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THYROID DYSFUNCTION AND ADHESIVE CAPSULITIS: A COMPREHENSIVE STUDY OF PHYSICAL, PSYCHOLOGICAL AND FUNCTIONAL VARIABLES

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Abstract

In this study, 46 individuals were examined for their prevalence, physical activity levels, and psychological factors associated with thyroid disorders and adhesive capsulitis (AC), a common shoulder condition. There is some evidence that thyroid disease is associated with AC, though research on the topic is limited. There is a higher prevalence of thyroid disorders in women (72.99%) than men, based on the sample, which is predominantly composed of individuals aged 50 and older (69.76%). The study found that 84.3% of participants had hyperthyroidism, suggesting that hyperthyroid women are more likely to seek treatment for AC associated with thyroid dysfunction. In terms of physical activity, hyperthyroid patients are inactive in large numbers, with longer disease durations being associated with higher rates. People with hyperthyroidism experience poor sleep quality, particularly those with chronic conditions. Additionally, individuals with thyroid dysfunction exhibited moderate to severe symptoms ofdepression and stress, suggesting psychological impact. Patients with hyperthyroidism as well as hypothyroidism often suffer from kinesiophobia, a fear of movement, which can exacerbate their musculoskeletal symptoms. Patients with AC and hypothyroid dysfunction showed functional limitations on the Disability of Arm, Shoulder, and Hand (DASH) scale. Thyroid disease type and TSH serum levels did not significantly correlate with quality of life (QoL) scores based on the SF-36 questionnaire. In contrast, chronic pain sufferers had a higher proportion of unhealthy individuals, indicating that their QoL could be negatively affected. There were higher levels of pain reported by hyperthyroidism patients, whereas there were higher levels of irritability among AC patients with thyroid dysfunction. As a result of this study, it is evident that thyroid disorders, AC, physical activity, and psychological factors interact in complex ways. It emphasizes the need for comprehensive management strategies to address the multifacetedeffects of thyroid dysfunction on AC patients.

Keywords: Adhesive capsulitis, Physical activity, Hyperthyroid, Hypothyroid

Introduction

Musculoskeletal involvement is a significant aspect of this endocrine disorder that extends beyond thyroid function. There are a number of symptoms associated with primary hypothyroidism, including myalgia, stiffness, cramps, and arthralgia. Moreover, conditions such as adhesive capsulitis, carpal tunnel syndrome, trigger finger, and tarsal tunnel syndrome are frequently observed. There are several causes of primary hypothyroidism, which include thyroid dysfunction and elevated thyroid-stimulating hormone (TSH) levels, but the most common is thyroid disease, which is often autoimmune in origin. There is a strong association between Hashimoto thyroiditis and palpable goiters, which can progress to fibrotic, nonfunctional thyroid glands over time. This disorder has diverse musculoskeletal impacts, as Dupuytren's contracture and noninflammatory back pain underscore. Various muscle changes are common in primary hypothyroidism, ranging from reductions caused by interstitial myxedema to slight increases characterized by a feeling of firmness. A comprehensive assessment and management strategy are needed to address the diverse clinical presentations of primary hypothyroidism as a result of these musculoskeletal manifestations. There is a clinical condition known as adhesive capsulitis, which is also known as frozen shoulder, which is characterized by severe pain and decreased movement in the joints due to thinning and contraction of the joint capsule as well as synovium.[1-3] As Duplay described in 1896, scapulohumeral periarthritis was the most common form of this condition. A frozen shoulder is characterized by long-term pain in the shoulder, often brought about by occasional immobilization or disuse of the joint, according to Codman. The term has been defined and classified in several ways since then. As part of the latest consensus published by the International Society of Arthroscopy Knee and Orthopedic Surgery (ISAKOS), the term adherent capsulitis is discouraged, and rigid shoulder is defined as a general term covering any restriction in range of motion that occurs in the upper limbs [4,5]. A number of risk factors include female gender, patients over the age of 40, trauma, diabetes, prolonged immobility, thyroid disease, stroke, and myocardial infarction. A number of studies have suggested that thyropathies may be a contributing factor to frozen shoulder and other musculoskeletal disorders, but the cause still remains unclear. [6-9] A series of thyroid diseases are known as thyropathy, with hypothyroidism, which occurs most commonly in the general population, characterized by low thyroid hormone production. Although hyperthyroidism occurs in 1.5% of the population, hypothyroidism occurs almost 10 times more often. According to studies, its prevalence ranges from 6–20%, depending on the patient's age, gender, race, and iodine sufficiency. [10-12]. The clinical course of adhesive capsulitis consists of four stages [13]. It is important to keep ethical standards and patient confidentiality throughout the study while investigating the relationship between Adhesive Capsulitis and thyroid dysfunction.

