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Research Article

Comparison of Hand Grip Strength Between Vitamin- D Supplemented and Non- Supplemented Hypothyroid Patients.

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Abstract: Vitamin- D deficiency is one of the causes for muscle disorders. The present study was aimed to evaluate the performance of hand grip muscle strength (HGS) to determine muscle dysfunctions in patients with newly diagnosed hypothyroidism. Our study objectives are to compare the hand grip strength (HGS) results with vit-D supplement and without vit-D after 8 months' of thyroid therapy. A prospective study of Eight months' period was carried out among 120 subjects attending the Shadan hospital in India. About 40 controls were healthy individuals, 80 subjects were newly diagnosed hypothyroid cases, hypothyroid were divided into two equal groups, Age and gender-matched subjects diagnosed as hypothyroid were included. The three study groups were divided: Group1-. Vitamin-D supplemented cases, Group-2 without Vitamin-D supplementation cases, Group-3 healthy controls. TSH, T3 and T4 levels were estimated by using the immunoassay method. Hand grip strength (HGS) assessed by hand grip dynamometer and Vitamin-D levels were assessed by Minividaas. Statistical analysis was done with sigma plot 14.5 version. Between Hypothyroid groups, supplemented and non-supplemented, statistical significance was obtained for reduced BMI, improved levels of Vitamin-D, reduction of TSH, not much change in T3&T4, and improved HGS. Statistically significant HGS was seen with high levels TSH, low T3&T4. HGS in left &right hand Standard mean is 19.6 & 27.6 and 15.6 & 24.56 respectively. HGS was found to be improved with Vitamin-D supplementation in hypothyroid cases along with hypothyroid treatment. We found that Vitamin-D deficiency is one of the reasons to decrease HGS in hypothyroid patients, Vitamin-D supplementation improves handgrip muscle strength, which is the major concern in hypothyroidism. Our study concludes Vitamin-D supplementation is beneficial in hypothyroid patients who have decreased HGS.

Keywords: Vitamin-D, HGS (Hand Grip Strength), Dynamometer, Hypothyroid, Thyroid stimulating hormone (TSH).

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1. INTRODUCTION

Thyroid disorders are metabolic endocrine disorders accounting for 2-15% in general population in the world. In India second most to Diabetes mellitus, neuromuscular deficits are commonly encountered in hypothyroid patients[1]. It has been known for a long time that skeletal muscles are targets of thyroid hormone [2]. Vitamin-D deficiency causes muscular weakness[3-5]. Earlier reports were on neuromuscular symptoms in 75% of hypothyroid patients and in 67%of hyperthyroid patients, and they observed remission in these symptoms with treatment[6]. The lack of a significant correlation between muscle weakness and biochemical severity of hypothyroidism shows that hypothyroidism is associated with myopathy rather than functional muscle diseases [6-8]. Muscle weakness and pain commonly seen in Vitamin-D deficiency related muscle disorders, and several studies were reported immerse association present between Vitamin-D and muscular dysfuctions[8-10], improved mitochondrial functions and optimized contractility by regulating the phosphate and calcium metabolism with Vitamin-D supplementation[10-12]. The effects of Vitamin-D may be dependent on interventional factors like other co-nutrients such as calcium intake. unfortunately, we did not have adequate information regarding diet and calcium intake. Non skeletal actions of vitamin –D have been studied over the past few decades, and evidence suggests there are a relationship between vitamin D deficiency and various diseases[13]. The increased life span of individuals has led to increases in the incidence of hand grip strength, which has become a major healthcare problem, especially in older adults[14]. Muscle mass and muscle quality are the two main factors determining muscle strength, with muscle quality deteriorating faster than muscle mass by age[15]. Because muscle mass contributes only about 5% to muscle strength, evaluating muscle quality is very important in assessing and treating muscle dysfunctions[16,17]. Hand grip strength (HGS), a fast and simple measurement of maximum voluntary force, is a reliable indicator of muscle quality and the European guideline has recommended HGS as a key index for low muscle strength in the muscle ill[18,19]. Vitamin D plays a substantial role in lowering the occurrence of autoimmune diseases and maintenance of vitamin D levels is of much importance in case of deficiency of thyroid hormones. A gene in the Vitamin D receptor was revealed to predispose individuals to autoimmune thyroid diseases[20]. Vitamin D facilitates its effect by binding to VDR, (Vitamin-D Receptor) which leads to the activation of VDR genes, but autoimmune thyroid diseases are associated with VDR gene polymorphism[21]. Hence, patients suffering from thyroid problems must be treated for vitamin- D' deficiency. In view of scanty studies regarding Vitamin–D supplemented hypothyroid cases, this systematic study has been presented here. Our study reported that Vitamin–D supplementation has improved the HGS, in Vitamin-D deficiency adult subjects. In our study, we aimed to find the Vitamin D supplementation would improve restoration of thyroid and muscle related disorders, and differences in Vitamin D supplemented thyroid patients' hand grip muscle strength and without supplemented patients along with non–thyroids.

