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A Cross-Sectional Survey on the Prevalence of Hypothyroidism in Reproductive Age Women from Unnao District, Uttar Pradesh, India

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Abstract

Thyroid hormones play a crucial role in regulating various physiological processes of the body and deficiency of thyroid hormones severely impacts all these processes. Although hypothyroidism is common in India, there is still a lack of sufficient data on its prevalence in rural areas of the country. It is more common in women. To find out the prevalence of hypothyroidism in reproductive-age women residing in rural areas, a cross-sectional survey was carried out in three villages of the Unnao district using a standard questionnaire. A total of 138 individuals participated in the survey. The data is presented as the mean and standard deviation and was analysed using GraphPad Prism5. It was found that the prevalence of hypothyroidism in these villages of the Unnao district was 3.62% or 36 cases per 1,000.

Major Findings: 1. Prevalence of Hypothyroidism: The study found a hypothyroidism prevalence of 3.62%, or 36 cases per 1,000 individuals, among reproductive-age women in rural areas of Unnao, India. 2. Demographics and Methodology: The research focused on reproductive-age women, utilizing a cross-sectional survey method and a standard questionnaire to gather data from 138 participants in three villages. 3. Lack of Data in Rural Areas: The study highlights the existing gap in research regarding the prevalence of hypothyroidism in rural India, despite its common occurrence.

Keywords: Cross-Sectional Survey, Hypothyroidism, Prevalence, Under-Active Thyroid (UAT), Unnao

1. Introduction

The thyroid gland is an important organ of the body which remains situated over the trachea just below the cricoid cartilage in mammals. It secretes mainly two hormones, namely, 3,5,3'Triidothyronine (T3) and 3,5,3'5'Tetraiodothyronine (Thyroxine, T4) which are involved in the regulation and coordination of numerous physiological processes of the body[1]. Deficiency of iodine in the body and/or certain other pathological conditions that interfere with normal processes involved in the biosynthesis of thyroid hormones results in increased or decreased secretion of the same which leads to hyperthyroidism and hypothyroidism respectively[2]. Both situations are pathological and may require clinical attention. If left untreated, they could have devastating consequences. Although rare causes of thyroid disorders may include disorders of the hypothalamus or pituitary or from peripheral causes like the struma ovarii[3], or thyroid cancer[4]. If hypothyroidism occurs because of an abnormality in the thyroid gland due to which it is not able to synthesise or secrete a sufficient quantity of thyroid hormones then it is termed primary hypothyroidism and if it occurs because of insufficient stimulation of the thyroid gland by Thyroid Stimulating Hormones (TSH) then it is known as central or secondary hypothyroidism. But the latter condition is rare. There is a complex association between TSH and the concentration of T4 and T3 in

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the blood. Accordingly, hypothyroidism could be overt or subclinical, it is defined as when the concentration of TSH is higher than the population reference range (<10.0 mU/l) and the concentration of free T4 and T3 is below the population reference range while in the case of subclinical, TSH concentration over the population reference range (4.0-10.0 mU/l) and the concentration of free T4 level remains within the population reference range[5].

Around one-third of the global population resides in areas that tend to be deficient in iodine and in regions that are acutely short of iodine as much as 80% of people may suffer from endemic goitre. People living in remote and mountainous regions of Southeast Asia, Central-South America and Central Africa are more vulnerable to iodine-deficiency-induced hypothyroidism[6].

Reproductive-age women are at higher risk of developing thyroid disorders than men[7]. Women are about ten times more likely to be affected by hypothyroidism than their male counterparts[8]. Thyroid hormones play a very important role in the reproductive physiology of both males and females. Thyroid disorders are a global health problem that can heavily affect well-being, particularly during childhood and pregnancy. Hypothyroidism has been associated with various types of reproductive abnormalities in males such as individuals suffering from hypothyroidism having decreased libido or impotence and abnormalities in sperm morphology. In women, hypothyroidism has been linked to abnormalities in the menstrual cycle and bleeding[7]. Thyroid hormones exert substantial effects on the regulation and maintenance of pregnancy which brings numerous substantial changes in the anatomy and physiology of the thyroid gland[9]. They are well-known for their crucial roles in the development, metabolism and maturation of the foetus.

The distribution of hypothyroidism and hyperthyroidism in a population depends on the nutrition of iodine, ethnicity, alcohol consumption, sex, genetics, autoimmune diseases, exposure to some clinical drugs, smoking status, age and geographic location[8].

