

Investigation and Analysis of Community General Practitioners' Knowledge of Hypothyroidism in Pudong New Area of Shanghai

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Abstract

Background Hypothyroidism has become a common disease in the community. Although multiple editions of adult hypothyroidism guidelines and primary care guidelines have been issued in China, research on community general practitioners' mastery of hypothyroidism-related knowledge and clinical skills remains limited. **Objective** To investigate and analyze community general practitioners' mastery of hypothyroidism-related knowledge and clinical skills, so as to provide evidence for promoting standardized diagnosis, treatment, and management of patients with hypothyroidism in primary care. **Methods** From 2024-01-15 to 01-30, according to the urban-rural geographical division of Pudong New Area, Shanghai, 341 general practitioners from 9 community health service centers were selected by stratified random cluster sampling for an online survey. The questionnaire was self-developed based on hypothyroidism-related guidelines and expert consensus, and included basic information on general practitioners and test questions on hypothyroidism-related knowledge and clinical skills, covering 3 dimensions: etiology and screening, identification and diagnosis, and diagnosis and treatment management and referral. Multiple linear regression was used to analyze the influencing factors of community general practitioners' mastery of hypothyroidism-related knowledge. **Results** A total of 341 questionnaires were distributed, and 338 valid questionnaires were recovered (99.12%). The average correct rates of general practitioners' knowledge of the etiology and screening, identification and diagnosis, and diagnosis and treatment management and referral of hypothyroidism were 68.37% (2 542/3 718), 61.06% (2 683/4 394), and 77.78% (4 206/5 408), respectively, with an average score of (69.74 ± 13.98) . Only 9.47% (32/338) were able to independently diagnose and treat elderly patients with hypothyroidism in combination with guidelines. Multiple linear regression analysis showed that professional title, sex, educational background, age, and the approach to diagnosing and treating elderly patients with hypothyroidism were influencing factors for the etiology and screening dimension, identification and diagnosis dimension, diagnosis and treatment management and referral dimension, and total score in the hypothyroidism-related knowledge and clinical skills test among general practitioners ($P < 0.05$). Professional title and the approach to diagnosing and treating elderly patients with hypothyroidism were positive predictors of scores in the etiology and screening dimension ($P < 0.05$); sex and educational background were positive predictors of scores in the identification and diagnosis dimension ($P < 0.05$); age was a negative predictor of scores in the identification and diagnosis dimension and total score ($P < 0.05$); educational background and the approach to diagnosing and treating elderly patients with hypothyroidism were positive predictors of scores in the diagnosis and treatment management and referral dimension ($P < 0.05$); and educational background and the approach to diagnosing and treating elderly patients with hypothyroidism were positive predictors of the total score ($P < 0.05$). **Conclusion** General practitioners in Pudong New Area, Shanghai need to improve their mastery of hypothyroidism-related knowledge and clinical skills, especially their abilities in screening, identifying,

and diagnosing hypothyroidism, and they have insufficient practice in diagnosing, treating, and managing elderly patients with hypothyroidism. Training should be strengthened for general practitioners with lower educational levels, aged (>30 years, and lacking practical experience in community-based diagnosis, treatment, and management of elderly patients with hypothyroidism.

Full Text

Investigation and Analysis of Community General Practitioners' Knowledge of Hypothyroidism in Pudong New Area of Shanghai

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[Abstract] Background Hypothyroidism (hereinafter referred to as hypothyroidism) has become a common disease in communities. Although multiple versions of adult hypothyroidism guidelines and grassroots guidelines have been issued in China, research on community general practitioners' mastery of hypothyroidism-related knowledge and clinical skills is limited. **Objective** To investigate and analyze community general practitioners' mastery of hypothyroidism-related knowledge and clinical skills, and to provide a basis for promoting standardized diagnosis, treatment, and management of hypothyroidism patients at the primary-care level. **Methods** From 2024-01-15 to 01-30, according to the urban-rural regional division of Pudong New Area, Shanghai, stratified random cluster sampling was used to select 341 general practitioners from 9 community health service centers for an online survey. The questionnaire was developed independently based on hypothyroidism-related guidelines and expert consensus. Its contents included basic information on general practitioners and test questions on hypothyroidism-related knowledge and clinical skills (including three dimensions: etiology and screening, identification and diagnosis, and diagnosis-and-treatment management and referral). Multiple linear regression analysis was used to analyze factors influencing community general practitioners' mastery of hypothyroidism-related knowledge. **Results** A total of 341 questionnaires were distributed, and 338 valid questionnaires were recovered (99.12%). The average correct rates of general practitioners' knowledge of the etiology and screening, identification and diagnosis, and

