



# Impact of Patient Age on Management of Hypothyroidism: A Survey of Physicians from Three Developing Regions

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## Abstract

**Background** The thyroid-stimulating hormone (TSH) levels increase with age, and aiming for the same TSH target applicable in a younger population in older patients who are on replacement with thyroid hormones.

**Methods** We assessed practice patterns regarding TSH goals and explored factors influencing physicians' decision-making when managing hypothyroidism. Multiple-choice questions in a case-based survey of a convenience sample of physicians practicing in relevant disciplines in three developing regions.

**Results** Of the total 286, senior physicians represented 63% and mid-grades represented 27% of the respondents. Forty-one percent were endocrinologists, 19% were internists with endocrine interests, and 16% were family physicians. Over half (52%) practiced at a tertiary level and 42% had been in practice for over 20 years. Fifty percent of respondents had more than 20% of their patients over 65 years.

Several attributes were factored into decision-making when managing hypothyroidism. Respondents took into account age (75%), preceded by the presence of cardiac arrhythmias (80%), pregnancy (79%), heart disease (78%), and patient symptoms (77%) when determining the treatment strategy. When presented with scenarios differing in patients' age, around 90% of physicians targeted a TSH  $\leq$  3.0 mIU/L in 30-year-old patients. Fifteen percent of respondents targeted a TSH of 1.6 to 3.0 mIU/L in octogenarians, but 78% targeted a TSH  $>$  3.1 to 5.0 mIU/L in this group. Regardless of sex, physician-reported TSH goal ranges (0.1–0.5, 0.6–1.5, 1.6–3.0, and 3.1–5.0 mIU/L) increased directly to patient age. Overall, respondents were less inclined to start

## Keywords

- ▶ older adults
- ▶ hypothyroidism
- ▶ survey
- ▶ thyroid hormone therapy
- ▶ overtreatment
- ▶ age

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treatment in 85-year-olds than in 70-year-old females with TSH of 6 mU/L (20% vs. 11%). Females with a TSH of 15 mU/L were more likely to get treated than those with a 6 mU/L TSH. Vital persons are more likely to be treated with thyroxine than vulnerable persons for the same TSH levels. Multivariate analysis showed that compared with endocrinologists, family physicians and other specialties were less likely to consider age in their clinical decisions, odds ratio (OR) 0.2 (95% confidence interval [CI] 0.1–0.7),  $p = 0.018$ , and OR 0.3 (95% CI 0.1–0.8),  $p = 0.013$ , respectively.

**Conclusion** A consensus is needed on the role of patients' age in hypothyroidism management, the complexity of managing hypothyroidism in an older adult patient, and the variability in practice patterns among physicians. Addressing these challenges demands ongoing dialogue and collaboration among health care providers to improve patient care and outcomes in hypothyroidism management across different age groups.

## Introduction

Hypothyroidism is the most common thyroid disorder in adults globally. Hashimoto's thyroiditis has a female preponderance of 4:1; however, there are discrepancies in the regions with different economic levels.<sup>1</sup> Population studies indicate that hypothyroidism prevalence increases with age, with 1.7% of adults over the age of 65 diagnosed with overt hypothyroidism.<sup>2</sup> The prevalence of subclinical hypothyroidism (defined as normal free T4 [FT4] and elevated thyroid-stimulating hormone [TSH]) in adults over the age of 65 has been quoted as high as 13.7% in North America when assuming 4.5 mU/L as the upper limit of normal for TSH.<sup>1</sup> There is compelling population data to support the concept that a "normal" TSH range, which is the target for treatment, may be higher in older adults and associated with longevity and better survival.<sup>3–5</sup> Lowering the TSH in these individuals may not be warranted and can pose a risk of overtreatment, leading to detrimental consequences, especially in the older adults.<sup>6,7</sup> Risks include cardiac arrhythmias, increased cardiovascular mortality, osteoporosis, and fractures.<sup>8–15</sup>

Despite the compelling evidence indicating an age-related increase in serum (TSH) levels and the potential risks associated with overtreatment, current guidelines lack specific recommendations for TSH goals tailored to different age groups among individuals with hypothyroidism. Specific TSH ranges are currently only recommended for women of childbearing age interested in conception and for pregnant women.<sup>16</sup> However, clarity is needed for the necessity for age-specific TSH targets in the treatment of adults with hypothyroidism.<sup>17–20</sup> Furthermore, there is currently growing evidence against the routine treatment of older adult patients with subclinical hypothyroidism.

