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Original Article

Prevalence, Incidence, and Risk Factors of Hypothyroidism in Adult Residents of Yazd Greater Area, 2015–2021: Results of Yazd Health Study

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What's Known

- Several countries, including China, India, and the United States, have reported an increasing prevalence of hypothyroidism in recent years.
- Being female is a risk factor for hypothyroidism.
- A considerable proportion of undiagnosed hypothyroidism cases is concerning.
- Salt iodization is helpful for the prevention of hypothyroidism.

What's New

- The trend of hypothyroidism in Yazd is increasing.
- Prevalence and incidence of hypothyroidism in the Yazd Greater Area are reported for the first time.
- Prevalence of hypothyroidism is high among women of childbearing age.
- Tobacco smoking has an impact on hypothyroidism.
- Impact of fluoride content on hypothyroidism is observed.
- Salt iodization has not been fully implemented in recent years in Iran, which may justify hypothyroidism to some extent in Yazd.

Abstract

Background: Any abnormal change in thyroid hormone levels leads to thyroid disorders, including hyperthyroidism, hypothyroidism, goiter, and so on. Recent studies have reported an increasing prevalence and incidence of thyroid disorders worldwide. This study aims to determine the hypothyroid prevalence, incidence, and risk factors related to this disorder.

Methods: Data from a comprehensive prospective cohort study, collected from a population of 10,000 Yazd (Iran) individuals over a period of 6 years (2015-2021) was analyzed. Physicians diagnosed hypothyroidism and reported it. Data processing and preparation were performed using SQL18 and Excel, while STATA17 and SPSS22 software were employed for data analysis. Descriptive statistics, logistic regression, and Chi-square tests were conducted at a significance level of 0.05.

Results: The prevalence of hypothyroidism was found to be 93/1000, and the incidence was 15/1000 of the population, respectively. Women had five folds more chance of hypothyroidism (adjusted OR=5.31, 95% CI=3.06-9.19 vs. unadjusted OR=6.28, 95% CI=3.90-10.12), and they usually developed it between the ages of 30 and 39. Eating less (iodized) salt also increased the risk of hypothyroidism (unadjusted OR=1.47, 95% CI=1.02-2.11). Iron supplementation (unadjusted OR=2.09, 95% CI=1.26-3.48) was identified as one of the significant risk factors. Based on our findings in the unadjusted model, tooth brushing once or twice a day increases the chance of hypothyroidism (OR=1.89, P=0.008, and OR=2.12, P=0.016, respectively). Tobacco smoking (unadjusted OR=0.29, 95% CI=0.107-0.786) was also among the factors that need further investigation.

Conclusion: The increasing trend of hypothyroidism is concerning in our population. The high prevalence, particularly among women of childbearing age, is notable.

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Keywords ● Hypothyroidism ● Prevalence ● Incidence ● Risk factors ● Cohort studies

Introduction

Years of living with disability (YLD) is a crucial measure that reflects the burden imposed by diseases. By 2019, non-communicable diseases (NCDs) were responsible for 5 to 14,000

years of YLDs worldwide.[1] Iran is currently facing an epidemic of NCDs and has entered the third stage of epidemiological transition, with nearly 10,000 YLDs attributed to NCDs.[2]

Thyroid diseases are among the NCDs that contribute to disability, although they do not typically result in significant mortality.[3] The prevalence of thyroid disorders varies across different regions. The proper functioning of various physiological processes in the body, including temperature regulation, growth, energy metabolism, hemostasis, and cellular proliferation and development, relies on thyroid hormones.[3-5] Any abnormal elevation or decrease in thyroid hormone levels can lead to thyroid disorders such as hyperthyroidism, hypothyroidism, goiter, Hashimoto's thyroiditis, Graves' disease, thyroid nodules, and thyroid cancer. Hypothyroidism, a common endocrine disorder, occurs when there is a decrease in thyroid hormone levels due to factors such as autoimmune thyroiditis, iodine deficiency, surgery, or radioiodine therapy.[3] Measurement of thyroid hormones, including triiodothyronine (T3), thyroxine (T4), and thyroid stimulating hormone (TSH) helps to assess thyroid function. An elevated TSH level along with normal T4 levels may indicate subclinical hypothyroidism, which can progress to overt disease.[5]