2. Epidemiology of Hypothyroidism Across the World

Hypothyroidism is common throughout the world but its frequency and magnitude of prevalence vary across the globe. The prevalence of hypothyroidism in the general population differs between 0.3 to 3.7% in the United States and between 0.5 to 3.4% in Europe, depending on the criteria used to define it[10]. A 2007 study carried out in Australia reported that the prevalence of thyroid disease was 10% in the population and found that 7.1% of women and 3.7% of men had an abnormal concentration of TSH. However, the study was confined to an older population whose average age was 66.8 years (range 50-98)[11]. Another study from Australia conducted in 2010 documented the 5-year incidence of thyroid dysfunction. It was found that the prevalence of thyroid disorders was 4.7%, with women being at a substantially higher risk of developing hypothyroidism[12].

The prevalence of hypothyroidism in Middle-Eastern countries is not properly understood because very few studies have been carried out and those that have been conducted in the region are limited because they do not capture the full picture.

A study carried out in Tehran found the annual incidence of overt hypothyroidism and subclinical hypothyroidism was 2.0 per 1000 and 7.62 per 1000 respectively[13]. A study carried out in Libya found the prevalence of subclinical hypothyroidism was 2.3% and that of overt hypothyroidism was 6.18%[14].

The burden of hypothyroidism in Sub-Saharan Africa is reported to be minimal but these studies are limited and have largely been carried out in urban areas and based on hospital clinic data so studies should also be carried out in rural areas of the continent. A hospital-based study in 2021 that was carried out in Somalia reported that the incidence of overt hypothyroidism and subclinical hypothyroidism was 15.4%, and 12.5% respectively[15].

In Asian countries, China used to be an iodine-deficient country and due to that, iodine-deficiency-induced disorders were highly prevalent in the country. After the universal salt-iodisation program was introduced in China and fully implemented in 1996, consumption of iodine increased and the incidence of thyroid disorders decreased. A cross-sectional study was carried out in 2016 in China to assess the status of iodine consumption and the prevalence of thyroid diseases reported that the intake of iodine was sufficient and in some areas, iodine was being consumed excessively. The study documented that the prevalence of subclinical hypothyroidism was 16.7% whereas clinical hypothyroidism was found to be 1.03%[16].

3. Prevalence of Hypothyroidism in India

India, being a developing country has a huge burden of numerous diseases and one of them is thyroid disorder which accounts for a significant proportion of the country. In India, a universal salt-iodisation program was introduced in 1983 and since then iodine-deficiency-induced disorders have been found to have decreased significantly which were endemic before that. In 2004, a WHO report assessed household iodine consumption and found that India had transitioned from an iodine-deficient to an iodine-sufficient country[17]. In 2013 a comprehensive study was performed to assess the prevalence of thyroid disorders in the country which tried to cover diverse geographical areas of the country. The study was conducted in eight major cities, Bangalore, Mumbai, Ahmedabad, Kolkata, Goa, Chennai, Delhi and Hyderabad. It found that the prevalence of hypothyroidism was 10.9%which is remarkably high. In addition to that, the study also recorded regional variations in the incidence of the disease, with a higher prevalence of hypothyroidism in inland cities compared to coastal cities. Among the cities covered in the study, Kolkata was found to have the highest incidence of hypothyroidism with 21.67% of people suffering from it. Inland-situated cities had 11.73% and coastal cities had a 9.45% prevalence of hypothyroidism[18].

Hypothyroidism, particularly, is widely prevalent in the country with one in ten adult individuals suffering from the disease. Despite the increase in consumption of iodised salt in the country, the 2013 study showed that 42.2% of households consumed insufficiently iodised salt and 10.5% consumed salt with no iodine altogether[19]. A literature survey of recent research findings shows that most of the studies on the prevalence of hypothyroidism in the country have been limited to urban areas and very few studies have been performed in rural areas so we still do not know for sure the extent of prevalence in the rural areas of the country. Therefore, a cross-sectional survey was required to assess the prevalence of hypothyroidism in rural areas of the district. The goal of the present study was to find out the prevalence of hypothyroidism in reproductive-age women in rural areas of Unnao district also to assess the quality of life of individuals with hypothyroidism.