What factors affect health care providers' decision-making when setting target TSH treatment goals is still being determined. A study recently explored TSH goals in hypothyroidism.<sup>21</sup> However, primary care providers are often the

ones who prescribe thyroid hormone preparations. Although another survey included primary care physicians, it was conducted over two decades ago.<sup>18</sup>

Due to limited evidence about the benefits and risks of treatment on clinical outcomes, it is still being determined whether treatment of subclinical hypothyroidism is necessary, especially in older people.<sup>22–25</sup> Therefore, we conducted a multiregional physician survey to assess current clinical practice patterns regarding TSH goals among a diverse group of clinicians and to elucidate the factors influencing physicians' decision-making in managing adults with hypothyroidism. Additionally, we aimed to investigate the variation in treatment strategies for older patients with subclinical hypothyroidism, depending on select patient characteristics.

## Materials and Methods

### Target Population

The study population was defined by convenience sampling. In the absence of a single regional endocrine society with a well-defined membership list that can represent a study population, the target population was identified from a list of electronic mail pooled from continuous professional development delegates, speakers, authors, or members of various scientific groups or forums in different parts of the Middle East and Africa (MEA) region. Consequently, several questions were added to the survey to help define the demographic professional profiles of the respondents and their practices similar to those of our previously published studies.<sup>26–29</sup> The study used a convenience sampling method, and therefore no sample size was calculated. Also, the response rate could not be calculated as we have no information on the nonrespondents. English was used being the main language used by the medical profession, although some parts do

admittedly use French. Due to the sample size restrictions and inhomogeneous mismatch distribution between regions, we consciously refrained from making any subgroup analysis.

### Survey Management

A Web-based commercial survey management service (Survey Monkey, Palo Alto, California, United States) was used. All participants received an initial email that explained the rationale of the survey and what was required from the consented respondents, followed by five subsequent reminder emails during the study period. Each message included an explanation of the rationale and method of participation, full credentials and contact details of the principal investigator, and a unique email-specific electronic link to the questionnaire. The survey service automatically blocked repeated submissions from the same IP (Internet Protocol) address. The survey Web site was open for the 12-month study period. Finally, survey responses were collected and stored electronically for an anonymous analysis.

### Survey Questionnaire

The questionnaire was adapted from two recently published studies with the same goals.<sup>30,31</sup> The questionnaire's contents were validated in the original studies and were used in their original language. The descriptive part to characterize the responding population has been established in many of our studies cited in the methodology section. However, we have a small pilot test for the survey before we run out to the larger sample. The text of the pooled survey instrument is provided in the online ► **Supplementary Material S1** (online only). Section I aimed to get insight into respondents' demographic and professional profiles (8 questions). In addition, what is the number of people seen in their practices? They were also asked how much time had elapsed since last diagnosing a patient with subclinical hypothyroidism and how much time had elapsed since last starting thyroxine treatment in a patient with subclinical hypothyroidism. Section II included two survey items addressing the provider's decision-making regarding goal TSH in managing hypothyroidism. One survey item explored the influence of patient age, patient symptoms (such as racing heart tremors), patient preference, fatigue, cardiac arrhythmias, heart disease, osteoporosis, fractures, multiple falls, and weight on decision-making regarding goal TSH. Another survey item asked what TSH goal range providers targeted in 8 clinical scenarios. The scenarios differed in patient sex and age (30, 50, 65, or 85). For the clinical scenarios, TSH goal ranges were set as 0.1 to 0.5, 0.6 to 1.5, 1.6 to 3.0, and 3.1 to 5.0 mIU/L.<sup>30</sup> Section III is a case-based survey discussing eight different fictional patients. All patients were older females with a normal body mass index and experienced nonspecific complaints resulting in fatigue. The females differed in age (70 vs. 85 years), vitality status (vital vs. vulnerable disposition), and TSH (6 vs. 15 mIU/L). All eight females had a raised TSH, while free thyroxine was normal. Each case description was followed by questions on the physicians' treatment strategy. They were asked (1) whether they

would start treatment and (2) what the starting dose of thyroxine would be.<sup>31</sup>

### Statistical Analysis

We used STATA 15 software (Stata Corp LP, College Station, Texas, United States) for data analysis. We summarized categorical data as percentages and continuous data as mean  $\pm$  standard deviation. We have no details of the nonresponders; hence, we did not calculate the response rates. To assess the characteristics of physicians associated with considering age when treating older adult patients with elevated TSH, we ran a multivariate regression analysis that included the gender, region, age groups, years of experience, specialty, grade, practice type, and proportion of patients  $> 65$  years. We used the chi-square test and Fisher's exact test to compare the response of physicians (stratified by specialty) to the case scenarios. We used analysis of variance and Bonferroni post hoc analysis to measure the differences in the mean levothyroxine doses suggested by physicians (stratified by specialty) when treating older adult patients. We considered  $p < 0.05$  to be significant.