Hypothyroidism has been associated with cardiovascular diseases, insulin resistance, increased adipose tissue, risk of type 2 diabetes mellitus, infertility, and non-alcoholic steatohepatitis.[4, 5]

Several countries, including China, India, and the United States, have reported an increasing prevalence of hypothyroidism in recent years.[6, 7] More than 30% of the global population resides in iodine-deficient areas, particularly in parts of Africa and North and East Asia, placing them at risk of developing hypothyroidism due to iodine deficiency.[3, 8]

Given the high prevalence of hypothyroidism and its detrimental effects on population health, our research is valuable.[3] Both developed and developing countries require comprehensive data on thyroid diseases to understand the consequences of current treatment practices and changes in nutrition and lifestyle.[3] This study utilizes data from the "Health Study of Yazd People" to analyze the prevalence, incidence, and risk factors of hypothyroidism in adults residing in Yazd City, Iran, between 2015 and 2021.[9]

Patients and Methods

The data from the Yazd Health Study (YaHS) were used to determine the incidence and prevalence of hypothyroidism in adults in Yazd city. YaHS was the first prospective cohort study of the health and diseases of the Yazd population. These data were collected from 10,000 citizens of the Yazd, which is equivalent to 2% of the total population of the city in 2013-2014.

The selected sample for the study were people aged 20 to 70 years, based on two-stage cluster sampling. First, 200 clusters were selected based on the area zip code, with each cluster comprising 25 men and 25 women. The individuals were equally divided into five age groups, with a 10-year age difference within each group. The selected citizens were contacted by the interviewers who explained the study's purpose and procedures and obtained their consent for participation.

The study protocol, patient information sheet, and consent forms underwent a comprehensive review by the Ethical Committee of Shahid Sadoughi University (IR.SSU.SPH.REC.1401.052) of Medical Sciences in Yazd, Iran.

A 300-question YaHS questionnaire was used to assess thyroid disorders and other conditions, which had high reliability (Cronbach's alpha=0.89) and face validity based on a pilot sample of 50 people and experts' feedback.[9] In the first stage, the answers were recorded on an Optical Mark Reading (OMR). To verify the answers, 5% of the participants were being re-questioned by the supervisors. Participants were instructed to self-report any occurrence of thyroid disorders diagnosed by a physician to the follow-up executive team and were encouraged to provide supporting medical documents. Passive follow-up methods were employed, involving collaboration with healthcare and research centers such as disease registration centers. Active follow-ups were also conducted annually via phone calls by interviewers or physicians.

Our research has been conducted over a 6-year follow-up period with a focus on NCDs including thyroid disorders, particularly hypothyroidism. Upon de-anonymization, the data underwent pre-processing, integration, and connection using SQL18 and Microsoft Excel. Duplicated, ambiguous, and incorrect records were excluded from the analysis. To determine rates associated with hypothyroidism, individuals diagnosed with thyroid disorders other than hypothyroidism (e.g., hypothyroidism during pregnancy) were excluded from the analysis. However, deaths were accounted for in relevant cases. Variables related to hypothyroidism were found by reviewing related articles. Variables answered in questionnaires were investigated and also matched with reported variables in articles to choose the maximum possible

identified risk factors. Logistic regression (enter method) was performed using Stata Statistical Software, Release 17 (Stata Corporation College Station, TX, USA), while descriptive and Chi square statistical tests were conducted using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp, Armonk, NY, USA). Statistical significance was set at $P<0.05$.

