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Indian Journal of Clinical Anatomy and Physiology

Journal homepage: https://www.ijcap.org/

Original Research Article

Assessment of muscle strength ineuthyroid primary hypothyroidism

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Abstract

Background: Primary hypothyroidism with deranged TSH levels affects skeletal muscle strength, indicative of metabolic or neuromuscular dysfunction. The dysfunction may reverse when a euthyroid level is achieved with levothyroxine supplementation. Our study investigated whether skeletal myopathy exists even after achieving and maintaining an euthyroid state. The isometric hand grip test is a validated method to test for skeletal muscle strength. Our study aims to assess skeletal muscle strength in euthyroid hypothyroidism by employing it.
Materials and Methods: Forty subjects diagnosed with primary hypothyroidism and rendered euthyroid for more than six months (levothyroxine supplementation) were assessed for muscle strength using the isometric hand grip test and compared with an equal number of age-matched healthy euthyroid controls.
Results: Preliminary results indicated that individuals with euthyroid hypothyroidism demonstrated significantly lower grip strength compared to controls, even though thyroid hormone levels remained within normal range. The data suggests that muscle weakness in euthyroid hypothyroidism may be influenced by other factors related to metabolism and neuromuscular function.
Conclusion: Muscle strength weakness is present in primary hypothyroidism even though the patients maintain euthyroid state with levothyroxine supplementation. This needs to be further evaluated so that proper timely measures are taken for further deterioration of muscle weakness that could impair the quality of life in such patients.
Keywords: Primary hypothyroidism, Levothyroxine supplementation, Grip strength

Received: 11-04-2025; **Accepted:** 19-05-2025; **Available Online**: 05-07-2025

1. Introduction

Muscle strength maybe impaired in patients with hypothyroid conditions, even when thyroid hormone levels are normalized.[1-3] This can significantly impact quality of life as it may hamper many day to day activities. The isometric hand grip test, a simple and reliable measure of muscle strength, is widely used in clinical practice to assess functions of the neuromuscular system. The test could be a valuable tool for detecting subtle muscle dysfunction in euthyroid hypothyroidism, where standard thyroid tests may not show any abnormalities.

This study aimed to assess whether muscle weakness persists in patients with primary hypothyroidism who have been rendered euthyroid with levothyroxine therapy.

2. Materials and Methods

This was a cross sectional study carried out in the Endocrinology Outpatient Department of a tertiary hospital in Bengaluru, the sample size included forty individuals aged 20 to 40 years, diagnosed with primary hypothyroidism and rendered euthyroid on a stable dose of levothyroxine monotherapy for more than six months, and forty healthy, age and gender matched euthyroid controls. Pregnancy, lactation, diabetes mellitus, hypertension, dyslipidemia, Vitamin B12 deficiency, smokers and alcoholics, patients on: steroid therapy, patients with psychiatric illnesses, any serious medical conditions including pulmonary, cardiac, hepatic, renal, musculoskeletal and neurological illnesses and athletes were excluded from the study.

Patients were recruited by random selection from the endocrinology outpatient department of a tertiary hospital in Bangalore. They were assigned to Group I. Controls were

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http://doi.org/10.18231/j.ijcap.2025.014

assigned to Group II. A written informed consent was obtained before commencing the test. The subjects underwent biochemical tests for TSH, total T4, anti-TPO antibodies, HbA1c, FBS, haemoglobin, serum lipid profile and serum vitamin B12 levels. All participants were assessed in the same laboratory after they were acclimatized to the laboratory conditions for at least 10 to 15 min. We followed the recommendation of the American Society of Hand Therapists for the grip test,[4] using the computerized isometric hand grip dynamometer (Grip Force Transducer, LabChart 8 Pro, AD Instruments, Australia) to asses muscle strength of the dominant hand. The subject was seated with shoulders abducted and in neutral rotation, the elbows flexed at 90 degrees, the forearms in a neutral position, and the wrist extended between 0 and 30 degrees. Each subject was instructed to squeeze the device with maximum effort for 5 seconds. The test was repeated three times, with a 1-minute rest period between attempts. The highest value from the dominant hand was recorded as the participant's maximum hand grip strength. The Fried's criteria to measure the optimum handgrip force according to gender and BMI values was considered. It is illustrated in (**Table 1**).