## Results

### Respondents' Characteristics

A convenience sample of physicians practicing in the MEA in relevant disciplines was invited to take a Web-based survey of previously validated questionnaires to determine the goal of TSH when treating hypothyroidism. A total of 286 surveys were received, predominantly males, 180 (63.9%), mainly from the Middle East 194 (67.8%), and the majority were senior physicians, 179 (62.6%), as shown in ► **Table 1**. Most physicians were endocrinologists, 117 (40.9%), followed by internal medicine, 88 (30.8%), and family medicine, 46 (16.1%).

### Respondent's Involvement in Hypothyroidism in Older Adults

The extent of the participant's involvement in the general care of older adults and in diagnosing and managing hypothyroidism in this group is detailed in ► **Table 1**. About half of the respondents stated that  $> 20\%$  of patients in their practice are 65 years or above; 24% reported having 10 to 20% of their patients in this age group. When they were asked when they last diagnosed a patient over 65 with subclinical hypothyroidism, 19, 34, and 26% responded as less than 1 week, 1 month, and 1 year, respectively. Starting thyroxine treatment in patients over 65 with subclinical hypothyroidism was reported within the past week, past month, and past year by 11, 25, and 26%, respectively. However, 20% never did it.

### Impact of Age on Decision-Making Regarding TSH Target

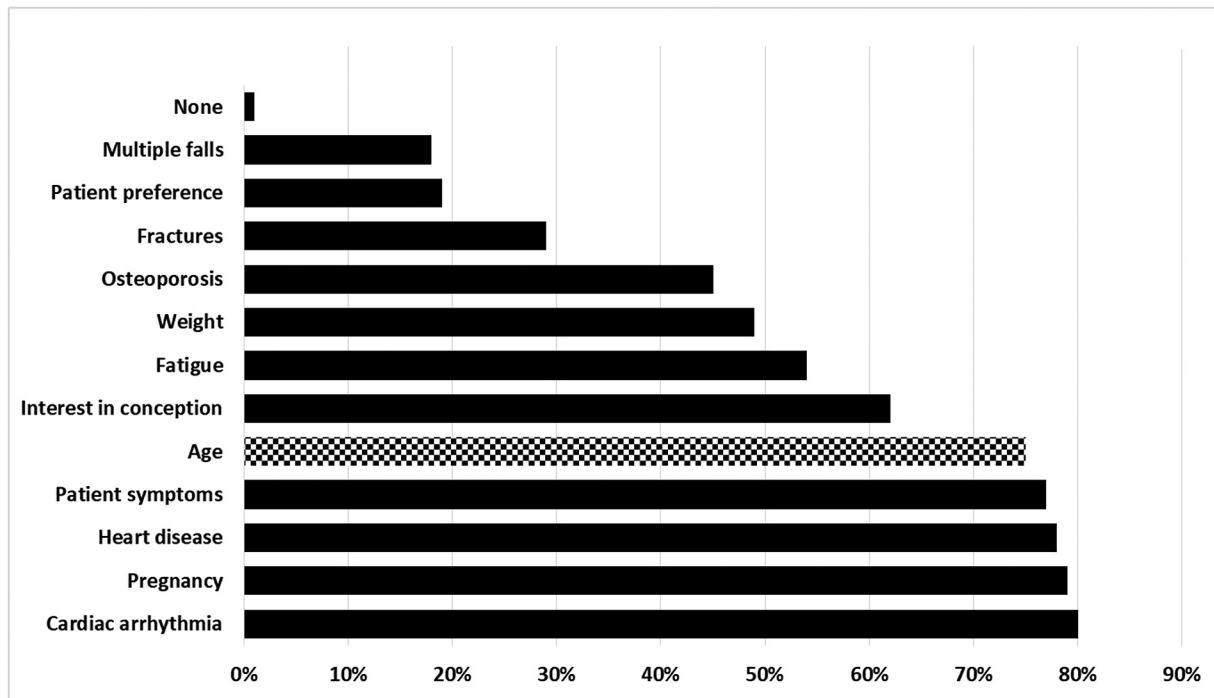
► **Fig. 1** shows the factors influencing the respondent's decision-making regarding the "goal TSH range" when treating patients with thyroid hormone replacement therapy. Seventy-five percent of physicians reported patient age as