Results

Baseline Dataset

After cleaning the data, 9,712 cases (female=51.3%) remained to analyze, of which 763 had hypothyroidism at the time of registration. After a 6-year follow-up, 134 new cases of hypothyroidism were observed. By excluding thyroid disorders at the time of enrolment, 8,721 participants remained free from thyroid disorders at the end of the study.

Table 1 shows 83% of participants reported no history of thyroid disorder in their first-degree family. In this study, 75% of the participants were indigenous of Yazd city, nearly 28% had a body mass index of more than 30 kg (BMI>30 Kg/m^2), 15.3% had diabetes mellitus, 11% were regular or occasional smokers, and almost 90% of them were men.

Prevalence and Incidence

Thyroid disorders affected 8.2% of our study population in 2015, with hypothyroidism accounting for 96% of the cases with a prevalence of 7.8% (78/1000). By 2021, the prevalence of thyroid disorders increased to 9.6% (96/1000), with hypothyroidism still being the most common one (90%). Women (15%) and men (3%) had different rates of hypothyroidism prevalence. Compared to the start of our cohort study, hypothyroidism prevalence rose from about 20 to 93 per 1000. The incidence of hypothyroidism in our 6-year study was 15/1000, or 2.5/1000 per year. The incidence of hypothyroidism was higher in women (2.7%) than in men (0.4%). The age- and sex-specific prevalence in 2021 is estimated to be 2.84% in men and 15.04% in women, and the age- and sex-specific incidence in the same year for men and women was 0.44% and 2.92%, respectively (table 2).

Risk Factors

In this study, factors such as a positive history of thyroid disease in the first-degree family, sex, diabetes mellitus (DM), indigenous of Yazd, age, body mass index (BMI), pharmaceutical supplements, smoking, and hookah smoking were considered as risk factors.

Table 1: The Most important demographics of the participants at the enrolment phase- Yazd Health Study, 2014-2015

Variable		Frequency (valid percent)
Sex	Male	4723 (48.7%)
	Female	4980 (51.3%)
	Missing	9
Age	20-29	1915 (19.8%)
	30-39	1972 (20.4%)
	40-49	2008 (20.8%)
	50-59	1928 (19.9%)
	60-69	1846 (19.1%)
	Missing	43
History of the thyroid in the family	Yes	1501 (16.5%)
	No	7618 (83.5%)
Yazd originality	Yes	7233 (75.0%)
	No	2405 (25.0%)
	Missing	74
BMI	Lower 18.5	249 (2.7%)
	18.5-24.9	2875 (31.2%)
	25-29.9	3468 (37.6%)
	30-39.9	2336 (25.3%)
	Above 40	301 (3.3%)
	Missing	483
Diabetic	Yes	1476 (15.3%)
	No	8192 (84.7%)
	Missing	44
Smoking	Yes	857 (8.8%)
	Sometimes	211 (2.2%)
	Quit	274 (2.8%)
	Never using	8370 (86.2%)
	Missing	0

Table 2: Age-sex-standardized prevalence and incidence of hypothyroidism per 100 population-Yazd Health Study, 2015-2021

Year		2015			2021		Incidence	
Index		Cases	Prevalence		New Case	Prevalence		
Sex	Age		Age-sex-adjusted	Sex-adjusted		Age-sex-adjusted	Sex-adjusted	Age-sex-adjusted	Sex-adjusted
Male	20-29	20	0.75	2.41	3	0.87	2.84	0.12	0.44
	30-39	19	0.54		5	0.68		0.14	
	40-49	28	0.55		5	0.65		0.10	
	50-59	30	0.42		4	0.48		0.06	
	60-69	22	0.14		3	0.16		0.02	
Female	20-29	97	3.80	12.36	26	4.89	15.04	1.15	2.92
	30-39	137	3.50		32	4.35		0.96	
	40-49	159	2.68		19	3.03		0.38	
	50-59	135	1.62		22	1.91		0.31	
	60-69	112	0.76		14	0.86		0.11	