diagnosis-and-treatment management and referral of hypothyroidism were 68.37% (2 542/3 718), 61.06% (2 683/4 394), and 77.78% (4 206/5 408), respectively, with an average score of (69.74 ± 13.98) points. The proportion able to independently diagnose and treat elderly patients with hypothyroidism in combination with guidelines was only 9.47% (32/338). Multiple linear regression analysis showed that professional title, sex, educational level, age, and the way of diagnosing and treating elderly patients with hypothyroidism were influencing factors for the scores in the etiology and screening dimension, identification and diagnosis dimension, diagnosis-and-treatment management and referral dimension, and total score of the hypothyroidism-related knowledge and clinical skills test among general practitioners ($P < 0.05$). Professional title and the way of diagnosing and treating elderly patients with hypothyroidism were positive predictors of the score in the etiology and screening dimension ($P < 0.05$); sex and educational level were positive predictors of the score in the identification and diagnosis dimension ($P < 0.05$); age was a negative predictor of the score in the identification and diagnosis dimension and the total score ($P < 0.05$); educational level and the way of diagnosing and treating elderly patients with hypothyroidism were positive predictors of the score in the diagnosis-and-treatment management and referral dimension ($P < 0.05$); educational level and the way of diagnosing and treating elderly patients with hypothyroidism were positive predictors of the total score ($P < 0.05$). **Conclusion** General practitioners in Pudong New Area of Shanghai need to improve their mastery of hypothyroidism-related knowledge and clinical skills. In particular, their ability to screen for, identify, and diagnose hypothyroidism is inadequate, and their practice in diagnosing, treating, and managing elderly patients with hypothyroidism is insufficient. Training should be strengthened for general practitioners with relatively low educational levels, aged (> 30) years, and lacking practice in community diagnosis, treatment, and management of elderly patients with hypothyroidism.

[Key words] Hypothyroidism; Community general practitioners; Knowledge; Investigation and analysis

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[Abstract] Background Hypothyroidism has become a common disease in communities. Although multiple versions of adult hypothyroidism guidelines and grassroots guidelines have been released in China, there is relatively little research on the knowledge and clinical skills of community general practitioners. **Objective** To investigate and analyze the mastery of knowledge and clinical skills related to hypothyroidism among community general practitioners, to provide a reference

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for promoting the standardized treatment management of community hypothyroidism patients. **Methods** From January 15th to January 30th, 2024, based on the regional division of urban and rural areas in Pudong New District, Shanghai, 341 general practitioners from 9 community health service centers were randomly selected for an online survey. The survey questionnaire was developed in combination with relevant guidelines and expert consensus on hypothyroidism, including basic information of general practitioners, knowledge related to hypothyroidism, and clinical skill test questions (covering three dimensions: etiology and screening, identification and diagnosis, treatment management and referral). It uses multiple linear regression analysis to examine the influencing factors of general practitioners' mastery of hypothyroidism-related knowledge in the community. **Result** A total of 341 questionnaires were distributed and 338 (99.12%) valid questionnaires were collected. The average correct rate of general practitioners on the etiology and screening, identification and diagnosis, treatment management and referral knowledge of hypothyroidism was 68.37% (2 542/3 718), 61.06% (2 683/4 394), 77.78% (4 206/5 408), with an average score of (69.74 ± 13.98) . The proportion of general practitioners who can independently diagnose and treat elderly hypothyroidism patients with guidelines is only 9.47% (32/338). The results of the multiple linear regression analysis showed that the factors such as professional title, gender, educational back-

ground, age, and the way of treating elderly patients with hypothyroidism were the influencing factors for the etiology and screening dimension, identification and diagnosis dimension, treatment management and referral dimension, and total score of the test questions on thyroid-related knowledge and clinical skills of general practitioners ($P<0.05$). Professional title and the way of diagnosing and treating elderly patients with hypothyroidism are positive predictors of the scores in the dimensions of etiology and screening ($P<0.05$). Gender and educational attainment are positive predictors of the scores in the identification and diagnosis dimensions ($P<0.05$). Age is a negative predictor for the dimensions and total score of recognition and diagnosis ($P<0.05$). Educational background and the approach to treating elderly patients with hypothyroidism are positive predictors of the scores in the dimensions of diagnosis management and referral ($P<0.05$). Educational background and the approach to treating elderly patients with hypothyroidism are positive predictors of the score ($P<0.05$). **Conclusion** The knowledge and clinical skills of general practitioners in Shanghai Pudong New Area regarding hypothyroidism need to be improved. Particularly, their abilities in screening, identification and diagnosis of hypothyroidism are insufficient, and their practical experience in the diagnosis and management of elderly patients with hypothyroidism is also inadequate. It is necessary to strengthen the training of general practitioners with lower education levels, who are over 30 years old and who lack community practice and management of elderly patients with hypothyroidism.

[Key words] Hypothyroidism; General Practitioner; Knowledge; Investigation and Analysis

Hypothyroidism (hereinafter referred to as hypothyroidism) has reached a prevalence of 17.8% in China; among these cases, the prevalence of clinical hypothyroidism is 1.1%, while the prevalence of subclinical hypothyroidism rose rapidly from 3.2% in 1999 to 16.7% in 2017^[1], and continues to increase with the accelerated aging of the community population^[2]. More and more studies have confirmed that the hazards of hypothyroidism should not be ignored; however, its typical symptoms and signs are absent or very mild, and especially among elderly people in the community it is easily covered up by various factors, resulting in missed diagnosis and misdiagnosis. Primary-care general practitioners should attach importance to the identification, diagnosis, and long-term management of patients with hypothyroidism^[3]. Although multiple adult hypothyroidism guidelines and primary-care guidelines have been issued in China, studies on general practitioners' mastery of hypothyroidism-related knowledge remain limited. Therefore, this study conducted a survey on the mastery of hypothyroidism-related knowledge and clinical skills among general practitioners in Pudong New Area, Shanghai, aiming to identify problems among general practitioners in the screening, identification and diagnosis, treatment management, and referral of hypothyroidism, provide targeted training, and offer a certain reference for better promoting standardized primary-care diagnosis and treatment management of patients with hypothyroidism.

