may appear with low ranks of vitamin D [11]: and historically vitamin D was used as a curative substance [12]. Deficiency of vitamin D is described as less than 50 nmol/L or 20 ng/mL, and its insufficient level lies in between 20 - 32 ng/mL or 50 - 80 nmol/L whereas optimum level is more than 40 ng/mL or 100 nmol/L. It is anticipated that the human body needs vitamin D 3000 to 5000 IU on a daily basis to congregate the requirements of body's all cells and tissues [13]. In vitamin D supplementation it has been observed in this study that lower levels of concentrations come out with greater response, so, upcoming studies may discover further considerable results by separating subjects into groups on the basis of their baseline 25-hydroxy vitamin D levels [14].

Moreover vitamin D supplementation has been recommended for individuals short of vitamin D, with supplementation they can get better muscle power; it is supposed that rise in quantity and size of fast twitch muscle fibers linked through supplementation of vitamin D [15]. It has been observed that fast twitch fibers are main contributors for anaerobic activities and strength, and are engaged primarily to avert falls, linked to muscle power in the old age people [15].

Particularly about skeletal muscle, it has long been implicit that patients suffering from osteomalacia resulting from insufficient intake of vitamin D in normal diet are often prone to proximate muscle weakness that is responsive to

vitamin D supplementation which exhibit an associated skeletal muscle myopathy [16,17,18,19]. Characteristically Vitamin D is considered as a crucial endocrine controller of bone health by means of its function in phosphate and calcium homeostasis [20]. Nevertheless, innumerable non-skeletal effects of the steroid hormones are now recognized and are mainly imputable to the recognition of the vitamin D receptor in almost all tissues [21] together with skeletal muscle [22].

Vitamin D is prepared within the skin or swallowed; cholecalciferol goes through the process of hydroxylation into the liver at upper right of the molecule (position 25) to calcidiol [23]. Microsomal enzyme vitamin D 25-hydroxylase work as catalyst in this reaction, this enzyme is formed by hepatocytes, when calcidiol are prepared, the creation is unconfined in the blood plasma, wherever it will make binding with vitamin D binding protein is called α-globulin [24]. Absorption of vitamin D in the body is carried out in the blood supply to liver, wherever this is transformed as the prohormone called calcidiol, moving calcidiol might next be changed as calcitriol which is biologically lively type of cholecalciferol in the kidneys, next ultimate changing point in the kidney, where calcitriol (lively shape of cholecalciferol) is freely discharged in the blood flow; through strapping up with vitamin D binding protein (VDBP): transporter protein in blood cells, $1,25(OH)_2D$ is carried to different aimed parts, apart from the kidneys, in the immune system calcitriol is also manufactured by monocyte-macrophages, when produced by monocyte-macrophages, calcitriol proceeds in the vicinity as a cytokine, it helps in protecting the body next to microbial invaders by inspiring the inborn immune system [25].

Among the living animals, experimentations reveal that vitamin D dearth consequences in reduced strength [26]. Scarcity of vitamin D is linked with skeletal muscle weakness [27,28]. Deficiency of vitamin D is associated with shrivel of type II skeletal muscle fibres [29] [30]. In adrenal medullary cells vitamin D raises appearance of the tyrosine hydroxylase gene, moreover it is implicated in the neurotrophic biosynthesis aspects, production of nitric oxide synthesis enzyme, and augmented concentration of glutathione [31].

It is established fact that serum calcidiol concentrations more than 75 nmol/L (30 ng/mL) are not constantly allied by means of amplified advantages, Serum calcidiol elevation greater than 50 ng/mL (125 nmol/L) might reason in favor of apprehension; on other hand, the preferred assortment of serum calcidiol is amid 20 to 50 ng/mL [32]. Manifestation of vitamin D receptor in adult skeletal muscle has been reported [33,34].

There has been greater understanding of the effect of vitamin D on morphology of muscles and role in recent decades, but this is not well acknowledged in the Sports Medicine [35]. In the 20^{th} century beginning, coaches and athletes sensed that UV rays had an affirmative effect on physical performance and progressively more proof is mounting up to hold up this observation [35]. Equally longitudinal and cross-sectional studies suggest to a purposeful function for vitamin D in muscle and more freshly the detection of the vitamin D receptor (VDR) in muscle tissue supply as a mechanistic sort of the utility of vitamin D inside muscle [35]. The detection of broad genomic and non-genomic functions for vitamin D inside skeletal muscle has tinted the possible effect; vitamin D insufficiency might have a link with the injury risk and under-performance in players [35].