Table 3: Unadjusted and adjusted odds ratio for predictors of hypothyroidism

Predictor		Unadjusted				Adjusted			
		OR	P value	95% CI		OR	P value	95% CI	
				Lower	Upper			Lower	Upper
Sex	Male (1)- Female	6.28	<0.001*	3.898	10.119	5.306	<.001*	3.063	9.189
Diabetes mellitus	Yes (1)- No	1.239	0.424	0.733	2.097	1.033	0.917	0.558	1.914
Originality	Yazd native (1)		0.769				0.838		
	Yazd province	0.624	0.202	0.303	1.287	1.586	0.369	0.580	4.336
	Province near Yazd	1.092	0.792	0.567	2.102	1.753	0.277	0.637	4.819
	Another province	1.056	0.877	0.531	2.099	1.668	0.468	0.419	6.638
	Other country	0.952	0.933	0.299	3.026	1.558	0.267	0.712	3.406
Age	60-69 (1)		0.137				0.478		
	20-29	1.638	0.109	0.897	2.991	1.727	0.164	0.800	3.729
	30-39	2.076	0.013*	1.165	3.702	1.846	0.097	0.895	3.807
	40-49	1.333	0.367	0.714	2.49	1.294	0.492	0.621	2.696
	50-59	1.499	0.197	0.81	2.773	1.487	0.263	0.742	2.978
BMI	Lower 18.5 (1)		0.481				0.324		
	18.5-24.9	1.494	0.583	0.357	6.258	3.059	0.275	0.411	22.791
	25-29.9	1.894	0.378	0.458	7.83	4.615	0.135	0.622	34.236
	30-39.9	1.979	0.35	0.473	8.279	3.777	0.197	0.500	28.509
	Above 40	2.829	0.206	0.565	14.159	4.598	0.165	0.534	39.592
Family thyroid disorder	Yes (1)- No	0.827	0.441	0.51	1.34	0.930	0.776	0.562	1.537
Using additional salt	Use (1)- Not Use	1.469	0.038*	1.021	2.114	1.324	0.164	0.892	1.966
Tooth brushing	Never (1)		0.016				0.416		
	Sometimes	0.896	0.766	0.435	1.845	1.532	0.139	0.871	2.697
	Once a day	1.892	0.008*	1.181	3.032	1.517	0.254	0.741	3.102
	Twice a day	2.125	0.016*	1.152	3.921	1.268	0.678	0.414	3.881
	Three times a day	1.471	0.479	0.505	4.285	0.906	0.806	0.410	2.000
Supplements	Nothing (1)		0.06				0.991		
	Iron supplement	2.095	0.004*	1.26	3.484	1.027	0.928	0.570	1.853
	Calcium supplement	1.405	0.31	0.729	2.709	0.911	0.817	0.413	2.010
	Supplemental vitamins	0.791	0.691	0.249	2.511	0.776	0.671	0.241	2.498
	Other supplements	1.328	0.631	0.417	4.234	0.853	0.827	0.206	3.541
Tobacco Smoking	Non-smokers (1)		0.043				0.504		
	Smokers	0.29	0.015*	0.107	0.776	0.585	0.467	0.138	2.284
	Occasional-smokers	1.222	0.696	0.447	3.341	2.021	0.245	0.617	6.626

The logistic regression is adjusted for Sex, Diabetes mellitus, Originality, Age, BMI, Family thyroid disorder, Using additional salt, Tooth brushing, Supplements, and Tobacco smoking; OR: Odds Ratio; P<0.05 was considered Statistically significant.

Among people with hypothyroidism, 85% were women, and as was expected, female sex increases the chance of hypothyroidism by more than six times (unadjusted OR=6.28, 95% CI=3.90-10.12, P<0.001) (table 3). Generally, based on the observations recorded in the YaHS, women had the highest contribution to the occurrence of hypothyroidism in the 6-year survey. It was found that using additional salt at the time of serving food was effective in preventing

hypothyroidism (P=0.033), and 69.3% of women with hypothyroidism were in the category of people who did not use salt during eating meals. Regarding the effect of tooth brushing frequency on hypothyroidism, it could be considered more effective in women who brush their teeth once a day compared to those who used to brush their teeth more or less frequently daily (P=0.066). Other investigated factors were not statistically related to the occurrence of hypothyroidism in the female population (table 4).