Methodology

The study involved a prospective cohort design conducted over a period of two years. The study utilized an observational approach and employed convenient sampling to select participants. The

sample size consisted of 46 individuals. In this study, diagnosed cases of Adhesive Capsulitis (also known as frozen shoulder) were selected from the Physiotherapy Outpatient Department (OPD) at SRM Medical College Hospital and Research Center, adhering to specific selection criteria. The study was enrolled with the Institutional Ethical Board, SRM MCH & RC, SRM IST and procured approval. A clinical trials registry-India registration was also obtained for the study. Ethical Clearance number: 2171/IEC/2020. CTRI registry number: CTRI/2021/12/038843. Both men and women have been included in the sample. Furthermore, the selected subjects were specifically being diagnosed cases of Adhesive Capsulitis with co-existing thyroid dysfunction. Prior to participation, informed consent has been obtained from all subjects after providing a detailed explanation of the study's procedures, which encompass both medical and physical examinations. The subjects' thyroid history has evaluated by reviewing their medical records. Subsequently, all enrolled subjects will undergo assessments to evaluate the physical, psychological and pain levels with the extent of shoulder motion restriction. Data collection and analysis were carried out in accordance with ethical guidelines and standards for research involving human subjects.

Inclusion criteria

- Both Men and Women
- Age: 40 to 60 years
- Once patients have been diagnosed with adhesive capsulitis with thyroid dysfunction, they will be included in this study.

Exclusion criteria

- Subjects with Diabetes Mellitus.
- Subjects with recent history of shoulder trauma and post traumatic stiffness.
- Previous history of fracture around the shoulder and dislocation.

- History of previous surgery of involved shoulder.
- Concomitant shoulder joint pathologies.
- Smoker and alcoholic will be excluded.
- Claustrophobic subjects.
- Subjects with metallic implants, prosthetic heart valves and Pacemakers

Physical variable

a. Physical activity level (IPAQ):

A physical activity assessment was conducted using the International Physical Activity Questionnaire (IPAQ). Based on the correlation coefficient (r) of 0.8, the IPAQ was deemed to be very reliable, indicating strong consistency in the responses. In addition, the IPAQ's validity was examined, with a correlation coefficient of 0.30, indicating moderate agreement between IPAQ's measurements and other established measures of physical activity.

Psychological variables

b. Pittsburgh Sleep Quality Index: An assessment of sleep quality levels over a one-month period was conducted using the Pittsburgh Sleep Quality Index (PSQI). Ultimately, the questionnaire generates a single global score by categorizing 19 items into seven components. Approximately 5 to 10 minutes are usually required for participants to complete the questionnaire. It was reported that the PSQI had a reliability coefficient of 0.76, indicating that its questions were internally consistent. The tool provides valuable insights into participants' sleep patterns and disturbances over time by evaluating various aspects of sleep quality.

c. Depression Anxiety Stress Scales: DASS-42, a scale used to assess negative emotional symptoms, was administered to assess negative emotional symptoms. Approximately five to ten minutes are needed to complete each of the 42 items in this self-report questionnaire. According to a four-point Likert scale, participants rate the severity or frequency of their experiences over the past week. A more accurate assessment of emotional states can be achieved when this scale emphasizes states over traits. There are three subscales within the DASS-42: depression, anxiety, and stress, each with its own items. Depression has a reliability coefficient of 0.91, anxiety has a reliability coefficient of 0.84, and stress has a reliability coefficient of 0.90. It is clear from these reliability coefficients that the questionnaire has a high degree of internal consistency within each subscale, ensuring that negative emotional symptoms can be accurately measured. Participants' emotional well-being can be examined through the DASS-42 in order to identify any significant distress they are experiencing.

d. Tampa Scale (Kinesiophobia): As part of the study, participants were asked to rate statements that expressed a fear of participating in specific activities due to potential pain or injury. This questionnaire assesses fear avoidance, fear of work-related activities, fear of

movement, and fear of injury recurrence. There is moderate to strong internal consistency among the items of the FABQ, based on reliability coefficients ranging from 0.64 to 0.80. Additionally, validity coefficients were calculated, with reported values ranging from r=0.33 to 0.59, which indicate moderate to good construct validity. It can be concluded from these coefficients of reliability and validity that the FABQ is a reliable and valid instrument to assess fear avoidance behaviors in individuals suffering from musculoskeletal conditions.

Functional variables

e. **Disability of Arm, Shoulder and Hand (DASH):** In order to determine patients' ability to perform upper extremity activities, the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire was administered. Using a five-point Likert scale, the DASH questionnaire evaluates functional limitations of upper extremities based on 30 items. Based on their arm, shoulder, and hand impairments, patients were asked how difficult they found various activities. A reliability coefficient of 0.97 indicates that the items in the DASH questionnaire have excellent internal consistency. The high reliability coefficient of the DASH questionnaire suggests it provides consistent and reliable information about upper extremity function. Researchers and clinicians can use the DASH questionnaire to assess patients' ability to carry out daily activities while compromised by upper extremity impairments. In order to improve upper extremity function and quality of life, the questionnaire can identify specific functional limitations and track changes over time.

f. **SF-36 Quality of Life:** A total of 36 items are included in the SF-36 questionnaire, each representing one of the eight domains of health. A specific period of time, typically the past month, was used in order to give participants an idea of how they felt about their health over the course of each item. SF-36 questionnaire reliability and validity were assessed in order to ensure its accuracy and consistency. An internal consistency coefficient of 0.791, an indicator of reliability, was determined for the items. Further, the validity coefficient, a measure of how effectively a questionnaire measures what it intends to measure, was found to be 0.786, which indicates satisfactory validity. A comprehensive assessment of a person's overall health status and well-being can be obtained using the SF-36 questionnaire. Health-related quality of life can be improved with this information by assessing the impact of interventions, planning healthcare services, and identifying target areas for targeted interventions.