2. METHODOLOGY

The study was conducted as per declaration of Helsinki, after institutional ethical approval (Reference number: 069/SIMS/admin/2019) and, written consent declaration was taken from all subjects before conducting the study. Study was conducted on the Newly Diagnosed 80 hypothyroid patients for about 8 months with thyroid therapy along with vitamin – D supplementation in shadan medical college & Hospital in India. An ethical committee permission was taken from the institution before the commencement of the study. All the subjects were instructed to fill informed consent form before enrolment in the study. 5ml of blood sample is collected from each subject and by centrifugation the blood serum is separated and stored at -40 degrees' temperature.

Groups allotted as

120 subjects were divided into 3 groups.

Group -1

Vitamin D supplemented hypothyroid subjects (n=40)

Group-2

Without Vitamin D supplemented hypothyroid subjects (n=40)

Group -3

Healthy controls (n=40)

To assess the vitamin –D response, 80 hypothyroid subjects were divided into two groups; Group -1 Vitamin-D supplementation were provided for 8 months, Group-2 without Vitamin-D supplementation along with thyroid therapy. During follow-up 28 members failed to attend the study.

2.1 Inclusion Criteria

Cases: Newly diagnosed hypothyroid subjects (with increased serum TSH and or with decreased T3 or serum T4 Levels).

Controls: Healthy age and gender-matched euthyroidism.

2.2 Exclusion Criteria

Subjects who were already on hypothyroid medication, subjects suffering from any cardiovascular, pulmonary, renal, neurological, or reproductive disorders were excluded.

2.2.1 Thyroid Profile

Thyroid profile was done by chemiluminescence Immunoassay (CLIA) [22.] In the presence of complimentary antigen and antibody, the paratope of the antibody binds to the epitope of the antigen to form an immune complex. 20µl sample transferred into the well containing thyroid profile antibodies labeled with alkaline phosphatase. The conjugate enzyme catalyses the hydrolysis of this substrate in to a fluorescent product (4- methy-umbelliferone), which was measured at 450nm. At the end of the assay, the results were automatically calculated by instrument.

2.2.2 Vitamin D

Done by Minividaas automated immunoassay analyzer[23]**.** The assay principle combines a one – step enzyme immunoassay sandwich method with a final fluorescent detection. 20µl sample was transferred into the well containing Vitamin-D antibodies labeled with alkaline phosphatase. The conjugate

enzyme catalyses the hydrolysis of this substrate into a fluorescent product (4- methy-umbelliferone) which is measured at 450nm.At the end of the assay the results are automatically calculated by instrument.

2.2.3 Hand Grip Strength

HGS was measured with digital hand grip dynamometer. This dynamometer measures 5 to 120kg/m^2 force. This instrument is an electro-mechanical system with an adjustable complacent of hand shape and digital display[24]. Subject has to hold the HG Dynamometer comfortably by testing hand in standing position with 90^0 flexion of hand fingers, instructed to squeeze as per their strength and force continuously for a minimum 3sec period. In this study, we adopted the Korean specific cutoff points of hand grip strength and cut off values of HGS is 29 and 16 Kg respectively based on the study population[25]. Anthropometric measurements for body mass index were also calculated.