1 Objects and Methods

1.1 Study Subjects

This study was conducted from 2024-01-15 to 01-30. Based on the urban and rural regional division, urban-rural fringe areas, and suburban urban-rural division of Pudong New Area, Shanghai^[4], stratified random sampling was performed in each district by computer. Three communities were randomly selected from each different region, for a total of 9 community health service centers corresponding to 9 communities; all Western-medicine general practitioners in each community health service center were selected as a group for a cross-sectional survey. Inclusion criteria: (1) registered and currently engaged in general medical work; (2) understood the significance of the survey and voluntarily participated in this survey. Exclusion criteria: (1) absent from the post for a cumulative period of more than 6 months due to personal or illness-related reasons; (2) clinical work experience of less than half a year. The study was reviewed and approved by the ethics committee of the Medical Consortium Public Welfare Hospital (ethics approval number: GLYY1s2024-008). PASS 11 was used to calculate the required sample size, specifically: Means $\rightarrow$ One Mean $\rightarrow$ Confidence Intervals $\rightarrow$ Confidence Interval for One Mean, with the parameter settings as follows: Confidence Level 0.95, Standard Deviation(S) 8.5, Confidence Interval Width 10.

1.2 Research Methods

1.2.1 Questionnaire Design The questionnaire in this study was designed by sorting out and combining the *Guidelines for the Diagnosis and Treatment of Adult Hypothyroidism*^[1], the *Guidelines for Primary-Care Diagnosis and Treatment of Hypothyroidism (Practice Edition • 2019)*^[5], and the *Expert Consensus on the Diagnosis and Treatment of Thyroid Diseases in Elderly Chinese People (2021)*^[2], and in conjunction with 4 thyroid disease diagnosis and treatment specialists.

experts and 5 general-practice medical experts designed the interview themselves. In each region, 5 general practitioners were also selected for a preliminary survey. Based on the preliminary survey results, some items in the questionnaire were revised or deleted, and after expert validation the final survey questionnaire was formed. The questionnaire's Cronbach's α coefficient was 0.808, indicating relatively high internal consistency.

1.2.2 Questionnaire content

Part 1 was the informed consent form; Part 2 covered the basic characteristics of general practitioners, including institution, sex, age, professional title, educational background, etc.; Part 3 consisted of test questions on knowledge related to hypothyroidism and clinical skills. The test questions included 3 dimensions: etiology and screening (11 questions), identification and diagnosis (13 questions),

and diagnosis-and-treatment management and referral (16 questions), for a total of 40 questions, all of which were multiple-choice questions. Each question had clearly defined correct options based on the above-mentioned guidelines and related sources. Each correctly answered question was scored 2.5 points, and each incorrectly answered question 0 points, with a full score of 100 points. The diagnostic and treatment approaches adopted by general practitioners for elderly outpatients with hypothyroidism were also investigated.

1.3 Survey methods

The basic information of the general practitioners was verified and provided by the medical departments of 9 community health service centers. Each center had 1 staff member responsible for the process. After unified training, the staff managed the survey process and sent the “Wenjuanxing” QR code to participants via WeChat, using standardized instructions. All items in the questionnaire were mandatory; if any item was left blank, the questionnaire could not be submitted. The questionnaire did not involve private information such as names. After the questionnaires were collected, invalid questionnaires, such as those with an answering time of less than 3 min or obvious logical errors, were excluded.

1.4 Statistical methods

PASS 11 was used to calculate the required sample size for this study, and SPSS 19.0 statistical software was used for analysis. Measurement data conforming to a normal distribution were expressed as $(\bar{x} \pm s)$, and intergroup comparisons were performed using one-way analysis of variance; count data were expressed as relative numbers. Multiple linear regression analysis was used to analyze the factors influencing community general practitioners’ mastery of knowledge related to hypothyroidism. A value of $P < 0.05$ was considered statistically significant.

2 Results

2.1 Basic characteristics of the included general practitioners

A total of 341 general practitioners were surveyed in this study, and 340 questionnaires were returned, with a response rate of 99.71% (340/341). There were 338 valid questionnaires, with an effective rate of 99.12% (338/341). Among the 338 respondents, 135 (39.94%) worked in urban areas, 88 (26.04%) in urban-rural fringe areas, and 115 (34.02%) in suburban areas; 103 (30.47%) were male and 235 (69.53%) were female. The age range was 25–62 years, with a mean age of (42.36 ± 7.71) years; 20 (5.92%) were aged ≤ 29 years, 100 (29.59%) were aged 30–39 years, 157 (46.45%) were aged 40–49 years, and 61 (18.05%) were aged ≥ 50 years. In terms of educational background, 17 (5.03%) had a junior-college degree or below, 266 (78.70%) had a bachelor’s degree, and 55 (16.27%) had a master’s degree or above. There were 229 (67.76%) general practitioners who had not received standardized resident physician training, and 109 (32.25%)

who had received standardized resident physician training. Regarding years of community work, 56 (16.57%) had worked for ≤ 5 years, 52 (15.38%) for >5 –10 years, 94 (27.81%) for >10 –20 years, and 136 (40.23%) for >20 years. There were 48 (14.20%) resident physicians, 214 (63.31%) attending physicians, and 76 (22.49%) associate chief physicians or above.