Results and Discussion

Table: 1 Demographic characteristic of patients

Characteristics	N	%
Age factor		
• <50	13	30.23%
• 50 and Above	30	69.76%
Gender		

• Male • Female	12 31	27.90 72.09
Parents Occupation • Government employee • Administrative officer • Farmer • Driver • Housewife • Own Business • Others	 2 2 1 1 21 5 11	 4.65 4.65 2.32 2.32 48.83 11.62 25.58
Location • Rural areas • Urban areas	 0 43	 0 100
Side of Hand Dysfunction • Right • Left	 37 6	 86.04 13.95
Height of patients • <160cm • 160 and more	 27 16	 62.79 37.20
Weight of patients • <60kg • 60 and more	 11 32	 25.58 74.41
Hyperthyroidism state in years • 1 year and less than 1 year • 2-4 years • 5 and above	 6 11 6	 13.95 25.58 13.95
Hypothyroidism state in years • 1 year and less than 1 year • 2-4 years • 5 and above	 7 11 2	 16.27 25.58 4.65
Pain duration • Acute (below 3months) • Chronic (3and above)	 5 38	 11.62 88.37

This study provides insight into the characteristics of individuals affected by hypo- and hyperthyroidism-related adhesive capsulitis based on the demographics of study participants. In terms of age, 69.76% of the sample consisted of participants aged 50 and up, and 30.23% consisted of participants aged under 50. In light of this age distribution, it might be reasonable to assume that older individuals may be more susceptible to thyroid disorders as well as adhesive capsulitis-related shoulder dysfunctions.

There were slightly more women (72.99%) than men (27.90%) in the study sample. This finding is in line with previous studies that also found a higher prevalence of thyroid disorders in women. According to a study cited in our discussion, 75.2% of participants were females aged 26 to 52, which is consistent with our sample's predominance. Moreover, the vast majority of study participants (84.3%) had hyperthyroidism, indicating hyperthyroid women were more likely to seek treatment for adhesive capsulitis related to thyroid dysfunction [14].

A similar demographic pattern was observed in other regions, including Asian countries [15], with a majority of female participants in middle-aged groups, however hypothyroidism was more prevalent in those populations [16]. A higher prevalence of thyroid nodules was observed in studies conducted in Europe among middle-aged and older individuals [17]. There were a notable proportion of housewives among participants' parents (48.83%) and individuals who own their own businesses (25.58%). There may be a correlation between occupation and health outcomes due to the diverse socioeconomic backgrounds of the participants. There was a high concentration of participants living in urban areas, suggesting there may be less awareness of adhesive capsulitis in rural areas. Participants reported that their right shoulder was dysfunctional in the majority (86.04%), while their left shoulder was dysfunctional in a smaller proportion (13.95%). There may be other factors contributing to shoulder dysfunction, in addition to this asymmetrical distribution. The majority (62.79%) of participants measured less than 160cm and weighed 60kg or more, according to the height and weight distributions. In the context of Hypo and hyperthyroidism-related shoulder dysfunction, individuals may exhibit a variety of physical characteristics and body compositions.

Table: 2 Physical activity level using (IPAQ Scale) among subjects with adhesive capsulitis associated with hypo and hyperthyroid dysfunction states

Hyperthyroid and Hypothyroid dysfunction state in years	**IPAQ Scale**					
Hyperthyroid state	Physically Inactive (n)	%	Minimally Inactive (n)	%	HEPA Active	%
1 year and less than 1 year (6)	5	83.33	1	16.66	-	
2-4 yrs (11)	8	72.72	3	27.27	-	
5 and above (6)	4	66.66	2	33.33	-	
Hypothyroid state						
1 year and less than 1 year (7)	4	57.14	3	42.85	-	
2-4 yrs (11)	9	81.81	2	18.18	-	
5 and above (2)	1	50	1	50	-	
Pain (Duration)						
Acute (5)	4	80	1	20	-	-
Chronic (38)	27	71.05	11	28.94	-	-

Table: 3 Sleep Quality level using (PITTSBURGH SCORE) among subjects with adhesive capsulitis associated with hypo and hyperthyroid dysfunction states

Hyperthyroid and Hypothyroid dysfunction state in years	PITTSBURGH SCORE			
	Good Sleep (n)	%	Poor sleep (n)	%
Hyperthyroid state				
1 year and less than 1 year (6)	2	33.33	4	66.66
2-4 yrs (11)	3	27.27	8	72.72
5 and above (6)	2	33.33	4	66.66
Hypothyroid state				
1 year and less than 1 year (7)	4	57.14	3	42.85
2-4 yrs (11)	9	81.81	2	18.18
5 and above (2)	1	50	1	50
Pain (Duration)				
Acute (5)	2	40	3	60
Chronic (38)	12	31.57	26	68.42

Table: 4 Depression stress anxiety level (DASS Scale) among subjects with adhesive capsulitis associated with hypo and hyperthyroid dysfunction states