3. STATISTICAL ANALYSIS

Statistical Analysis Executed by using the sigmaplot 14.5version (system software inc, St. Louis, USA). Data analysis was done by statistical tools: a) Descriptive analysis, b) student t-test, c) Chi-square test.

4. RESULTS

120 subjects who participated in our study, were age-matched (mean age 33 years) and female predominance was observed (controls=69.2% and cases=55.3%).

Table 1. Baseline measurements of BMI, thyroid profile, vit-D, hand grip strength in subjects and controls.

S.No.	Parameter	Groups	Mean	SE	Analysis
1	BMI	Control	24.7	0.3	t = -2.584
		Hypo thyroid	27.4	0.6	P < 0.001
2	TSH	Control	2.84	0.1	t = -4.6
		Hypo thyroid	18.0	2.3	P < 0.001
3	T_3	Control	1.19	0.0	t = -4.075
		Hypo thyroid	3.8	0.4	P < 0.001
4	T_4	Control	5.5	0.2	t = -2.8
		Hypo thyroid	8.1	0.6	P < 0.001
5	Serum Vitamin D	Control	33.820	0.88	t = 16.127
		Hypo thyroid	16.003	0.61	P < 0.001
6	Muscle strength (HGS) Right hand	Control	34.3	1.1	t = 11.07
		Hypo thyroid	19.08	0.7	P < 0.001
7	Muscle strength (HGS) left hand	Control	31.68	1.4	t=-9.5
		Hypo thyroid	17.63	1.9	P< 0.001

Table 1 depicts baseline line parameters of hypothyroid subjects and controls of BMI, TSH, T3&T4, Vitamin-D and Left & Right handgrip muscle strength. All parameters were different statistically significant between controls and subjects.

Table:2 After 8 months - Details BMI, thyroid profile, vit-D, hand grip strength in Vitamin D supplemented and Non- supplemented hypothyroid patients.

S.No.	Parameter	Groups	Mean	SE	Analysis
1	BMI (Kg/m^2)	No Vit D	27.7	1.0	t = 1.26
		Vit D Suppl	26.05	0.8	P < 0.001
2	TSH (µg/dl)	No Vit D	5.78	0.4	t=8.33
		Vit D Suppl	4.9	0.9	P=0.407
3	T3 (Pg/ml)	No Vit D	2.450	1.6	t=2.813
		Vit D Suppl	1.56	0.2	P=0.007
4	T4 (ng/dl)	No Vit D	6.688	1.9	t=0.35
		Vit D Suppl	5.4	0.2	P=0.735
5	Vit -D	No Vit D	18.2	4.2	t=-7.06
		Vit D Suppl	27.63	5.9	P=0.093
6	Right hand HGS (kg)	No Vit D	19.68	7.4	t=-4.5
		Vit D Suppl	27.63	4.9	P< 0.001
7	Left-hand HGS (kg)	No Vit D	15.45	6.4	t=-3.5
		Vit D Suppl	24.56	3.8	P< 0.001

Table 2 depicts the statistical analysis after 8 months' therapy of BMI, thyroid profile, and vit-D, hand grip strength in vit –D supplied and without supplied groups. BMI got statistically significant in group 1&2 with standard Mean of 27.7 &26 Value (P< 0.001). TSH levels in both groups standard Mean 5.7&4.9 that are statistically not significant, T3 in both groups standard Mean 2.4&1.5, T4 in both groups standard Mean 6.6&5.4 both T3&T4 where statistically P value is not significant. Vit-D Standard Mean is 18.2&27.63 while it is compared significant. HGS in right hand Standard Mean is 19.6 &27.6 statistically P value is significant. HGS in left hand Standard Mean is 15.6 &24.5.6 statistically P value is significant.