The effects of Vitamin D3 on bone and muscle health are well described in above review which explains the importance of Vitamin D3 in humans. Present work will embark upon the effects of Vitamin D3 on Powerlifting players of Pakistan regarding the impact of cholecalciferol on their muscle and bone strength with the measuring parameter of increase in their serum calcidiol level and best lifting total. It is assumed that Vitamin D insufficiency is frequent in athletes especially in power sports. For sportsmen showing stress fractures, musculoskeletal pain, and frequent illness, one should have a better knowledge of the further possible diagnosis of vitamin D deficiency. This research will show that how improvement in serum calcidiol level can be managed by uniform and supervised oral supplementation procedure which may produce momentous musculoskeletal sports fitness benefits. It is pertinent to mention that there is research study on vitamin D supplementation usage in power lifters in Punjab; Pakistan is yet awaited.

Research Methodology

There were 40 elite class powerlifting volunteers chosen from four different cities of Punjab on the basis of their lifting best total of squat, bench press and deadlift along with serum calcidiol level measured at the initiation of the experiment as pre test. They were divided into two groups as Group A and Group B by random selection of equal number of subjects from the four cities taken up for sample selection. In pre test, both groups were treated with a generalized but game specific training program for two months under the supervision of their native coaches, and Group A was treated with Cholecalciferol (Vit. D_3) and Group B was treated with placebo through single blind technique.

Experimental Design

A. A total number of 40 elite-class healthy Powerlifters of age between 20 - 26 years of body weight from 67kg to 95kg were selected from different powerlifting and bodybuilding clubs of Lahore, Gujranwala, Sialkot and Faisalabad.
B. Complete data form of all these players was procured in tabulated form.
C. Best total in powerlifting events (Squat + Bench press + Deadlift) and serum calcidiol level was checked in pre test and recorded.
D. All the players were divided into two groups by dividing 20 Power lifters in each group named as Group A and Group B. A total number of 05 participants were selected from each city in both groups on behalf of their 1RM in the back squat, bench press and dead lift total in pre test.
E. A seven day generalized game specific training program was developed for subjects and was repeated eight times in two months and applied on both groups. Than post test study was conducted and improvement analyzed on behalf of their Powerlifting total improvement and increase in serum calcidiol level.
F. Group A was treated with one capsule of cholecalciferol (D-ZAK 50) where each capsule contains 50,000 I.U. of

cholecalciferol on weekly basis for two months. Group B was treated with placebo through single blind technique under the supervision of a registered medical practitioner, pharmacist and other paramedical staff observing full ethical protocol.

G. After two month treatment, a post test of best lifting total of both groups was conducted and recorded on specific data form. A post test of serum calcidiol level for both groups was also done and recorded on specific data form.

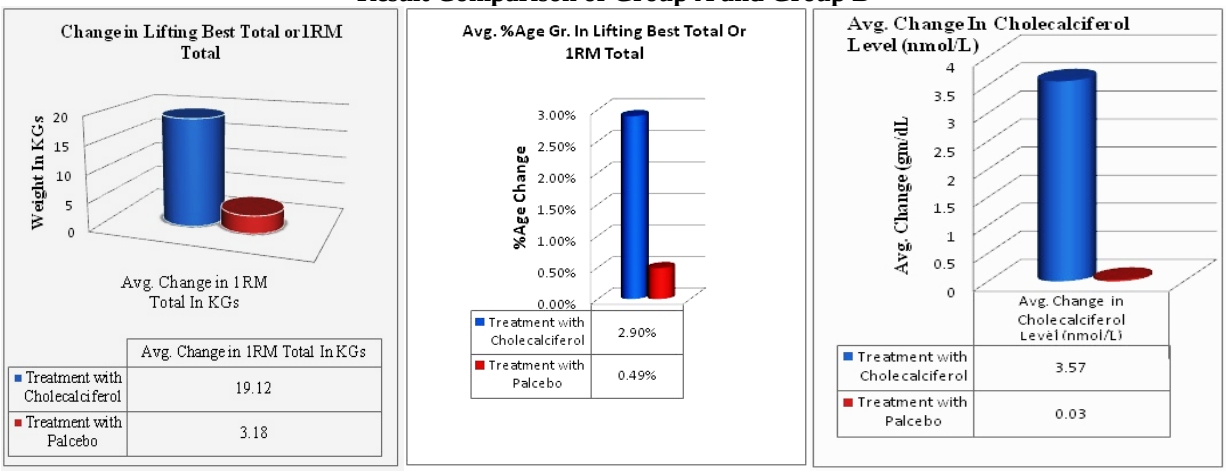
H. A study of comparison was done on behalf of improvement in best lifting total from pre test to post test and likewise comparison of serum calcidiol level was also done between pre test and post test serum calcidiol level.