Hyperthyroid and Hypothyroid dysfunction state in years	DASS Scale							
	Normal (n)	%	Mild	%	Moderate	%	Severe	%
Hyperthyroid state								
1 year and less than 1 year (6)	1	16.66	2	33.33	3	50	-	-
2-4 yrs (11)	1	9.09	3	27.27	6	54.54	1	9.09
5 and above (6)	1	16.66	2	33.33	2	33.33	1	16.66
Hypothyroid state								
1 year and less than 1 year (7)	1	14.28	1	14.28	4	57.14	1	14.28
2-4 yrs (11)	2	18.18	2	18.18	7	63.63	-	-
5 and above (2)	1	50	-	-	1	50	-	-
Pain (Duration)								
Acute (5)	2	40	1	20	2	40	-	-
Chronic (38)	11	28.94	9	23.68	16	42.10	2	5.26

Table: 5 Kinesiophobia level (TAMPA Scale) among subjects with adhesive capsulitis associated with hypo and hyperthyroid dysfunction states

Hyperthyroid and Hypothyroid dysfunction state in years	TAMPA Scale			
	Presence(n)	%	Absence	%
Hyperthyroid state				

1 year and less than 1 year (6)	4	66.66	2	33.33
2-4 yrs (11)	8	72.72	3	27.27
5 and above (6)	5	83.33	1	16.66
Hypothyroid state				
1 year and less than 1 year (7)	4	57.14	3	42.85
2-4 yrs (11)	9	81.81	2	18.18
5 and above (2)	2	100	-	-
Pain (Duration)				
Acute (5)	3	60	2	40
Chronic (38)	29	76.31	9	23.6

Table: 6 Disability of shoulder level (DASH Scale) among subjects with adhesive capsulitis associated with hypo and hyperthyroid dysfunction states

Hyperthyroid and Hypothyroid dysfunction state in years	**DASH Scale**					
	Mild (n)	%	Moderate (n)	%	Severe (n)	%
Hyperthyroid state						
1 year and less than 1 year (6)	1	16.66	3	50	2	33.33
2-4 yrs (11)	2	18.18	6	54.54	3	27.27
5 and above (6)	1	16.66	3	50	2	33.33
Hypothyroid state						
1 year and less than 1 year (7)	1	14.28	4	57.14	2	28.57
2-4 yrs (11)	1	9.09	7	63.63	3	27.27
5 and above (2)	-	-	1	50	1	50
Pain (Duration)						
Acute (5)	1	20	3	60	1	20
Chronic (38)	6	15.78	22	57.89	10	26.31

Table: 7 Quality of life (SF36 Scale) among subjects with adhesive capsulitis associated with hypo and hyperthyroid dysfunction states

Hyperthyroid and Hypothyroid dysfunction state in years	**SF36 Scale**			
	Healthy(n)	%	Unhealthy	%
Hyperthyroid state				
1 year and less than 1 year (6)	5	83.33	1	16.66
2-4 yrs (11)	8	72.72	3	27.27
5 and above (6)	4	66.66	2	33.33
Hypothyroid state				
1 year and less than 1 year (7)	5	71.42	2	28.57
2-4 yrs (11)	7	63.63	4	36.36
5 and above (2)	1	50	1	50

Pain (Duration)				
Acute (5)	4	80	1	20
Chronic (38)	21	55.26	17	44.73

Table: 8 Pain level (VAS Scale) among subjects with adhesive capsulitis associated with hypo and hyperthyroid dysfunction states

Hyperthyroid and Hypothyroid dysfunction state in years	**VAS Scale**					
	Mild (n)	%	Moderate (n)	%	Severe (n)	%
Hyperthyroid state						
1 year and less than 1 year (6)	-	-	5	83.33	1	16.66
2-4 yrs (11)	-	-	9	81.81	2	18.18
5 and above (6)	-	-	4	66.66	2	33.33
Hypothyroid state						
1 year and less than 1 year (7)	-	-	5	71.42	2	28.57
2-4 yrs (11)	-	-	8	72.72	3	27.27
5 and above (2)	-	-	1	50	1	50
Pain (Duration)						
Acute (5)	-	-	3	60	2	40
Chronic (38)	-	-	27	71.05	11	28.94

Table: 9 Irritability Scale among subjects with adhesive capsulitis associated with hypo and hyperthyroid dysfunction states

Hyperthyroid and Hypothyroid dysfunction state in years	**SF36 Scale**			
	Irritable(n)	%	Non-irritable (n)	%
Hyperthyroid state				
1 year and less than 1 year (6)	5	83.33	1	16.66
2-4 yrs (11)	8	72.22	3	27.27
5 and above (6)	4	66.66	2	33.33
Hypothyroid state				
1 year and less than 1 year (7)	4	57.14	3	42.85
2-4 yrs (11)	9	81.81	2	18.18
5 and above (2)	2	100	-	-
Pain (Duration)				
Acute (5)	4	80	1	20
Chronic (38)	36	94.73	2	5.26