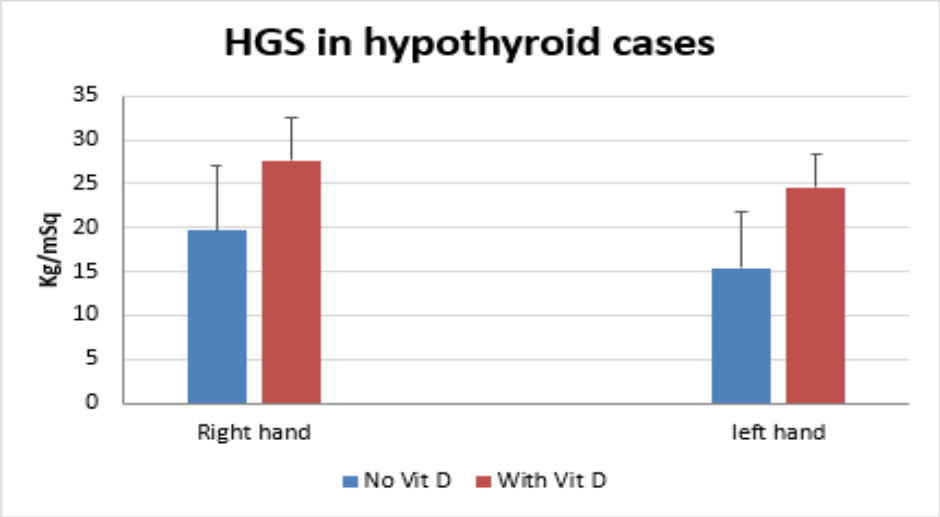

Fig. 1: The level of T3, T4, TSH and Vitamin D in control and hypothyroidism
Values are mean ± SE

Figure 1shows an HGS levels of Vitamin-D supplemented and without supplementation subjects. HGS in left hand, Standard Mean is 19.6 &27.6 statistically P value is significant. HGS in right hand Standard Mean is 15.6 &24.5.6 statistically P value is significant. While we compared with the Vitamin-D supplemented groups with non-supplementation subjects showing significant HGS. Few recent studies also have reported that Vitamin-D can develop the muscularsarcotubular system and it can improve muscle strength quality[8,9]. Our study results reported that Vitamin-D supplementation can shows the better result in hypothyroids HGS.

Table:3 Factors effecting Hand grip muscle strength.

Variables	Mean	S.E	p-value.
Baseline vita-D levels	19.3	0.7	P< 0.05
Baseline TSH	16.1	0.8	P< 0.01
Vitamin-D-supplementation	27.6	4.9	P< 0.001*
Age	23.4	2.6	P< 0.05
Standing posture	30.2	1.8	P< 0.01

Table 3 showing factors effecting HGS, base line Vitamin-D levels and TSH levels to HGS are not significant. Vitamin-D supplemented hypothyroid cases shown significant HGS levels. Age and posture does not show much significance.