I. A graphical representation of increase in serum calcidiol level and performance improvement was developed.

RESULTS SUMMARY

After the participants exposure to two months training program along with the supplementation of cholecalciferol (Vit. D_3) to Group A, there was an increase in lifting best total / 1RM of Squat, Bench press and Deadlift as well as increase in serum calcidiol level. There was variation in both 1RM total and serum calcidiol level in participants of Group A whom were treated with D-ZAK 50. The average increase in 1RM total of all three events of Powerlifting in Group A was 19.12kg with percentage increase of 2.90% of participants of Group A. The average increase in serum calcidiol level was 21.70 nmol/L of participants of Group A. There was minor or negligible increase in lifting best total / 1RM of Squat, Bench press and Deadlift along with minor increase in serum calcidiol level in participants of Group B treated with Placebo. The average increase in 1RM total of all three events of Powerlifting in Group B was just 3.18kg with percentage increase of 0.49% of participants of Group B. The average increase in serum calcidiol level was just 2.03 nmol/L in participants of Group B.

Result Comparison of Group A and Group B



DISCUSSION

Power production is key factor for Powerlifting. Much concentration is given to the improvement, modification and evaluation of the capability on the part of Power lifters and coaches.

Among the living animals, experimentation reveal that vitamin D dearth consequences in reduced strength [26]. Scarcity of vitamin D is linked with skeletal muscle weakness [27,28]. Deficiency of vitamin D is associated with shrivel of type II skeletal muscle fibers [29,30]. In adrenal medullary cells vitamin D raises appearance of the tyrosine hydroxylase gene, moreover it is implicated in the neurotrophic biosynthesis aspects, production of nitric oxide synthesis enzyme, and augmented concentration of glutathione [31].

In vitamin D scarce athletes, vitamin D might develop athletic feat, athletic performance may hit the highest point when 25-hydroxy-vitamin D levels move toward those attained by natural, full body, summer sun disclosure, which is minimum 50 ng/mL [36]. Such 25-hydroxy-vitamin D levels possibly will also guard the athlete from numerous severe and chronic health condition [36]. The impact of vitamin D supplementation on health condition is indecisive [37], the effect of vitamin D on morphology of muscle is not well acknowledged in the Sports Medicine [35]. There is a significant role of Vitamin D in skeletal muscles, earlier documented for its special effects on bone; at present it is recognized that vitamin D has a much wider range of utility for muscle, research points out that vitamin D paucity is epidemic [38].

Current substantiation identify that vitamin D_3 supplementation alleviate exercise incited skeletal muscle harm [39]. There is remarkable increase in lifting best total of players after two months treatment with Cholecalciferol in contrast to those players treated with Placebo. The rise in the serum calcidiol level augmented the bones and type II muscles strength by regulating the parathyroid hormone secretion from parathyroid gland, by regulating the osteoblast and osteoclast function in bones and by increasing the calcium absorption from small intestine resulted the increase in calcium deposition in bones and muscles results an increase in bone strength and power due to which increase in lifting best total of powerlifting events was done in contrast to Placebo, where increase in lifting best total or 1RM of all powerlifting events and serum calcidiol level are negligible The association between low serum 25(OH)D concentration and low physical performance therefore remains mainly uncertain for muscle strength [40].

CONCLUSION

Research shows that the supplementation of cholecalciferol increased the serum calcidiol level of players treated with cholecalciferol (Vit. D_3) with an increase in lifting best total or 1RM of all powerlifting events in contrast to those players (Group B) treated with placebo with application of same type of training program. So proper supplementation of vitamin D_3 to vitamin D_3 deficient or normal but at par level players cause increase in bone and muscle strength which cause better regulation of calcium in muscles as a result of that muscle strength increased which results an increase in lifting capability of powerlifting players which is established by results of this research.

RECOMMENDATIONS

The purpose of this research was to decide that cholecalciferol supplementation increase the muscle strength and power in elite class powerlifting players with low serum calcidiol concentration. To further validate the effect of cholecalciferol (Vit. D_3), research should be applied on young athletes in both conditions with usual serum calcidiol level as well as with serum calcidiol scarce powerlifting players. More research is warranted to examine the efficacy of different resistance exercise protocols to see what type, volume, and intensity of exercise is minimally required to produce an impact. The Current research is confined only to male powerlifting players; it can also be applied to female powerlifting players for young and elite class in both conditions with usual serum hemoglobin level as well as with serum calcidiol deficient powerlifting players. The current study is limited by a small participant pool and lack of full control due to training of players in their native cities of Pakistan along with under supervision of different coaches. It would be helpful to apply this research program to a large cluster of subjects under one roof for an organized effect of control condition and better experimental condition tests. An effort can also be made to better standardize for the training state of the participating athletes.

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