2.2 General practitioners' mastery of knowledge related to hypothyroidism and clinical skills

The mean accuracy rates for knowledge of the etiology and screening, identification and diagnosis, and diagnosis-and-treatment management and referral of hypothyroidism were 68.37% (2 542/3 718), 61.06% (2 683/4 394), and 77.78% (4 206/5 408), respectively; see Table 1.

2.3 Scores on general practitioners' hypothyroidism-related knowledge and clinical-skills test questions and univariate analysis

The mean score of the 338 general practitioners on the hypothyroidism-related knowledge and clinical-skills test questions was (69.74 ± 13.98) points. Among them, 78 (23.08%) scored <60 points, and only 1 (0.29%) scored 100 points. Only 32 (9.47%) were able to independently diagnose and treat elderly patients with hypothyroidism in accordance with the guidelines. The univariate analysis showed that the total scores on hypothyroidism-related knowledge and clinical-skills test questions differed significantly among general practitioners from different regions, by sex, age, educational background, and diagnostic/treatment approach for elderly patients with hypothyroidism ($P < 0.05$). Scores in the etiology-and-screening dimension differed significantly by professional title and diagnostic/treatment approach for elderly patients with hypothyroidism ($P < 0.05$). Scores in the identification-and-diagnosis dimension differed significantly by region, sex, age, educational background, and whether standardized training had been completed ($P < 0.05$). Scores in the diagnosis-and-treatment management and referral dimension differed significantly by educational background and diagnostic/treatment approach for elderly patients with hypothyroidism ($P < 0.05$); see Table 2.

2.4 Multivariate linear regression analysis of general practitioners' hypothyroidism knowledge scores

The scores for the etiology-and-screening dimension, identification-and-diagnosis dimension, diagnosis-and-treatment management and referral dimension, and total score in the general practitioners' hypothyroidism-related knowledge and clinical-skills test questions were used separately as dependent variables (assigned the measured values; see Table 3). Region, sex, age, educational background, professional title, whether standardized training had been received, and diagnostic/treatment approach for elderly patients with hypothyroidism were included as independent variables in the multivariate linear regression analysis. The results showed that professional title, sex,

educational background, age, and diagnostic/treatment approach for elderly patients with hypothyroidism were factors influencing general practitioners' scores in the etiology-and-screening dimension, identification-and-diagnosis dimension, diagnosis-and-treatment management and referral dimension, and total score on the hypothyroidism-related knowledge and clinical-skills test questions ($P < 0.05$). Professional title and diagnostic/treatment approach for elderly patients with hypothyroidism were positive predictors of scores in the etiology-and-screening dimension ($P < 0.05$); sex and educational background were positive predictors of scores in the identification-and-diagnosis dimension ($P < 0.05$); age was a negative predictor of scores in the identification-and-diagnosis dimension and total score ($P < 0.05$); educational background and diagnostic/treatment approach for elderly patients with hypothyroidism were positive predictors of scores in the diagnosis-and-treatment management and referral dimension ($P < 0.05$); and educational background and diagnostic/treatment approach for elderly patients with hypothyroidism were positive predictors of the total score ($P < 0.05$); see Table 4.

3 Discussion

In recent years, the prevalence of hypothyroidism in China has shown a continuous upward trend. In a systematic review of the prevalence of hypothyroidism among Chinese adults, Guan Yunfeng et al. [6] showed that the crude prevalence of hypothyroidism in 2011–2016 was higher than that in 2002–2010.

Table 1 Number of correct answers and percentage for each question in the knowledge and clinical skills test on hypothyroidism related to general practitioners

Item	Composition ratio cases(
Etiology and screening	
1. Classification of hypothyroidism according to the site of lesion?	279 (82.54)
2. The most common cause of primary hypothyroidism?	325 (96.15)
3. For patients with psychiatric disorders, is hypothyroidism screening recommended?	115 (34.02)
4. For those with pericardial effusion or dyslipidemia, is hypothyroidism screening recommended?	130 (38.46)

Item	<i>cases</i> (	Composition ratio
5. For those with pernicious anemia or hyperprolactinemia, is hypothyroidism screening recommended?		217 (64.20)
6. For those taking amiodarone and similar drugs, is hypothyroidism screening recommended?		221 (65.38)
7. For those with abnormal thyroid examination findings, is hypothyroidism screening recommended?		262 (77.51)
8. For those with a history of thyroid surgery or thyroid dysfunction, is hypothyroidism screening recommended?		303 (89.65)
9. For those with a history of cervical radiotherapy, is hypothyroidism screening recommended?		319 (94.38)
10. For those with autoimmune disease themselves or a first-degree relative with autoimmune thyroid disease, is hypothyroidism screening recommended?		328 (97.04)
11. When elderly patients enter nursing homes or are hospitalized, the preferred indicator for hypothyroidism screening?		43 (12.72)
Recognition and diagnosis		
1. The first-line diagnostic indicator for hypothyroidism?		198 (58.58)
2. The first-line diagnostic indicator for subclinical hypothyroidism?		257 (76.04)
3. Indicator for distinguishing mild from severe subclinical hypothyroidism?		103 (30.47)