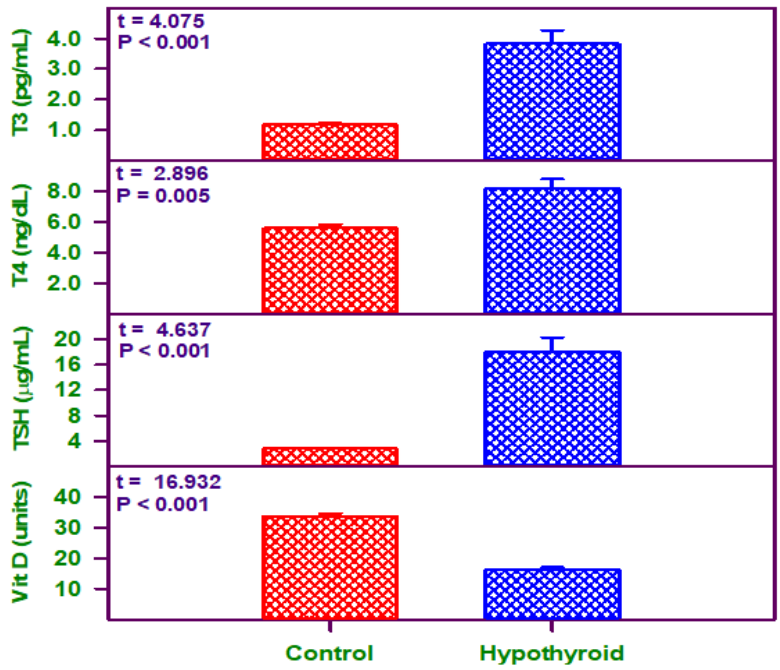

Fig 2: The level of T3, T4, TSH and Vitamin D in control and hypothyroidism

Figure 2 shows correlation between the non-thyroids and thyroid patients and T3&T4, TSH and vit –D levels, all the variables were statistically significant with P value <0.005. Our Study reported, as compared with controls, hypothyroid subjects have increased TSH and decreased T3&T4. levels. And Vitamin-D levels were at optimally sufficient [20 to 45 mmol] levels in controls than hypothyroid subjects.

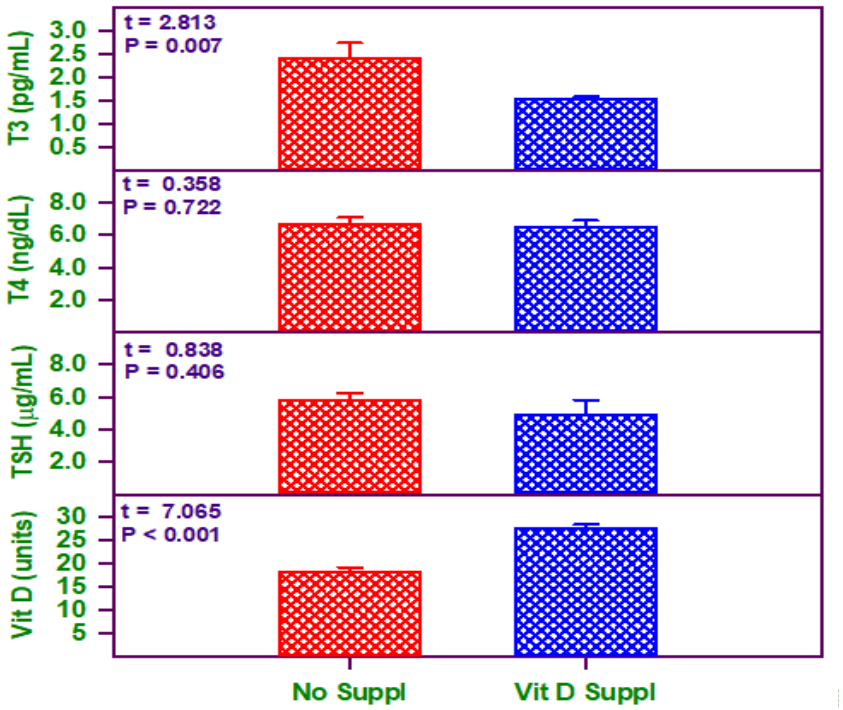

Fig 3: The level of T3, T4, and TSH in with and without vitamin D supplementation
Values are mean ± SE

Figure 3 shows correlation between the group 1&2 T3&T4, TSH and vit –D levels. Thyroid profile does not show significant level. In Vitamin-D supplemented group TSH levels were significant than without supplementation hypothyroid group subjects.

4.1 Predictors of Hand Grip Strength Recovery

Significant difference between baseline Vitamin-D and handgrip muscle strength in hypothyroid subjects and controls were expected. However, Vitamin-D supplementation to hypothyroid patient's hand grip strength is recovered (fig:1). Increased HGS expected functional efficiency of muscle and improve the quality of life in hypothyroids. Variable analysis showed that, Vitamin-D supplementation was progressively improved TSH, with not much change in T3&T4, supplemented group BMI was normalised.