The unadjusted odds ratio of hypothyroidism at the age of 30-39 years compared to the age of 60-69 years is 2.08 (95% CI=1.16-3.70, P=0.01) followed by 20-29 years (21.8%). Using additional salt while serving food had a protective role for hypothyroidism, and the chance of hypothyroidism in people who said they did not use salt on the table was increased almost up to 1.5 times (unadjusted OR=1.47, 95% CI=1.02-2.11, P=0.038). Based on our findings in the unadjusted model, tooth brushing once or twice a day increased the chance of hypothyroidism by 1.89 (P=0.008) and 2.12

Table 4: Hypothyroidism in males and females according to different variables- Yazd Health Study, 2015-2021

Variables		Male			Female		
		No outcome	Hypothyroidism	P value	No outcome	Hypothyroidism	P value
Diabetic	Yes	602 (99.5%)	3 (0.5%)	1	654 (98.1%)	13 (1.9%)	0.21
	No	3944 (99.6%)	17 (0.4%)		3471 (97.2%)	100 (2.8%)	
Origin	Yazd indigenous	3467 (99.5%)	17 (0.5%)	0.587	3005 (97.2%)	85 (2.8%)	0.761
	Yazd province	408 (99.8%)	1 (0.2%)		404 (98.3%)	7 (1.7%)	
	Province near Yazd	272 (99.3%)	2 (0.7%)		309 (97.5%)	8 (2.5%)	
	Other provinces	266 (100%)	0 (0%)		275 (96.8%)	9 (3.2%)	
	Other country	101 (100%)	0 (0%)		99 (97.1%)	3 (2.9%)	
Age groups	20-29	917 (99.7%)	3 (0.3%)	0.941	832(97.0%)	26 (3.0%)	0.109
	30-39	926 (99.5%)	5 (0.5%)		835 (96.2%)	32 (3.7%)	
	40-49	917 (99.5%)	5 (0.5%)		862 (97.8%)	19 (2.2%)	
	50-59	906 (99.6%)	4 (0.4%)		808 (97.3%)	22 (2.7%)	
	60-69	886 (99.7%)	3 (0.3%)		794 (98.3%)	14 (1.7%)	
BMI	Lower 18.5	117 (100%)	0 (0%)	0.768	115 (98.3%)	2 (1.7%)	0.892
	18.5-24.9	1587 (99.6%)	6 (0.4%)		1052 (97.4%)	28 (2.6%)	
	25-29.9	1772 (99.4%)	10(0.6%)		1351 (97.1%)	41 (2.9%)	
	30-39.9	793 (99.6%)	3 (0.4%)		1259 (97.5%)	32 (2.5%)	
	Above 40	52 (100%)	0 (0%)		194 (97%)	6 (3%)	
Family history of thyroid disorder	Yes	500 (99.2%)	4 (0.8%)	0.268	618(97.5%)	16 (2.5%)	0.914
	No	3787 (99.6%)	15 (0.4%)		3240 (97.3%)	89 (2.7%)	
Using additional salt at the time of eating	Yes	1937 (99.5%)	9 (0.5%)	0.717	1659 (97.9%)	35 (2.1%)	0.033*
	No	2542 (99.6%)	10 (0.4%)		2409 (96.8%)	79 (3.2%)	
Tooth brushing	Never	1344 (99.7%)	4 (0.3%)	0.426	945 (98.0%)	19 (2.0%)	0.066
	Once a day	1915 (99.5%)	10 (0.5%)		1926 (96.8%)	63 (3.2%)	
	Twice a day	341 (100%)	0 (0%)		548 (96.6%)	19 (3.4%)	
	Three times a day	119 (99.2%)	1 (0.8%)		151 (98.1%)	3 (1.9%)	
	Sometimes	750 (99.3%)	5 (0.7%)		473 (98.7%)	6 (1.3%)	
Supplements	Iron supplement	112 (98.2%)	2 (1.8%)	0.219	492 (96.9%)	16 (3.1%)	0.939
	Calcium supplement	163 (99.4%)	1 (0.6%)		337 (97.4%)	9 (2.6%)	
	Supplemental vitamins	123 (100%)	0 (0%)		144 (98%)	3 (2%)	
	Other supplements	73 (100%)	0 (0%)		86 (96.6%)	3 (3.4%)	
	Nothing	4016 (99.6%)	17 (0.4%)		3018 (97.3%)	83 (2.7%)	
Tobacco smoking	Non-smokers	3457 (99.6%)	15 (0.4%)	0.795	3984 (97.3%)	110 (2.7%)	0.296
	Smokers	769 (99.5%)	4 (0.5%)		53 (100%)	0 (0%)	
	Occasional-smokers	144 (99.3%)	1 (0.7%)		51 (94.4%)	3 (5.6%)	
	Previous-smokers	197 (100%)	0 (0%)		57 (98.3)	1 (1.7%)	