DISCUSSION

Previously Researchers have mainly studied athletes and military personnel and paid little attention to the general population when it comes to thyroid function and physical activity [18]. Research on the relationship between thyroid function and physical performance in non-athletic individuals is especially lacking [19]. Physical performance is defined as the ability to perform activities of daily living satisfactorily. There is also a lack of data on women or studies with small sample sizes in the literature [20], which is largely based on studies conducted in men. Currently, there are no longitudinal studies investigating this association, which are essential for determining the direction of the relationship between thyroid hormone levels and physical activity, thereby minimizing the risk of reverse causation. The data from our study can be analyzed in both cross-sectional and longitudinal ways, addressing this gap. Our findings indicate that thyroid function and physical activity levels do not correlate significantly, whether analyzed cross-sectionally or longitudinally. Physical capacity is dependent on the cardiovascular and skeletal-muscular systems, both of which are influenced by thyroid hormones [21]. Although it is important to recognize the multifaceted nature of the bodily functions involved, it is also essential to acknowledge the complex relationship between physical capacity and physical activity. Physical activity is influenced significantly by thyroid hormones, but precise mechanisms underlying their influence remain unclear. As well, it should be noted that the questionnaire utilized in our study, the IPAQ, was created and validated for older individuals, thus possibly introducing age-related variations in reported physical activity patterns. Considering our study population's age range, which ranges from 45.5 to 89.4 years, we may have been influenced by age-related differences in physical activity patterns. Compared to subjects without adhesive capsulitis and those with hypothyroidism or hyperthyroidism, Table 2 illustrates the levels of physical activity among those with adhesive capsulitis. Subjects with hyperthyroidism reported being physically inactive across all duration categories. Specifically, 83.33 percent of hyperthyroidism patients seeking treatment for less than one year are physically inactive, while 16.66 percent are minimally inactive. Furthermore, 72.72% of those inactive for 2-4 years are physically inactive, and 27.27% are minimally inactive. There were 66.66% of subjects with hyperthyroid dysfunction who had not been physically active for 5 years or more, and 33.33% who had been minimally active for 5 years. Hypothyroid state participants reported varying levels of physical activity across duration categories. 57.14% of hypothyroid patients have been physically inactive for 1 year or less, while 42.85% are minimally inactive. Physical inactivity was reported by more subjects (81.81%) during the 2-4-year duration category than by the 18.18% in the minimal inactivity category. Among subjects who have been inactive for 5 years or more, 50% were physically inactive, and 50% were moderately inactive. Pain duration and physical activity levels, measured by the IPAQ scale, provide insight into the patterns of activity of chronic and acute pain sufferers. Those with acute pain and those with chronic pain engage in physical activity differently. Only a small proportion (20%) of people with acute pain

was classified as minimally active. A majority (80%) of those with acute pain were physically inactive. Individuals suffering from acute pain tend to limit their physical activity levels, possibly because of the immediate discomfort and limitations that accompany such pain. A considerable proportion (28.94%) of individuals with chronic pain was categorized as minimally active, while a slight majority (71.05%) was physically inactive. Despite falling short of the recommended activity levels for optimal health, chronic pain individuals may still demonstrate higher levels of physical activity than those with acute pain. There is a significant difference between acute and chronic pain groups in terms of physical activity levels, demonstrating the impact of pain duration on activity patterns. As individuals manage their immediate discomfort and avoid exacerbation of symptoms during acute pain episodes, they may temporarily reduce their physical activity. Physical activity can be manageable for individuals with chronic pain, as long as they incorporate low-intensity exercises that minimize flare-ups. Pain management should take physical activity into account regardless of its duration.

Sleep disturbances, mainly sleep deprivation and disruptions in circadian synchronisation, are common in modern society, as a result of occupational and personal pressures [22, 23]; indeed, disturbed sleep is the most frequent health complaint encountered [24]. Thyroid function is thought to be an important determinant of sleep quality. In 628 males aged >65 years, Akatsu et al. [25] analysed the association between thyroid function and objective sleep quality by using a “sleep watch” actigraph worn on the non-dominant wrist. In this population, which differed from our sample in terms of gender distribution, median age, and median TSH levels, the percentages of sub-clinical hyperthyroidism and sub-clinical hypothyroidism were 2% and 6%, respectively. In this subset of patients with TSH outside the normal range, the percentages of poor sleepers (sub-clinical hyperthyroidism: 46%; sub-clinical hypothyroidism: 50%) did not differ from that reported in euthyroid subjects (40%) [26] In the adult general population, the incidence rate of disturbed sleep is reported to vary widely from 9 to 33% [27-29]. Very few literature data on sleep quality in thyroid patients have been reported. Poor sleepers (PSQI score >5) were found in 54% and 33% of DTC and non-DTC patients, respectively, 1 month after surgery. On re-testing, the percentage of poor sleepers in the DTC group was seen to have increased to 71% after ablation, and reached 79% in the sub-group of patients in whom imaging documented metastatic disease [28]. In addition, patient age, which markedly modulates sleep duration, was different in the two studies, the mean age being 40 years and >60 years in ours. Recently, a study [27] compared female thyroid survivors with healthy women, and observed that sleep problems and fatigue symptoms were predicted by lower perceived cognitive effectiveness, worse cognitive performance and reduced QoL. In our study many participants in the hyperthyroid state reported poor sleep quality regardless of how long they had been hypothyroid. People with hyperthyroidism for 1-4 years reported poor sleep at a rate of 66.66%, whereas those with hyperthyroidism for 1 year or less reported it at a rate of 72.72%. The prevalence of poor sleep quality was also high (66.66%) among individuals with hyperthyroidism for 5 years or more. Sleep disruptions and overall sleep quality impairment may be associated with hyperthyroid dysfunction, based on these findings.