Table 1: The Fried's criteria (Cut-off points for handgrip strength)

Men	**Women**
≤29kgf (BMI ≤ 24 kg/m^2)	≤17 kgf (BMI ≤ 23 kg/m^2)
≤30 kgf (BMI 24.1–26 kg/m^2)	≤17.3 kgf (BMI 23.1–26 kg/m^2)
≤30 kgf (BMI 26.1–28 kg/m^2)	≤18 kgf (BMI 26.1–29 kg/m^2)
≤32 kgf (BMI > 28 kg/m^2)	≤21 kgf (BMI > 29 kg/m^2)

kgf: kilogram force, BMI: Body Mass Index

Statistical analysis was performed using SPSS 16.0 software (IBM, USA). Descriptive variables were analysed using mean ±standard deviation. Fisher's exact test was used to analyse differences for categorical variables between the two groups. The demographic data of the two groups were also compared (**Table 2**).

Table 2: Demographic data and group comparison.

	Group 1 N =40	**Group 2 N=40**	**P value**
Sex (F/ M)	21/19	23/17	0.78
Age (mean ± SD)	32.9 ± 5.0	33.4 ± 4.6	0.66
BMI (Kg/m^2)	27.8 ± 2.1	28.1± 1.3	0.71
Right hand dominance	38	37	0.99

F: female; M: male; SD: standard deviation; BMI: Body Mass Index

Table 3: Comparison of the maximum Isometric Hand grip test scores of the two groups in KGF

Subjects	**Group I N =40**	**Group II N =40**	**P value**
Males (mean ± SD)	38.48 ± 3.39	45.77 ± 3.86	0.004*
Females (mean ± SD)	27.05 ±1.39	33.25 ± 3.04	0.002*
Total	32 ± 3.01	36 ± 5.02	0.05*

kgf: kilogram force; SD: standard deviation

3. Results

There were no significant differences in the demographic characteristics (age, sex, and BMI) between the two groups. The mean maximum hand grip strength for individuals in the euthyroid hypothyroidism group was significantly lower as compared to the control group (P value < 0.05). There was a gender wise variation between the two groups, with males in group I scoring less than the male controls, and females in group I scoring less than the female counterparts in the control group too (P value < 0.004, 0.002 respectively).

4. Discussion

The study demonstrates that muscle strength, as assessed by the isometric hand grip test, is significantly reduced in individuals with euthyroid hypothyroidism compared to healthy controls, despite normal thyroid hormone level, there was a gender wise variation as well as overall decrease in muscle strength. The finding suggests that muscle weakness in euthyroid hypothyroidism could be a consequence of factors other than thyroid hormone levels. In a study conducted by Duyff et al., clinical improvement in hypothyroid patients was found to be 67%. No significant correlation was observed between biochemical severity of hypothyroidism and muscle weakness, indicating that myopathy in hypothyroidism could be the cause rather than functional muscle diseases.[5]

Several mechanisms could explain this phenomenon. First, there could be changes in muscle metabolism or mitochondrial function that are not detected through routine thyroid function tests. Additionally, altered neuromuscular function or even subtle myopathy could contribute to the observed weakness. Neuromuscular derangements are commonly encountered in hypothyroid patients.[6] Moreover, thyroid hormones modulate skeletal muscle functions.[7] Biochemical abnormalities such as decreased enzymatic activities for energy production, and glycogen accumulation are observed in hypothyroid type I muscle fibers.[8-10] The mitochondrial membrane in skeletal muscles have T3 receptors that are altered by oxidative metabolism.[11] The extent of mitochondrial damage in hypothyroidism is influenced by decreased activity of electron transport chain cytochrome complexes and mitochondrial enzymes.[12] Many recent studies have highlighted cardiovascular, neuromuscular and metabolic alterations without thyroid

hormone derangement wherein defective mitochondrial function and increased lactate production during exercise is the responsible factor.[13]

Parameters such as age, gender, body mass index (BMI), and dominant extremity affect isometric dynamometer measurements.[14-15] In this study, there was no statistically significant difference among hypothyroidism and control groups on these parameters.

While this study focuses on the isometric hand grip test, future research could explore additional functional tests (e.g., endurance tests, muscle biopsies) to investigate the precise mechanism underlying the reduced muscle strength observed in this population.

5. Conclusion

The study concludes that muscle weakness may persist in euthyroid hypothyroidism despite achieving euthyroid state with levothyroxine supplementation. It highlights the importance of considering muscle dysfunction in this population, which could help guide treatment strategies aimed at improving quality of life. Further studies with larger sample size are required for in depth understanding of the pathophysiological mechanisms behind muscle weakness in euthyroid hypothyroidism and to explore potential therapeutic interventions.

6. Source of Funding

None.

7. Conflict of Interest

None.

8. Ethical No:

MSRMC/EC/AP-07/04-2021.

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Cite this article: Hasan AZ, Kalra P, Vijayadas, Assessment of muscle strength in euthyroid primary hypothyroidism. *Indian J Clin Anat Physiol*. 2025;12(2):63-65.