**Table 1** Demographic and professional characteristics of the study participants, including the extent of their involvement in the general care of older adults and in diagnosing and managing hypothyroidism in older adults

Sex (N = 286)	Male	180 (63.9%)
	Female	106 (37.1%)
Region (N = 286)	Middle East	194 (67.8%)
	Africa	58 (20.3%)
	Southeast Asia	34 (11.9%)
Age groups	≤ 30 y	6 (2.1%)
	31–40 y	65 (22.7%)
	41–50 y	102 (35.7%)
	51–60 y	75 (26.2%)
	> 60 y	38 (13.3%)
Career stage (N = 286)	Junior	12 (4.5%)
	Middle	78 (27.3%)
	Senior	179 (62.6%)
	Other	16 (5.6%)
Specialty (N = 286)	Endocrinology	117 (40.9%)
	Internal medicine	88 (30.8%)
	Family medicine	46 (16.1%)
	Others	34 (12.2%)
Type of practice (N = 286)	Primary care	64 (22.4%)
	Secondary care	65 (22.7%)
	Tertiary care	148 (51.8%)
	Others	9 (3.1%)
Years of experience (N = 286)	< 5 y	15 (5.3%)
	5–10 y	43 (15.2%)
	11–15 y	54 (19.2%)
	16–20 y	50 (17.7%)
	21–25 y	40 (14.2%)
	> 25 y	80 (28.4%)
The percentage of patients in practice is 65 years or above (N = 276)	< 10	27%, 74
	10–20	24%, 66
	20–30	30%, 82
	> 30	20%, 54
When did you last diagnose a patient over 65 with subclinical hypothyroidism? (N = 274)	< 1 week ago	19%, 51
	< 1 month ago	34%, 92
	< 1 year ago	26%, 72
	< 3 years ago	7%, 20
	> 3 years ago	14%, 39
When did you last start thyroxine treatment in a patient over 65 with subclinical hypothyroidism? (N = 275)	< 1 week ago	11%, 31
	< 1 month ago	25%, 70
	< 1 year ago	26%, 72
	< 3 years ago	8%, 23
	> 3 years ago	8%, 23
	Never	20%, 56

an important factor influencing decision-making regarding goal TSH in treating hypothyroid patients. Patient age was scored fifth to the presence of cardiac arrhythmia (80%), pregnancy (79%), heart disease (78%), and patient symptoms (77%). Interest in conception (62%), fatigue (54%), weight

(49%), and osteoporosis (45%) were less commonly considered in decision-making. Fractures, patient preference, and multiple falls were cited as relevant by even fewer respondents (29, 19, and 18%, respectively). Only 3 (1%) physicians reported that none of the above factors were important in



**Fig. 1** The factors influencing the respondent's decision-making regarding the "goal thyroid-stimulating hormone (TSH) range" when treating patients with thyroid hormone replacement therapy.

their decision-making regarding goal TSH when treating adults with hypothyroidism.

► **Table 2** shows the univariate and multivariate analysis for considering patients' age (dependent variable) in treating older adult patients with elevated TSH. Univariate analysis showed that the decision to treat older adult patients varies according to the age of the physicians ( $p=0.037$ ) and the specificity ( $p=0.021$ ). More endocrinologists consider age when treating older adult patients, 88 (75.2%), than internal medicine, 58 (65.9%), family physicians, 28 (60.9%), and others, 17 (48.6%). However, multivariate analysis showed that only specialty impacts the treatment decision in relation to age. Compared with endocrinologists, family physicians and other specialties were less likely to consider age in their clinical decisions, odds ratio (OR) 0.2 (95% confidence interval [CI] 0.1–0.7),  $p=0.018$ , and OR 0.3 (95% CI 0.1–0.8),  $p=0.013$ , respectively.

► **Table 3** shows the proportion of physicians who have decided to treat the patients in each scenario for the group as a whole. Furthermore, ► **Table 4** shows that in all scenarios that included cases with subclinical hypothyroidism (cases 1, 2, 5, and 8), endocrinologists and internal medicine physicians were less likely to recommend treatment compared with family physicians and others ( $p < 0.05$ ).

The recommended start dosage of levothyroxine in all cases of hypothyroidism is shown for the whole group in ► **Table 3** and by specialty in ► **Table 4**. Family and other physicians recommend higher starting doses than endocrinologists and internal medicine physicians. Post hoc analysis showed that family physicians recommend significantly higher doses of levothyroxine in all case scenarios than endocrinologists and internal medicine physicians.