As a result, sleep quality varied across different durations of hypothyroid dysfunction among participants with hypothyroid dysfunction. Significantly, 81.81% of hypothyroidism patients with 2-4 years of experience reported satisfactory sleep, while 18.18% reported poor sleep. The majority of individuals with hypothyroidism for one year or less reported good or excellent sleep quality (57.14%) while a significantly smaller percentage reported poor or poorer sleep (42.85%). Sleep quality may be relatively higher in individuals suffering from hypothyroid dysfunction compared to those suffering from hyperthyroidism, according to these findings. There is a complex relationship between thyroid function and sleep regulation, as evidenced by the observed differences in sleep quality between hypo- and hyperthyroid states. Sleep patterns may be less affected by hypothyroidism than by hyperthyroidism due to its weaker impact on sleep quality. Interpreting these findings, however, should consider individual variations in symptom presentation and treatment response. Various psychological and physical variables associated with adhesive capsulitis and thyroid dysfunction are compared across a range of pain durations in order to gain insight into the multifaceted nature of pain management. The Pittsburgh Sleep Quality Score shows that people suffering chronic pain are more likely to suffer poor sleep than those suffering acute pain. Sleep patterns may be affected more negatively by chronic pain, possibly because of prolonged discomfort and psychological distress.

Hypothyroidism and hyperthyroidism are associated with adhesion capsulitis that contributes to depression, stress, and anxiety levels. Considering the prevalence of depression, stress, and anxiety as well as the associated musculoskeletal conditions caused by thyroid-related adhesive capsulitis, it is crucial to address psychological well-being when treating these conditions. Increasing the presence of mental health screenings and interventions in the treatment approach for hypo- and hyperthyroidism might reduce the psychological impact of hypo- and hyperthyroidism. 153 patients with thyroid disorders were found to be depressed in previous studies, with only 15% (n=23) suffering from depression. The majority of hyperthyroid patients suffer from depression from mild to extremely severe depression as opposed to the majority of hypothyroid patients who have moderate to severe depression. However, the level of depression did not appear to be statistically significant with the thyroid disorders group ($p=0.283$). In contrast, three descriptive studies (30, 31, 32) found that hypothyroid patients had a high prevalence of depression. However, most studies did not include all types of thyroid disorders, so the researchers presented the results of depression specific to one type of thyroid disorder and could not generalize those results to others.

Our study found that about one third of participants with hyperthyroidism experienced mild to severe depression, stress, and anxiety throughout the duration of their hyperthyroidism. Specifically, 54.54% of those with hyperthyroidism for 2-4 years reported moderate depression, while 63.63% reported moderate stress during this time. For those who have suffered from hyperthyroidism for five years or more, moderate depression and stress were significantly correlated (33.33% and 33.33%, respectively). Thus, prolonged hyperthyroid dysfunction may negatively affect psychological well-being and contribute to psychological distress.

On the other hand, hypothyroid dysfunction participants experienced varying levels of depression, anxiety, and stress. Most hypothyroid patients who have suffered from depression for 2 to 4 years reported moderate to severe symptoms of stress and depression (63.63%). Additionally, among hypothyroid individuals with a history of hypothyroidism for five years or more, those with a history of hypothyroidism for five years or more are more likely to exhibit moderate depression (50%) and moderate stress (50%) than those without hypothyroidism. The findings from this study have also suggested that chronic hypothyroidism may also be associated with an increased psychological burden, which negatively impacts people's mental health, especially their emotional well-being. The DASS Scale also shows higher prevalence of moderate and severe symptoms among chronic pain sufferers than among acute pain sufferers. Pain management strategies should address mental health concerns in order to reduce psychological burdens associated with prolonged pain duration. This study examined the psychological aspects of adhesive capsulitis and the interaction between thyroid function and kinesiophobia levels among people with adhesive capsulitis associated with hypothyroid disease or hyperthyroid disease. There is a wide variation in the level of kinesiophobia among participants across different durations of hypothyroidism and hyperthyroidism. Most hyperthyroidism patients exhibit kinesiophobia, with long-term sufferers showing the highest prevalence. Individuals with adhesive capsulitis may also experience heightened fear of or avoidance of movement due to hyperthyroid dysfunction. Physical activities and rehabilitation efforts can be hindered by kinesiophobia, potentially hindering recovery and managing the condition. Hypothyroid participants also reported kinesiophobia. This was particularly true for those with long-term hypothyroidism. Individuals with adhesive capsulitis may experience fear of movement due to hypothyroid dysfunction. As a result of the high prevalence of kinesiophobia in this population, it can be concluded that the condition may be aggravated by a combination of musculoskeletal symptoms and psychological factors. Individuals with adhesive capsulitis should be aware that thyroid dysfunction and kinesiophobia have a bidirectional relationship. An individual's perception of pain, disability, and fear of movement is affected by thyroid hormones, which regulate mood, cognition, and emotional well-being. In contrast, suffering chronic pain and functional impairment as a result of adhesive capsulitis can aggravate or even cause kinesiophobia. As a result of kinesiophobia, psychological assessment and intervention are especially important when it comes to treating adhesive capsulitis in the context of concurrent thyroid dysfunction. Movement and physical activity maladaptive beliefs and behaviors may be addressed with cognitive-behavioral approaches, education, graded exposure, and relaxation techniques. On the TAMPA SCALE, individuals with chronic pain show a higher prevalence of kinesiophobia, or a fear of moving as a result of pain. Patients with chronic pain may experience functional limitations and reduced quality of life due to this fear. As part of the DASH Scale, the disability of the arm, shoulder, and hand (DASH) scale was utilized to assess the functional limitations experienced by patients with adhesive capsulitis accompanied by hypothyroid dysfunction. The DASH Scale provides valuable insights into the functional limitations that these individuals experience. There is a considerable variation in the degree of