Composition ratio	
Item	<i>cases</i> (
4. If a patient' s blood lipid level is elevated, should the possibility of hypothyroidism be considered?	125 (36.98)
5. If a patient has muscle and bone stiffness and pain, and numbness on palpation, should the possibility of hypothyroidism be considered?	142 (42.01)
6. If a patient has increased blood pressure or a slow heartbeat, should the possibility of hypothyroidism be considered?	154 (45.56)
7. If a patient gains weight, should the possibility of hypothyroidism be considered?	192 (56.80)
8. If a patient often has constipation and a decreased metabolic level, should the possibility of hypothyroidism be considered?	202 (59.76)
9. If a patient often feels low in mood and depressed, should the possibility of hypothyroidism be considered?	214 (63.31)
10. If a patient often feels cold, should the possibility of hypothyroidism be considered?	217 (64.20)
11. If a patient' s skin becomes dry, nails become brittle and easily broken, etc., should the possibility of hypothyroidism be considered?	251 (74.26)
12. If a patient has slow thinking, decreased memory, and slow movement, should the possibility of hypothyroidism be considered?	309 (91.42)

Item	cases(	Composition ratio
13. If a patient often feels fatigued, should the possibility of hypothyroidism be considered?	319	(94.38)
Diagnosis-and-treatment management and referral		
1. Treatment goal for primary clinical hypothyroidism	195	(57.69)
2. Individualized assessment of drug dosage for hypothyroidism replacement therapy?	290	(85.80)
3. Individualized assessment of the time to reach the dosage of hypothyroidism replacement therapy drugs?	300	(88.76)
4. First-choice replacement therapy drug for hypothyroidism?	271	(80.18)
5. Can L-T3 be used as a replacement therapy drug alone for hypothyroidism?	215	(63.61)
6. Treatment of subclinical hypothyroidism patients with hypothyroid symptoms, positive TPOAb, and dyslipidemia?	204	(60.36)
7. Method of taking L-T4?	288	(85.21)
8. In the early stage of L-T4 therapy, timing for rechecking relevant indicators?	176	(52.07)
9. After reaching the target with L-T4 therapy, interval for regular follow-up and rechecking?	195	(57.69)
10. For elderly hypothyroid patients taking L-T4 (Euthyrox 50 ug) , the dose-increase range for each adjustment?	222	(65.68)
11. Symptoms and referral for mucinous edema coma in hypothyroid patients?	311	(92.01)

Item	Composition ratio	
	cases(	
12. For patients with hypothyroidism who are planning pregnancy or are pregnant, is referral needed?	294	(86.98)
13. For patients with cretinism, juvenile hypothyroidism, etc., is referral needed?	297	(87.87)
14. After 3-6 months of standardized treatment, if TSH and other indicators do not reach target, is referral needed?	309	(91.42)
15. For newly discovered hypothyroidism, unclear etiology and classification, etc., is referral needed?	311	(92.01)
16. For patients with hypothyroidism combined with cardiovascular disease, other endocrine diseases, obvious thyroid enlargement, and other conditions difficult to manage in the community, is referral needed?	328	(97.04)

Note: Hypothyroidism = reduced thyroid function; L-T3 = liothyronine; TPOAb = thyroid peroxidase antibody; L-T4 = levothyroxine.

Table 2 Univariate analysis of scores of knowledge and clinical skills test of general practitioners on hypothyroidism ($\bar{x} \pm s$, points)

Item	Number of cases	Etiology and screening	Identification and diagnosis	Diagnosis/treatment	
				manage-ment and referral	Total score
Overall	338	18.80 $\pm$ 5.33	19.85 $\pm$ 7.93	31.09 $\pm$ 6.20	69.74 $\pm$ 13.98
Region					
Urban area	135	19.32 $\pm$ 5.62	21.20 $\pm$ 7.79	31.50 $\pm$ 6.15	72.02 $\pm$ 13.82

Item	Number of cases	Etiology and screening	Identification and diagnosis	Diagnosis/treatment	
				management and referral	Total score
Urban-rural fringe	88	18.84 ± 5.36	18.86 ± 7.81	31.71 ± 6.07	69.40 ± 13.33
Suburban area	115	18.17 ± 4.93	19.00 ± 8.02	30.15 ± 6.30	67.33 ± 14.35
<i>F</i> value		1.428	3.354	2.055	3.586
<i>P</i> value		0.241	0.036	0.130	0.029
Sex					
Male	103	18.25 ± 5.26	17.72 ± 7.74	31.19 ± 6.06	67.16 ± 13.75
Female	235	19.04 ± 5.36	20.78 ± 7.85	31.05 ± 6.27	70.82 ± 13.96
<i>t</i> value		1.576	10.962	0.034	5.109
<i>P</i> value		0.210	0.001	0.853	0.024
Age					
()29 years	20	19.75 ± 5.84	26.38 ± 5.59	32.00 ± 5.36	78.13 ± 12.82
30-39 years	100	18.05 ± 5.86	19.73 ± 7.67	31.13 ± 6.46	68.90 ± 13.63
40-49 years	157	19.12 ± 5.14	19.51 ± 7.97	31.23 ± 6.38	69.86 ± 14.32
()50 years	61	18.89 ± 4.69	18.77 ± 8.10	30.41 ± 5.61	68.07 ± 13.37
<i>F</i> value		1.072	5.181	0.412	2.857
<i>P</i> value		0.361	0.002	0.744	0.037
Educational background					
Junior college or below	17	17.79 ± 4.99	13.53 ± 4.68	26.03 ± 5.52	57.35 ± 11.54
Bachelor's degree	266	18.91 ± 5.13	20.05 ± 8.00	31.39 ± 5.98	70.35 ± 13.85
Master's degree or above	55	18.59 ± 6.34	20.82 ± 7.65	31.23 ± 6.84	70.64 ± 13.71
<i>F</i> value		0.400	6.067	6.172	7.299
<i>P</i> value		0.671	0.003	0.002	0.001