5. DISCUSSION

Decreased muscle strength is a frequent finding in overt hypothyroidism[26]. Vitamin D deficiency appeared to be a relevant risk factor for hypothyroidism and autoimmune thyroid disease, in addition to which supplementation with Vitamin-D provided measurable benefit[27-30]. In the present study, Vitamin–D supplemented hypothyroid patients HGS was statistically and significantly improved; in comparison to without Vit –D supplemented hypothyroid patients HGS. Duffy *et al.,* reported that, hypothyroid dysfunctions cause's neuron muscular dysfunctions, neuromuscular dysfunctions will be evaluated by decreased muscle strength.[45] Horak HA, Pourmand R reported recently, the number of cases diagnosed with endocrine myopathies has been increasing. However, the true incidence and prevalence are unknown. While female to male ratio is 5:1 in hypothyroid myopathy, this ratio is 1:1 in hyperthyroid myopathy. It has been reported that the incidence of hypothyroid myopathy increases after the age of 40 years[34]. However, some researchers have emphasized that muscle dysfunctions and neuromuscular symptoms are frequently observed with electromyography[31-35]. In subclinical hypothyroidism appears to be secondary to changes in hypothyroid type I and type II muscle fibers, as emphasized in previous studies [36]. Numerous epidemiological studies have suggested a potential role for vitamin D in the maintenance of skeletal muscle function, physical performance, and the preservation of independence in adults as vitamin D's extensive roles in immune cell function and inflammation, and these results are not surprising. Supplementation with vitamin D has been found to induce tolerance and reduce auto reactivity in other autoimmune conditions such as multiple sclerosis and improved muscle strength[33-37]. Vitamin D controls the initiation of muscular regeneration by promoting an increase of the cross-sectional area of skeletal muscle fibers through modulatory actions on the cell cycle of the skeletal tissue [37-40]. Numerous epidemiological studies have suggested a potential role for vitamin D in the maintenance of skeletal muscle function, physical performance, and the preservation of independence in adults[39,40] several observational studies vitamin D deficiency was associated with poor muscle strength and low physical performance and its decline in hypothyroid cases[41]. Regular Vitamin-D supplementation consistently improves the muscular skeletal balance[39]. Hypothyroid is associated with lower levels of vit D [41-43]. However, the effect of supplementation of vitamin D on muscle strength and quality of life in hypothyroid has not previously been investigated. We have investigated whether vitamin D

supplementation improves recovery of muscle performance and Quality of life in hypothyroid cases or not and secondly to describe the change in these outcome in response to hypo-thyroid medication. A considerable decreased HGS was noticed in hypothyroid cases. Decreased thyroid levels as well low levels of vitamin–D influence the muscle strength and quality. This may affect the efficiency of the hand muscle adversely that leads to functional limitations and reduced muscle efficiency. HGS in left hand was statistically is significant (P< 0. 005). HGS in right hand statistically significant (P<0.001) in comparison of two groups. Vitamin–D supplemented hypothyroid patients showed improved HGS as well better response to the thyroid therapy. Present study discloses the importance of Vitamin-D in thyroid patients and also it reveals the improvement of the muscle strength [HGS] in supplemented cases. Before supplementation means right & left hand HGS is 19.64 &15.6 and after supplementation 27.6 &24.5, P value is statistically significant, and hence in present study results we found vitamin – D supplementation improved the HGS in hypothyroid cases. Vitamin D controls the initiation of muscular regeneration by promoting an increase of the cross-sectional area of skeletal muscle fibers through modulatory actions on the cell cycle of the skeletal tissue[44].

6. CONCLUSION

Therefore, awareness about vitamin–D supplementation to patients will definitely have an immense impact to reduce in myopathies hypothyroid cases.

7. ACKNOWLEDGMENTS

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8. AUTHORS CONTRIBUTION STATEMENT

Final analysis of our study was done by Dr.vijayalakshmi and Dr.G.S.prema. Practical procedures was done under the guidance of Dr.S panda & Dr. Ibrahim. Manuscript was wtitten and drafted by Ratna Kumari, N

9. ETHICAL STANDARDS

The study was conducted as per declaration of Helsinki, after institutional ethical approval Reference number: 069/SIMS/admin/2019.

10. LIMITATIONS OF THE STUDY

Study population included hypothyroid cases, and healthy controls. Further studies can have proceeded with Vitamin-D supplementation in hyper thyroid subjects.

11. CONFLICT OF INTEREST

Conflict of interest declared none.

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