shoulder disability between hypothyroid and hyperthyroid states based on the duration of hypothyroidism or hyperthyroidism. There is a significant proportion of individuals who suffer from hyperthyroidism who experience mild to severe levels of shoulder disability, and this prevalence is highest among those with longer durations of hyperthyroidism. There may be an association between dysfunctional hyperthyroidism and functional impairments in shoulder mobility and performance in relation to hyperthyroidism. Additionally, a substantial proportion of those who had hypothyroidism reported mild to severe disability in their shoulders, particularly those who suffered from the condition for a prolonged period. Hypothyroid dysfunction has been found to have a detrimental effect on shoulder function, which contributes to the disabilities that people with adhesive capsulitis experience as a result. Individuals with shoulder disability are significantly restricted in their ability to do daily living activities, work-related tasks, and leisure activities due to adhesive capsulitis. Adhesive capsulitis can severely limit functional capacity and diminish quality of life due to shoulder pain, stiffness, and restricted range of motion. Individuals with adhesive capsulitis and thyroid dysfunction suffer from shoulder disability due to multiple factors. There is no clear explanation for the pathophysiological mechanism that underlies this association, but musculoskeletal, hormonal, and psychosocial factors may all play a part. Standardized shoulder disability assessment tools such as the DASH Scale enable functional limitations to be quantified and treatment outcomes to be tracked over time. Physical therapy, corticosteroid injections, and, in severe cases, surgical interventions can be used to improve shoulder mobility, reduce pain, and enhance overall function. Individuals with chronic pain are more likely to have moderate and severe shoulder disability, as determined by the DASH Scale, indicating greater limitations in daily activities.

Studies have previously examined the effects of overt thyroid dysfunction on quality of life. Physical functioning and PCS were significantly correlated with younger age, while social functioning and MCS were significantly correlated with older age. Patients with differentiated thyroid cancer who were younger than 14-17 had a better quality of life than the elderly (33-36). There is a significant correlation between higher education and better general health in patients with thyroid disease, and we found the same thing as well(17). In patients with thyroid disease, few studies have investigated the influence of tobacco smoking on quality of life.

A single study has shown that active smoking decreases physical and mental quality of life in thyroid disease patients(37). In a previous study(38), it was shown that duration of disease was significantly correlated with physical aspects of QoL (physical functioning, vitality, and PCS), and patients with shorter lasting diseases had better QoL than those with longer lasting diseases.

A cohort study found that women made up 89.0% of the cohort, while men made up 11.0% of the cohort.

Miccoli P. et al. also showed that thyroid disease did not have an influence on QoL in their study. Since thyroid disorders typically affect females 10-20 times more than males (39), we believe it did not influence our findings.

Research has shown that autoimmunity itself affects quality of life regardless of hormonal status (40,41). Based on our findings, mood/behaviour disturbances, depression and anxiety are significantly associated with decreased quality of life, not only in terms of mental quality but also in terms of physical quality of life. SF-36 scores were significantly correlated with patient characteristics.

According to the SF-36 questionnaire, QoL scores did not significantly correlate with the level of TSH serum and the type of thyroid disease.

According to a study, individuals with adhesive capsulitis suffering from hypothyroidism and hyperthyroidism were examined using the SF36 scale to assess their general well-being and functional status.

There was a relatively high level of quality of life reported by participants in the hyperthyroid state. Despite thyroid dysfunction, a significant portion of respondents reported poor health across intervals of time. In individuals with hyperthyroidism for 1 year or less, 16.66% reported poor health, while 27.27% and 33.33% reported poor health in patients with hyperthyroidism for 2-4 years and 5 years or more. A longer duration of hyperthyroid dysfunction may exacerbate the perceived decline in health status, thereby negatively affecting quality of life.

Participants with hypothyroid dysfunction, on the other hand, experienced different levels of quality of life with different durations of thyroid dysfunction. Hypothyroidism in the majority of cases is associated with good health, but there is also a proportion who report that their health is poor. The percentage of people who reported poor health was 36.36% and 50% among those with hypothyroidism for 2-4 years and 5 years or more. People suffering from thyroid dysfunction, particularly those with long-term hypothyroidism, may also find it difficult to maintain a high quality of life.