Item	Number of cases	Etiology and screening	Identification and diagnosis	Diagnosis/treatment management and referral	Total score
Whether received standardized training					
No	229	18.93 ± 5.08	19.20 ± 7.90	30.83 ± 6.13	68.96 ± 13.87
Yes	109	18.53 ± 5.84	21.93 ± 7.87	31.65 ± 6.35	71.38 ± 14.14
<i>F</i> value		0.411	4.698	1.298	2.208
<i>P</i> value		0.522	0.031	0.255	0.138
Years of community work					
()5 years ^a	56	18.21 ± 5.55	21.16 ± 8.13	31.16 ± 6.27	70.54 ± 14.55
>5-10 years ^b	52	19.52 ± 5.75	20.48 ± 7.60	31.44 ± 6.21	71.44 ± 13.38
>10-20 years ^c	94	18.48 ± 5.67	19.57 ± 8.29	31.52 ± 5.72	69.57 ± 14.45
>20 years ^d	136	18.99 ± 4.83	19.25 ± 7.72	30.64 ± 6.52	68.88 ± 13.72
<i>F</i> value		0.706	0.919	0.439	0.492
<i>P</i> value		0.549	0.432	0.725	0.668
Professional title					
Resident physician	48	16.77 ± 5.33	19.95 ± 8.32	30.52 ± 5.97	67.24 ± 14.57
Attending physician	214	18.98 ± 5.44	19.72 ± 7.86	31.18 ± 6.43	69.93 ± 14.25
Associate chief physician or above	76	19.57 ± 4.75	20.00 ± 7.99	31.22 ± 5.74	70.79 ± 12.80
<i>F</i> value		4.493	0.029	0.239	0.156
<i>P</i> value		0.012	0.972	0.787	0.856

Item	Number of cases	Etiology and screening	Identification and diagnosis	Diagnosis/treatment management and referral	Total score
Mode of diagnosing and treating elderly patients with hypothyroidism					
Independent diagnosis and treatment according to guidelines	32	22.19 ± 4.05	19.53 ± 8.86	35.31 ± 3.46	77.03 ± 12.07
Diagnosis and treatment with assistance sought	159	18.62 ± 5.42	19.62 ± 7.72	30.05 ± 6.19	68.29 ± 14.12
Referral to specialty department	147	18.27 ± 5.25	20.15 ± 7.99	31.31 ± 6.29	69.73 ± 13.80
<i>F</i> value		7.579	0.197	10.299	6.579
<i>P</i> value		0.001	0.821	<0.001	0.005

Note: $\hat{a}$ = ()5 years; $\hat{b}$ = >5-10 years; $\hat{c}$ = >10-20 years; $\hat{d}$ = >20 years.

Table 3 Assignment of independent variables in multivariate linear regression analysis of scores on knowledge and clinical skills test related to hypothyroidism among general practitioners

Independent variable	Assignment
Region	Urban area = 1, urban-rural fringe = 2, township area = 3
Sex	Male = 1, female = 2
Age	()29 years = 1, 30-39 years = 2, 40-49 years = 3, ()50 years = 4
Educational background	Junior college or below = 1, bachelor's degree = 2, master's degree or above = 3
Professional title	Resident physician = 1, attending physician = 2, associate chief physician or above = 3
Whether received standardized training	No = 1, yes = 2
Method for diagnosing and treating elderly patients with hypothyroidism	Referral to specialist = 1, seeking assistance for diagnosis and treatment = 2, independent diagnosis and treatment according to guidelines = 3

increased by 5.8 percentage points, reaching 10.8%; the prevalence in women was higher than that in men and increased with age^[7]. Among people aged ()60 years, the crude prevalence was as high as 11.8%. In 2022, a survey of 897 elderly people with dyslipidemia in this community also found that the prevalence of subclinical hypothyroidism alone reached 9.14%^[8]. Hypothyroidism has become a common disease in the community; it may involve multiple organs throughout the body, and severe cases may develop hypothyroid crisis. Community general practitioners can widely come into contact with patients with hypothyroidism and high-risk populations, especially elderly patients. Their mastery of hypothyroidism-related knowledge will directly affect the quality of primary diagnosis, treatment, and management of patients with hypothyroidism. However, there are very few related studies in China, and this study therefore has a certain degree of innovation.

The participants in this study had poor mastery of knowledge related to hypothyroidism guidelines and of diagnostic and treatment skills, with an average score of only (69.74 ± 13.98) points. Knowledge related to hypothyroidism

Table 4 Multivariate linear regression analysis of scores on GPs' knowledge and clinical skills tests of Hypothyroidism