Chi square test with a 0.05 significance level was applied.

(P=0.016), respectively, compared to those who did not brush their teeth regularly. Our results showed that smokers have less chance of hypothyroidism than nonsmokers, by unadjusted OR=0.29 (95% CI=0.107-0.786, P=0.015). The chance of developing hypothyroidism in this study was increased (unadjusted OR=2.09, 95% CI=1.26-3.48, P=0.004) in people who used iron supplements compared to the people who declared that they did not use any supplements. Other variables were not confirmed as risk factors for hypothyroidism in the unadjusted model. Female sex (adjusted OR=5.31, 95% CI=3.06-9.19) was the main risk factor for hypothyroidism in this population (table 3).

Discussion

Our study revealed an increasing prevalence of thyroid disorders in the Yazd population between 2015 and 2021. The prevalence of hypothyroidism in 2015 in this study was estimated to be 7.8%. However, over the 6-year follow-up period, the prevalence of hypothyroidism increased to 9.3% by 2021. The prevalence of hypothyroidism in the Yazd Greater Area was found to be higher than that reported in other cities in Iran, similar to the prevalence observed in Japan. However, it remained lower than the reported prevalence in other Middle Eastern countries such as Saudi Arabia (Makkah City).[10, 11]

In a prospective cohort thyroid study conducted in Isfahan (2006-2011) and Tehran (1997-2004), the prevalences of overt and subclinical hypothyroidism were reported to be more than 8% and 7.5%, respectively. The prevalence of hypothyroidism in Saudi Arabia (2008) was higher in than our samples (15%-47%).[10] The prevalence of thyroid disorders in Japan was 10% according to a survey conducted in 2009, which was mostly hypothyroidism.[11]

In a meta-analysis of the European population during 1975-2012, the rate of undiagnosed thyroid disorders was calculated to be 6.7%, and approximately 5% of these disorders were related to hypothyroidism.[12] In Finland, the prevalence of hypothyroidism in 2007 was 3.6% (95% CI=3.57-3.60).[13] The prevalence of hypothyroidism in the report of the National Health and Nutrition Survey of the US was recorded as 4.6% until 1988, with a steady increase to 9.6% in 2012 and 11.7% in 2019, which is similar to what was found by some other researchers.[7, 14]

Comparison of the annual incidence in our study (2.5/1000) with the reported incidence in the Isfahan and Tehran studies (respectively: overt hypothyroidism: 1.9 and 2, subclinical hypothyroidism: 20.6 and 7.62) suggests the presence of a substantial number of undiagnosed subclinical cases.[15, 16]