### Factors Determining the Goal TSH

► **Fig. 2** shows the distribution of the respondents' answers to clinical scenarios differing in patient age and sex regarding goal TSH range in hypothyroid patients. It is shown that around 90% of respondents aim for a TSH  $\leq 3.0$  mIU/L in a 30-year-old patient regardless of sex. This proportion decreases with age such that 15% of respondents targeted a TSH of 1.6 to 3.0 mIU/L in octogenarians, but 78% targeted a TSH of 3.1 to 5.0 mIU/L in this group. Regardless of sex, physician-reported TSH goal ranges (0.1–0.5, 0.6–1.5, 1.6–3.0, and 3.1–5.0 mIU/L) increased directly to patient age.

### Impact of Age, Vitality, and TSH on the Management of Subclinical Hypothyroidism

Overall, respondents were less inclined to start treatment in 85-year-olds than in 70-year-old females with TSH of 6 mIU/L (20% vs. 11%). Females with a TSH of 15 mIU/L were more likely to get treated than those with a 6 mIU/L TSH. Vital persons are more likely to be treated with thyroxine than vulnerable persons for the same TSH levels. When indicated, the dose does not seem different for the various groups other than a tendency for a lower dose in those vulnerable persons over 85 years (► **Table 3**). Patterns were similar when comparing the TSH goals in female and male patients, which differed by age (► **Fig. 2**).

### Discussion

In the present survey, we found a considerable variation in physicians' treatment strategies for older people with subclinical hypothyroidism. We reported that 75% of respondents considered the patient's age as an important factor in

**Table 2** Univariate and multivariable assessments of the characteristics of the physician linked to the weight given to the patient's age when establishing the target TSH in hypothyroidism

Variables		Proportion of physicians	Univariate p-value	Multivariate odd ratio	Multivariate p-value
Sex	Male	123 (68.3%)	0.536	Ref	
	Female	68 (64.8%)		1.1 (0.6–2.1)	0.702
Region	Africa	37 (63.85)	0.803	Ref	
	Middle East	132 (68.0%)		1.3 (0.6–2.9)	0.385
	Southeast Asia	22 (64.7%)		0.8 (0.3–2.2)	0.676
Age group	< 20 y	0 (0.0%)	0.037		
	21–30 y	3 (75%)		Ref	
	31–40 y	39 (60.0%)		1.3 (0.8–21.1)	0.846
	41–50 y	78 (76.4%)		4.7 (0.2–91)	0.310
	51–60 y	45 (60%)		1.7 (0.1–37.0)	0.724
	> 60 y	26 (68.4%)		2.0 (0.1–49.1)	0.651
Grades	Junior	11 (84.6%)	0.181	Ref	
	Middle	47 (60.2%)		0.15 (0.02–1.0)	0.053
	Senior	120 (67.0%)		0.17 (0.02–1.2)	0.076
	Other	13 (81.3%)		0.64 (0.07–6.3)	0.704
Specialty	Endocrinology	88 (75.2%)	0.021	Ref	
	Internal medicine	58 (65.9%)		0.7 (0.3–1.4)	0.323
	Family medicine	28 (60.9%)		0.2 (0.1–0.7)	0.018
	Others	17 (48.6%)		0.3 (0.1–0.8)	0.013
Practice	Primary care	41 (64.1%)	0.805		
	Secondary care	42 (64.6%)		0.6 (0.2–1.6)	0.300
	Tertiary care	101 (68.2%)		0.7 (0.3–2.0)	0.541
	Others	7 (77.8%)		2.3 (0.4–14.9)	0.376
Years of experience	< 5 y	30 (69.8%)	0.827		
	5–10 y	35 (64.8%)		Ref	
	11–15 y	33 (66.0%)		0.5 (0.2–1.5)	0.248
	16–20 y	30 (75.0%)		0.5 (0.1–1.7)	0.261
	21–25 y	50 (62.5%)		0.9 (0.2–4.0)	0.976
	> 25 y	10 (66.7%)		0.7 (0.2–2.7)	0.677
Proportion of patients > 65 years	< 10 patients	44 (59.5%)	0.301		
	10–20 patients	45 (68.2%)			
	20–30 patients	60 (73.2%)			
	> 30 patients	34 (18.6%)			

Abbreviation: TSH, thyroid-stimulating hormone.

their decision-making when determining TSH goals in hypothyroid patients. However, when presented with more granular clinical scenarios that incorporated patient sex and age, physicians' reported TSH goals shifted with age but not sex. Even though in our survey we found that a majority (78%) aim for a TSH of 3.1 to 5.0 mIU/L in octogenarians, those highest at risk for adverse outcomes with excess thyroid hormone replacement, over 90% of respondents aim for a TSH > 1.5 mIU/L in the 85-year-old category, which may suggest an attempt to avoid overtreatment in this age group.