Dependent variable	Independent variable	B (95% CI)	SE	β	t value	P value
Etiology and screening dimension	Constant	20.154 (18.953, 21.355)	1.201	—	16.778	<0.001
Etiology and screening dimension	Attending physician	2.058 (1.225, 2.891)	0.833	0.186	2.47	0.014
Etiology and screening dimension	Associate chief physician or above	2.314 (1.341, 3.287)	0.973	0.181	2.379	0.018
Etiology and screening dimension	Seeking assistance for diagnosis and treatment	−3.424 (−4.437, −2.411)	1.013	−0.321	−3.381	0.001
Etiology and screening dimension	Referral to specialist	−3.598 (−4.626, −2.57)	1.028	−0.335	−3.499	0.001
Identification and diagnosis dimension	Constant	19.651 (16.344, 22.958)	3.307	—	5.943	<0.001
Identification and diagnosis dimension	Urban-rural fringe	−1.793 (−2.862, −0.724)	1.069	−0.099	−1.676	0.095

Dependent variable	Independent variable	B (95% CI)	SE	β	t value	P value
Identification and diagnosis dimension	Township area	-1.646 (-2.69, -0.602)	1.044	-0.098	-1.577	0.116
Identification and diagnosis dimension	Female	2.161 (1.236, 3.086)	0.925	0.126	2.337	0.020
Identification and diagnosis dimension	30-39 years	-6.228 (-8.158, -4.298)	1.930	-0.359	-3.227	0.001
Identification and diagnosis dimension	40-49 years	-5.270 (-7.622, -2.918)	2.352	-0.332	-2.241	0.026
Identification and diagnosis dimension	50 years	-5.312 (-7.868, -2.756)	2.556	-0.258	-2.079	0.038
Identification and diagnosis dimension	Bachelor's degree	4.947 (2.884, 7.010)	2.063	0.256	2.398	0.017
Identification and diagnosis dimension	Master's degree or above	4.950 (2.521, 7.379)	2.429	0.231	2.038	0.042
Identification and diagnosis dimension	Standardized training	0.834 (-0.725, 2.393)	1.559	0.049	0.535	0.593

Dependent variable	Independent variable	<i>B</i> (95% <i>CI</i>)	<i>SE</i>	β	<i>t</i> value	<i>P</i> value
Diagnosis, treatment management, and referral	Constant	30.359 (28.616, 32.102)	1.743	—	17.42	<0.001
Diagnosis, treatment management, and referral	Bachelor's degree	5.267 (3.777, 6.757)	1.490	0.348	3.535	<0.001
Diagnosis, treatment management, and referral	Master's degree or above	5.433 (3.782, 7.084)	1.651	0.324	3.291	0.001
Diagnosis, treatment management, and referral	Seeking assistance for diagnosis and treatment	−5.280 (−6.435, −4.125)	1.155	−0.426	4.573	<0.001
Diagnosis, treatment management, and referral	Referral to specialist	−4.161 (−5.321, −3.001)	1.16	−0.333	−3.586	<0.001

Dependent variable	Independent variable	B (95% CI)	SE	β	t value	P value
Total score	Constant	74.087 (68.64, 79.534)	5.447	—	13.601	<0.001
Total score	Urban-rural fringe	−1.389 (−3.278, 0.500)	1.889	−0.044	−0.736	0.462
Total score	Township area	−3.552 (−5.387, −1.717)	1.835	−0.121	−1.935	0.054
Total score	Female	2.379 (0.746, 4.012)	1.633	0.078	1.457	0.146
Total score	30-39 years	−9.082 (−12.424, −5.740)	3.342	−0.297	−2.718	0.007
Total score	40-49 years	−7.644 (−10.886, −4.402)	3.242	−0.273	−2.358	0.019
Total score	()50 years	−7.666 (−11.251, −4.081)	3.585	−0.211	−2.138	0.033
Total score	Bachelor's degree	10.951 (7.326, 14.576)	3.625	0.321	3.021	0.003
Total score	Master's degree or above	10.819 (6.553, 15.085)	4.266	0.286	2.536	0.012
Total score	Seeking assistance for diagnosis and treatment	−8.217 (−10.851, −5.583)	2.634	−0.294	−3.119	0.002
Total score	Referral to specialist	−7.639 (−10.292, −4.986)	2.653	−0.271	−2.88	0.004

Note: For region, urban area was used as the reference; for age, (<29 years was used as the reference; for educational background, junior college or below was used as the reference; for professional title, resident physician was used as the reference; for the method of diagnosing and treating elderly patients with hypothyroidism, independent diagnosis and treatment according to guidelines was used as the reference. Overall test results of the regression model for the etiology and screening dimension: $F(2, 335)=5.568, P<0.001$, adjusted $R^2=0.63$; overall test results of the regression model for the identification and diagnosis dimension: $F(5, 332)=4.101, P<0.001$, adjusted $R^2=0.83$; overall test results of the regression model for the diagnosis, treatment management, and referral dimension: $F(2, 335)=8.518, P<0.001$, adjusted $R^2=0.70$.

...the insufficient mastery of the diagnosis and treatment of hypothyroidism in elderly patients and the lack of management practice. General practitioners who can independently diagnose and treat patients according to the guidelines accounted for only 9.47%, while in the 2019 survey by RAZVI et al.