A complex relationship exists between thyroid function and overall well-being as demonstrated by the observed differences in quality of life between hypo- and hyperthyroid states. Different aspects of physical and mental health can be affected by thyroid disorders, potentially resulting in diminished quality of life and reduced functional status. In order to optimize overall wellbeing and quality of life, thyroid dysfunction and its associated symptoms must be addressed. A lower proportion of healthy people and a higher proportion of unhealthy people are found among people with chronic pain based on the SF36 Scale. A chronic pain condition impacts physical, emotional, and social well-being on multiple levels.

A visual analog scale (VAS) can be used to assess the severity of pain in individuals with adhesive capsulitis associated with hypothyroidism and hyperthyroidism [42]. It is common for hypothyroid myopathy to cause weakness throughout the body, with the thighs and shoulders being the most affected. Muscle symptoms caused by hypothyroidism are rare. Hoffman's syndrome is one such example [43]. Muscle hypertrophy (enlarged muscles) occurs when a person develops it. As a result, muscles may become stiff, weak, and painful. Some experts

believe hypothyroidism-induced myopathy is caused by diminished thyroxine levels (T4), which are caused by hypothyroidism [44]. Muscle weakness and cramping can also occur in hyperthyroidism, although symptoms tend to differ from hypothyroidism-related myopathy. There is no clear explanation for the causes of hyperthyroidism-related myopathy. Muscle protein may be broken down more quickly and used up more energy when thyroid hormone levels are high [45,46]. Hyperthyroid myopathy is generally cured by treating your hyperthyroidism. Even after thyroid function has returned to normal, it may take several months before symptoms improve.

According to our study, participants reported varying degrees of pain severity during hypothyroidism and hyperthyroidism. A significant proportion of hyperthyroidism patients report severe pain, with the majority experiencing moderate to severe pain. Individuals with adhesive capsulitis may perceive and manage pain differently due to hyperthyroid dysfunction. A similar pattern was observed across different time intervals regardless of the duration of hyperthyroidism. Hypothyroidism also displays moderate to severe pain levels in a substantial proportion of participants, particularly those with long-term hypothyroidism. Individuals with adhesive capsulitis might experience heightened pain perception due to hypothyroid dysfunction. There was considerable overlap between the severity of pain described by individuals with hypothyroidism and those with hyperthyroidism, indicating a similar response to thyroid dysfunction regardless of thyroid status. Adhesive capsulitis and thyroid dysfunction are associated with multifactorial pain perception and management. Inflammation and pain modulation are some of the physiological processes that thyroid hormones regulate. Pain perception and sensitivity can be heightened as a result of dysregulation of thyroid function. Individuals with adhesive capsulitis and thyroid dysfunction experience pain, which emphasizes the need for comprehensive treatment strategies that address both the thyroid condition and musculoskeletal symptoms. In order to effectively alleviate pain and improve quality of life, these individuals may need a multidisciplinary approach, which may include pharmacological interventions, physical therapy, and lifestyle changes. According to the VAS Scale, people with chronic pain are more likely to report moderate to severe pain than those with acute pain. Pain severity and duration may often be increased in chronic pain conditions, according to previous studies.

Patients suffering from adhesive capsulitis who are also suffering from hypothyroidism or hyperthyroidism can be assessed for irritability levels. These levels may provide insight into the psychological impact of these conditions. There is a variation in irritability levels depending on the duration of hypothyroidism or hyperthyroidism. People with hyperthyroidism are prone to being irritable in significant proportions, with higher percentages observed among those with longer-term conditions. The physiological effects of thyroid hormone imbalances on mood regulation and psychological functioning may explain the possible association between hyperthyroid dysfunction and increased irritability.

Additionally, many participants with hypothyroidism also reported being irritable, particularly those with long-term hypothyroidism. Hypothyroid dysfunction may have a detrimental effect on irritability levels, and thyroid hormone deficiency may cause mood and affective changes. Adhesive capsulitis and thyroid dysfunction are associated with irritability and psychological distress. Irritability can result from chronic pain, physical limitations, and hormonal imbalances associated with these conditions. Chronic pain, physical limitations, and hormonal imbalances are all factors contributing to emotional distress and affective instability. Adhesive capsulitis and thyroid dysfunction are interconnected physical and psychological factors. A comprehensive approach to patient care and optimal outcomes requires addressing both physical symptoms and psychological distress. In this population, pharmacological and nonpharmacological interventions are available to manage irritability, such as thyroid hormone replacement therapy, pain management strategies, stress reduction techniques, and counseling or psychotherapy. Individuals with chronic pain tend to exhibit a high degree of irritability, possibly indicative of psychological distress and emotional dysregulation.

CONCLUSION

According to this study, thyroid dysfunction and adhesive capsulitis (AC) are interconnected in a complex way, emphasizing the need for comprehensive approaches to management of this condition. As a result of the predominance of hyperthyroidism and associated negative impacts on mental health, physical activity, and sleep quality, thyroid status is an important factor to consider in AC patients. The findings highlight the importance of interventions for individuals with thyroid disorders in addressing AC's multifaceted nature.

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