However, this target still would not adequately avoid overtreatment. A similar pattern is not seen in the 30-year-old group, the cohort at lowest risk for adverse effects from thyroid hormone overtreatment. Our findings indicate that endocrinologists and internal medicine specialists consider age more when making decisions than family physicians and other specialties. We consistently observed that family physicians are more inclined to treat individuals over 65 years with subclinical hypothyroidism as opposed to other specialties. Finally, we established that

**Table 3** The decision to treat or not to treat in a set of 8 fictional female cases of subclinical hypothyroidism (T4 is within the reference range) by age, vitality status, and serum TSH level and the starting dose per case scenario by the whole group of participants

Case (no.) <sup>a</sup>	Age (y)	Vitality level	TSH level	Would you treat? <sup>b</sup>		Starting dose <sup>c</sup> (mean ± SD) (mcg)
				Yes	No	
1 (N: 246)	70	Vital	6 mU/L	20%, 50	80%, 196	31.6 ± 17.8
2 (N: 248)	85	Vulnerable	6 mU/L	15%, 37	85%, 211	34.6 ± 19.3
3 (N: 246)	70	Vital	15 mU/L	91%, 225	9%, 21	36.3 ± 18.0
4 (N: 243)	70	Vulnerable	15 mU/L	89%, 216	11%, 27	33.7 ± 19.1
5 (N: 246)	85	Vital.	6 mU/L	11%, 28	89%, 218	31.9 ± 16.2
6 (N: 244)	85	Vital	15 mU/L	82%, 200	18%, 44	30.9 ± 17.1
7 (N: 243)	85	Vulnerable	15 mU/L	79%, 191	21%, 52	29.8 ± 17.0
8 (N = 243)	70	Vulnerable	6 mU/L	17%, 41	83%, 202	33.5 ± 18.6

Abbreviations: SD, standard deviation; TSH, thyroid-stimulating hormone.

<sup>a</sup>Identification of the cases numbers are the same in ► **Tables 3 and 4**. Further clinical definitions are also provided in the questionnaire (► **Supplementary Material S1**, online only).

<sup>b</sup>Subgroup analysis of the decision to treat or not to treat by specialty is shown in ► **Table 4**.

<sup>c</sup>Subgroup analysis of the thyroxine starting dose per specialty is shown in ► **Table 4**.

endocrinologists and internal medicine physicians recommend lower starting doses of levothyroxine for people with hypothyroidism who are above the age of 65 years.

Over a decade ago, a survey of primary care physicians and thyroid specialists regarding the management of hypothyroidism showed that only 30% of primary care physicians and 19% of thyroidologists aimed for a higher TSH range (2.0–5.0 mU/L) for a 73-year-old patient with hypothyroidism.<sup>32</sup> Another recent study that exclusively surveyed clinical endocrinologists showed that 29.5% would target a TSH range of 3.0 to 3.9 mU/L and 22.5% would target a TSH range