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of 565 multinational physicians regarding the diagnosis and treatment of elderly patients with hypothyroidism, only 7.6% of physicians could not manage patients according to the guidelines. Since 2017, China has continuously issued guidelines related to hypothyroidism

1, 2, 5

, but according to the present survey results, training still needs to be continuously strengthened. Among general practitioners, in the knowledge dimension of the etiology and screening of hypothyroidism, the accuracy rate for recommending screening among patients with psychiatric disorders

10

was the lowest. This may be related to the fact that psychiatric patients mainly seek care in specialist departments; however, chronic disease populations such as those with dyslipidemia are very common in the community, and insufficient awareness among community physicians requires enhanced training to avoid missed diagnosis or misdiagnosis. When elderly patients are admitted to nursing homes and other institutions, the preferred indicator for screening hypothyroidism is thyroid-stimulating hormone (TSH)

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, whereas the vast majority of general practitioners selected the five thyroid-function tests (TSH, free triiodothyronine [FT3], free thyroxine [FT4], total triiodothyronine [TT3], and total thyroxine [TT4]). When the same diagnostic effect can be achieved, low-cost screening should be performed while also considering health economics. A similar situation also occurred in the dimension of

general practitioners' identification and diagnosis of hypothyroidism. For example, for the first-line diagnostic indicators of primary hypothyroidism and the indicators for distinguishing mild from severe subclinical hypothyroidism, many general practitioners also selected the five thyroid-function tests

12

. Hypothyroidism has a long disease course and insidious onset and is easily confused with other diseases

13

. In particular, systemic symptoms in elderly patients with hypothyroidism, such as dyslipidemia, bone pain, increased blood pressure, weight gain, and constipation, may all be mistaken for manifestations of aging. Therefore, raising vigilance regarding hypothyroidism is of utmost importance. Scores for the diagnosis-management and referral knowledge dimension were somewhat better than those for other dimensions, but were still unsatisfactory. In the diagnosis and treatment of hypothyroidism, especially in replacement therapy—which is most important—individualized assessment is required before treatment. Treatment targets should consider not only the recovery of serum TSH, TT4, and FT4 levels, but also changes in symptoms and signs, while taking into account cardiovascular and skeletal safety. However, many physicians focus only on serum indicators and ignore changes in symptoms and signs. A similar situation was found among general practitioners surveyed by DEW et al. in the United Kingdom

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, which may reduce patients' quality of life and adherence to treatment

15

. The first choice for replacement therapy in hypothyroidism is levothyroxine (L-T4), and isolated use of liothyronine (L-T3) is not recommended

10

, because numerous clinical trials have demonstrated that, in terms of improving serum indicators and symptoms, it is not superior to L-T4 alone

15

. Patients with subclinical hypothyroidism accompanied by symptoms of hypothyroidism, TPOAb positivity, dyslipidemia, and other conditions

1

also require L-T4 replacement therapy, but many physicians ignore this, so training must be strengthened. During the initial stage of L-T4 therapy and after treatment targets have been reached, follow-up examinations are required

on schedule so as to promptly identify overtreatment or undertreatment during thyroid hormone therapy

16

. Especially for elderly patients, the dose increase for each L-T4 adjustment (e.g., Euthyrox 50 μ g) is generally 1/4 tablet, to avoid an excessive decrease in TSH caused by overtreatment and the resulting increased mortality

2, 17

. These points must be mastered in community diagnosis and management, but the clinical skills of general practitioners still need improvement. General practitioners' mastery of indications for urgent referral and routine referral for hypothyroidism was relatively satisfactory. Timely referral can enable patients to receive optimized treatment and promote the hierarchical diagnosis and treatment system in an orderly manner.

Further analysis of factors influencing general practitioners' mastery of hypothyroidism-related knowledge showed that, in the dimensions of etiology and screening, compared with attending physicians, physicians with higher professional titles had higher scores. This is consistent with previous research conducted in Pudong New Area

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. Promotion of professional titles involves stepwise assessment, with more comprehensive requirements for knowledge mastery. General practitioners who could independently diagnose and treat elderly patients with hypothyroidism according to the guidelines had more sufficient mastery of hypothyroidism knowledge. Women scored higher in the identification and diagnosis dimension, which is consistent with domestic survey results on general practitioners' knowledge level of chronic diseases

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; this may be because women are more patient and conscientious in learning. As years of medical practice increase, clinical experience becomes more solid, but the present study showed opposite results in both the identification and diagnosis score and the total score; inconsistent findings have also appeared in previous studies

18, 20

. Possible explanations are that increasing age leads to a decline in learning and memory capacity

21

, whereas higher educational attainment reflects good learning ability and habits

22

. The findings of the present study are consistent with previous studies

18, 20

, and are fully reflected in hypothyroidism knowledge scores.

4 Summary

The mastery of hypothyroidism-related knowledge and clinical skills among community general practitioners in Pudong New Area, Shanghai, remains to be improved. In particular, they lack knowledge of hypothyroidism screening, identification, and diagnosis; their ability to diagnose and treat common elderly patients with hypothyroidism in the community is insufficient. Among them, general practitioners with lower educational attainment, aged ($>$)30 years, and those unable to independently diagnose and treat elderly patients with hypothyroidism according to the guidelines require strengthened training. Systematic continuing education courses can be provided online and offline, combined with diagnosis and management practice for community clinical cases to improve learning effectiveness. Physicians may also be selected for further study in relevant departments of higher-level hospitals, and experts may be invited to provide long-term teaching in the community, so as to improve the knowledge level and clinical skills of general practitioners, scientifically manage patients at the primary level, and rationally use medical resources. This study also has certain limitations. Although the study randomly selected 9 community health service centers in Pudong New Area according to regional stratification, the sample size was relatively small and extrapolation is limited. There may also be some discrepancy between general practitioners' knowledge mastery and their actual diagnostic and treatment behaviors. Further in-depth research by the project team is still needed in the future.

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