Our findings indicated that additional salt consumption during meals acted as a protective factor against hypothyroidism (OR=0.68). Women who avoided salt usage on their food showed an increased relative risk of hypothyroidism by up to 1.5 times, although this relationship was not statistically significant in men. Yazd City was reported to be iodine-sufficient in 2016, but iodine deficiency testing in the Yazd Greater Area was discontinued after 2016 due to financial constraints.[17] The reduction in the standard level of iodine in the population of this region may explain the protective role of additional salt consumption. Other factors such as cooking methods and distance from the sea could contribute to the lower iodine concentration in the food consumed in this region.[18, 19]

Aging has been consistently identified as a risk factor for hypothyroidism, with some studies indicating a higher prevalence in men than women at older ages.[20, 21] In our study, the age group of 30-39 years exhibited the highest prevalence of hypothyroidism compared with other age groups.[21] The lower incidence in younger age deciles may be associated with the association between hypothyroidism and heart disease, higher prevalence in women due to pregnancy and childbirth, and the negative impact of fertility on the fetus.[22]

Our findings indicated that tooth brushing once or twice a day significantly increased the likelihood of hypothyroidism. This could be attributed to the fluoride content in toothpaste, as a study by Kheradpisheh and others demonstrated a direct and positive relationship between fluoride in drinking water and the incidence of hypothyroidism.[23]

The relationship between smoking and thyroid function has been investigated in previous studies. Smoking was found to contribute to hypothyroidism in patients with Hashimoto's disease but was not proven to have the same effect in patients with nodular goiter.[24, 25] While some studies reported smoking as a risk factor for hypothyroidism, increasing the risk significantly,[26, 27] other studies suggested that smoking reduced TSH levels, potentially lowering the risk of hypothyroidism.[28, 29] These findings align with the lower risk of thyroid cancer observed among smokers.[30] Our findings did not confirm smoking as a risk factor for hypothyroidism.

The use of pharmaceutical supplements, specifically iron supplements, was investigated for its association with hypothyroidism. Our study showed that using iron supplements doubled

the risk of hypothyroidism. Previous studies indicated a higher prevalence of iron deficiency in patients with hypothyroidism, and the use of iron supplements in females with hypothyroidism was shown to improve thyroid gland functionality and hormone levels.[31] Therefore, the observed incidence of hypothyroidism in patients with anemia may be due to early diagnosis of anemia and the consumption of iron supplements by patients before the diagnosis of hypothyroidism.

Data collection and registration over several consecutive years, alongside benefits such as increased study power, also come with challenges such as sample loss, participant non-cooperation, changes in project collaborators, and resulting deficiencies in experience transfer. In our study, efforts were made to manage these challenges, but it was not exempt. Limitations in calculating annual prevalence and incidence, as well as the lack of access to the regular laboratory results of the participants in certain time periods were among our limitations in this study.

Conclusion

This study shows that hypothyroidism is the most common thyroid disorder in our study population, affecting 90% of the cases. Women have a higher risk of developing hypothyroidism (2.92%) than men and should have regular checkups and thyroid function tests. The increasing trend of hypothyroidism is alarming, especially when many cases are undiagnosed. Our findings also indicate that thyroid tests should be done at a younger age for better prevention and treatment. Salt iodization, which has faced implementation challenges in recent years in Iran, and its use during the final stage of cooking, can serve as an effective strategy to ensure sufficient iodine intake and potentially play a preventive role in hypothyroidism. Furthermore, our study suggests a potential influence of fluoride content in toothpaste on the development of hypothyroidism. The impact of tobacco smoking on hypothyroidism warrants further investigation, particularly in females.

Given the increasing trend in the prevalence of hypothyroidism, it is crucial to provide adequate financial support to research centers conducting reliable and comprehensive studies in this field.

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Authors' Contribution

M.K: Study design, data gathering, statistical analysis, data processing and calculations, and drafting; R.A: Study design, data interpretation, and reviewing the manuscript; M.M: Study design, data interpretation, and drafting; H.F: Statistical analysis, data processing, and calculations, data interpretation, and reviewing the manuscript; All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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