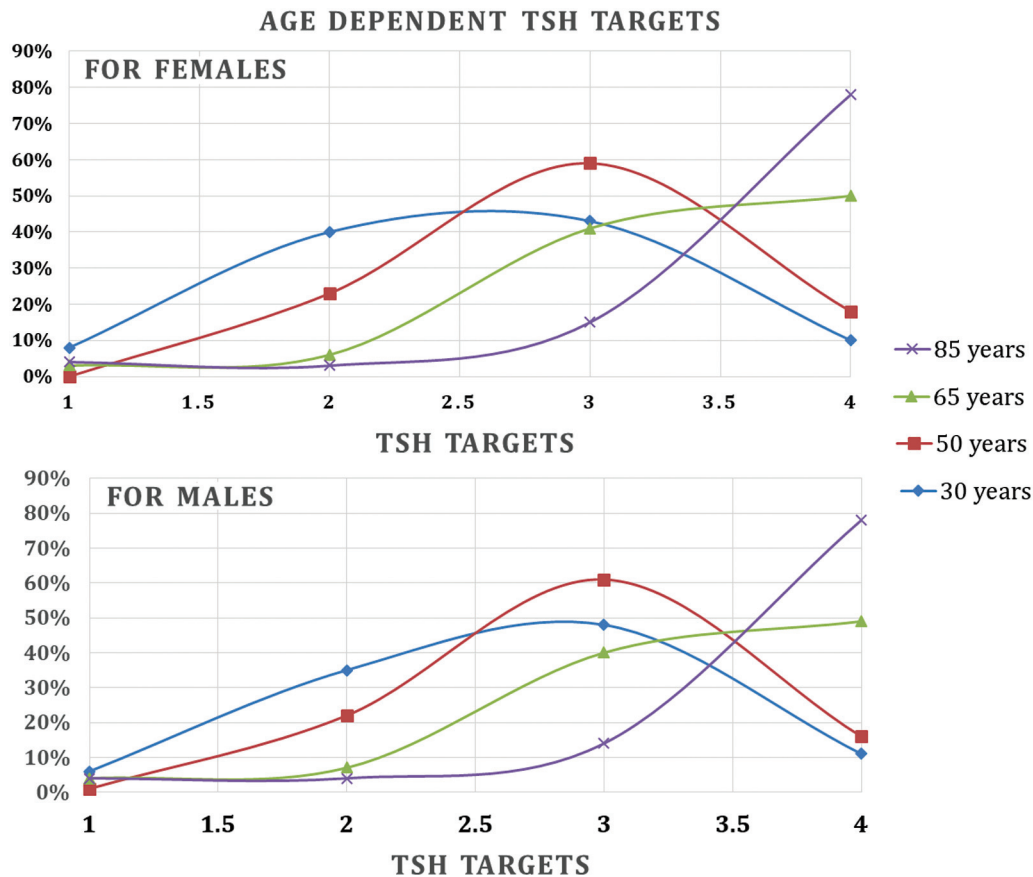
of 4.0 to 4.9 mU/L in an octogenarian.<sup>30</sup> Our study concurs with previous studies that showed no consensus among physicians regarding TSH goals depending on patient age.<sup>30,31</sup>

There is reasonably convincing evidence that TSH increases with age,<sup>2–5</sup> and lowering this with thyroid hormone therapy may increase the risk of overtreatment.<sup>6–8</sup> Previous population studies have shown that increasing patient age is associated with shifts in the TSH distribution curve to higher concentrations, presumably due to changes in TSH bioactivity, changes in negative feedback relationships between TSH and FT4, or influences from

**Table 4** The subgroup analysis was done by respondents' specialty of the proportion of physicians deciding to start treatment (I) and the mean starting dose (II) in each case scenario

Case <sup>a</sup>	Endocrinology	Internal medicine	Family medicine	Others	p-Value
I. The proportion of physicians deciding to start treatment, N (%):					
1 (N: 246)	18 (17.1)	10 (13.0)	13 (35.1)	9 (33.3)	0.011
2 (N: 248)	9 (8.6)	7 (9.0)	14 (37.8)	7 (25.0)	< 0.001
3 (N: 246)	102 (98.1)	68 (87.2)	33 (91.7)	22 (78.6)	0.003
4 (N: 243)	95 (89.5)	69 (90.8)	31 (86.1)	22 (84.6)	0.781
5 (N: 246)	9 (8.6)	2 (2.6)	9 (25.0)	8 (29.6)	< 0.001
6 (N: 244)	88 (85.4)	63 (80.8)	28 (77.8)	21 (77.8)	0.645
7 (N: 243)	79 (76.0)	62 (80.5)	30 (83.3)	20 (76.9)	0.772
8 (N = 243)	14 (13.4)	9 (11.7)	12 (34.3)	6 (22.2)	0.015
II. The mean start dose of levothyroxine therapy (mcg/day)					
3 (N: 246)	34.5 ± 14.2	33.0 ± 14.7	45.2 ± 27.7	42.0 ± 20.6	0.004
4 (N: 243)	28.1 ± 11.1	32.3 ± 16.2	46.5 ± 29.7	44.0 ± 24.5	< 0.001
6 (N: 244)	27.0 ± 11.0	27.8 ± 10.0	45.7 ± 30.2	36.6 ± 20.0	< 0.001
7 (N: 243)	24.8 ± 9.6	27.3 ± 11.8	44.0 ± 27.6	37.5 ± 21	< 0.001

<sup>a</sup>Identification of the case numbers are the same in ► **Tables 3 and 4**. Further clinical definitions are also provided in the questionnaire (► **Supplementary Material S1**, online only).



**Fig. 2** The percent participants' chosen goal thyroid-stimulating hormone (TSH) range mU/L (on the X-axis) for each of the age groups (30, 50, 65, and 85) and sex (females above and males below) ( $N = 252$ ).

medications.<sup>2,17,18</sup> Additionally, several other studies have demonstrated an association between longevity and higher TSH levels in several patient populations, suggesting that mildly elevated TSH levels may offer potential benefits to certain older adult patients.<sup>3,4</sup> Several guidelines recognize that the normal TSH reference range changes with age<sup>19,20</sup> but do not recommend targeting specific TSH goals based on patient age. Perhaps age-specific TSH ranges should be implemented to avoid overtreatment in vulnerable populations, such as older adults. A general population study demonstrated that only 60% of adults taking thyroid hormone have TSH levels in the euthyroid range, with up to 20% being overtreated.<sup>8</sup> In a cohort of men and women aged 65 years and older enrolled in the Cardiovascular Health Study, 41% of thyroid hormone users were found to be overtreated.<sup>9</sup> The deleterious effects of excess thyroid hormone on the cardiac system, including cardiac arrhythmias and increased cardiovascular mortality, and skeletal systems, including osteoporosis, have been described in several cohorts.<sup>10-16</sup> In addition, higher TSH and lower FT4 concentrations within the euthyroid range in older patients (age  $\geq 65$  years) not taking thyroid hormone medications are associated with a lower risk of multiple adverse events in older adults, including mortality.<sup>11</sup> In this current study, in addition to evaluating the role of age, we investigated other reasons for modifying TSH goals. Interestingly, cardiac disease, pregnancy, and symptoms (such as tremors and racing heartbeat) were

considered the most important factors influencing goal TSH for patients with hypothyroidism. This may be appropriate as symptoms may indicate overtreatment with thyroid hormone replacement, and dose adjustments may be necessary. Interestingly, over half of the treating physicians cited fatigue as an important factor influencing decision-making, contradicting current guidelines, which do not recommend adjusting the TSH goal in hypothyroid patients according to symptoms such as fatigue.<sup>17</sup>

Furthermore, despite the well-documented adverse effects of a low TSH on the cardiac and skeletal systems, physicians were more likely to consider cardiac arrhythmias and heart disease rather than osteoporosis, fractures, and falls in their decision-making process.<sup>10-16</sup> This discrepancy underscores the need for more comprehensive physician education to emphasize the skeletal risks associated with thyroid hormone overtreatment and cardiac risks, particularly in older adults.

In the section on subclinical hypothyroidism, a large variation in physicians' treatment strategies for older people with subclinical hypothyroidism was found by patient characteristics. Similar to the international study, the results reflect the lack of global consensus and the large variation in guidelines on whether or not to treat subclinical hypothyroidism, especially in older people.<sup>21,32,33</sup> Although guidelines often offer specific recommendations for the treatment of older patients with overt hypothyroidism, they usually



lack explicit guidance for managing older patients with subclinical hypothyroidism.<sup>34,35</sup>

The main strength of this study is its pioneering nature, which is the first of its kind to address this issue across a large geographical area of developing countries. We included various specialties in managing hypothyroidism in older adults and employed a comprehensive set of independent variables in a succinct online survey with diverse questions. However, notable limitations exist. The convenience sampling method used precludes the calculation of a reliable response rate, and there is a risk of nonresponse bias inherent in survey studies. While the survey encompassed an extensive array of factors influencing physician decision-making in managing hypothyroidism, other factors could have been included.

Moreover, discrepancies may exist between providers' responses to survey questions and their actual treatment behaviors. Furthermore, the focus solely on physicians overlooks the involvement of patients in the decision-making process. Additionally, physicians were not presented with cases involving differences in symptoms or various procedure options, such as watchful waiting or repeated thyroid function assessments. These limitations underscore the need for caution when interpreting the findings and suggest avenues for future research to address these gaps in knowledge and methodology.

## Conclusion

This study has implications for both patients and physicians. Failure to recognize the relationship between age and thyroid hormone requirements may lead to overtreatment, especially in older adults. Three-quarters of all physicians consider patients' age an important factor when determining TSH goals. When presented with clinical scenarios differing by patient sex and age, 90% of respondents reported aiming for a TSH > 1.5 mIU/L in octogenarians. This may indicate an attempt to avoid overtreatment in this specific age group. The observed physicians' treatment strategies for older people with subclinical hypothyroidism vary largely with patients' characteristics. The observed significant interphysician variations reflect the need for more evidence-based guidelines and increased awareness of treating physicians across specialties.

### Compliance with Ethical Standards

The Institutional Review Board of Sheikh Khalifa Medical City, Abu Dhabi, UAE, approved the study. Before accessing the survey questions, all participants provided electronic informed consent. All data were analyzed anonymously.

### Authors' Contributions

S.A.B. proposed the study, adapted the questionnaire, and managed the survey process. All authors examined the data, revised the manuscript for intellectual content and presentation, and approved its final version.

### Conflict of Interest

None declared.

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