4. Materials and Methods

4.1 Study Design

A population-based cross-sectional survey was carried out across three villages (Katra, Fazal Khera and Subas Khera) in the Hillauli block of the Purwa subdivision of the Unnao district. These villages were chosen randomly for the study so that we could obtain a better picture of the disease prevalence in the area.

4.2 Inclusion and Exclusion Criteria

The survey was performed among women and girls between 18 to 45 years old. All females were in their reproductive age. All the individuals who were below 18 and above 45 years old were excluded from the study and women who were pregnant were also excluded from the survey.

A total of 138 people participated in the survey and all the individuals were randomly selected. All the participants were interviewed and each one of them was interviewed for approximately 25 minutes. Hindi was the preferred language of communication.

4.3 Data Collection

All the participants who were willing to take part in the survey were invited either to a convenient location or were interviewed at their homes. The survey was carried out between March and April 2023. They were interviewed using a standardised questionnaire designed by The Institute of Functional Medicine, WA, United States[20]. Participants with hypothyroidism were also interviewed regarding their quality of life using a standardised questionnaire by MacMillan *et al.,* 2004[21]. The purpose of the survey was explained to all the participating individuals and informed consent was obtained from each participant as per the Declaration of Helsinki for ethical principles involving human participants.

The questionnaire on thyroid contained questions about typical symptoms associated with hypothyroidism such as cholesterol levels, tolerance of colds, fluctuation in weight, joint or muscle pain, mood, memory or concentration issues and familial history of thyroid as well as menstrual cycle and history of infertility or miscarriage. Information about participants' age, weight, occupation, family income, iodine consumption and education were also obtained.

4.4 Statistical Analysis

The data was analysed using Microsoft Excel 2007 and GraphPad Prism5 software. The crude rate of prevalence of the disease was calculated by using formulas obtained from the Centre for Disease Control and Prevention, US. Body Mass Index (BMI) and Basal Metabolic Rate (BMR) were calculated for both normal participants and those with hypothyroidism were calculated. Comparisons were made by generating graphs of both healthy participants and those with UAT using GraphPad prism5 software. The mean and standard deviation of the mean of BMI and BMR were also calculated for both categories of participants.

Table 1. Demographic details of healthy participants

Number of total participants	138
Number of normal participants	133
Average Age	33.33 years
Average Height	150.64cm
Average Weight	48kg
Literacy Rate: Illiterate Literate	 54.88% 45.13%
Residence	Rural
Occupation	Farmers, Housewives, Students
BMI (kg/m^2)	21.47 ± 0.2963 SEM
BMR (Cal/D)	1119 ± 11.95 SEM

Table 2. Demographic details of participants with under-active thyroid (UAT)

No. of total participants with UAT	05
Average Age	32.2 years
Average Height	159cm
Average Weight	75kg
Literacy Rate: Illiterate Literate	 0% 100%
Residence	Rural
Occupation	Either housewives or working
BMI (kg/m^2)	29.32 ± 0.9866 SEM
BMR (Cal/D)	1417±58.34 SEM

4.5 Results

We found that the prevalence of hypothyroidism in rural areas (Katra, Fazal Khera and Subas Khera) of the district of Unnao was 3.62% or 36 cases per 1,000 ($p < 0.05$).

The mean age of participants was 34.02 ±6.97 years and their mean weight was 49.36 ± 8.61kg. The mean age of healthy participants was 33.33 years and their mean weight was 48kg (Table 1) and mean age of participants with UAT was 32.2 years and their mean weight was 75kg (Table 2). All the participants were inhabitants of rural areas of the district. 85% of healthy participants were involved in agricultural activities, 12% were students, 2% were teachers, 1% were homemakers and 60% participants with UAT were homemakers and 40% teachers.

Participants with hypothyroidism had a higher body-mass index (29.32 ±2.20 Kg/m^2) than the healthy participants (21.47 ±3.41 Kg/m^2) and slightly higher basal metabolic rate (1416.8 ±130.46 calories/day) than the healthy participants (1118.72 ±137.86 calories/day). In the survey, a total of 138 people participated and only five participants manifested typical symptoms associated with hypothyroidism and all of them were undergoing treatment (Table 3 and 4).

All the participants with UAT had a familial history of hypothyroidism and three of them had experienced the problem in the past as well. Three participants were found to have suffered miscarriage or infertility. One subject had cardiovascular disease which also happens to have suffering from hypothyroidism. A total of 10 out of 138 participants did not wish to respond to a question regarding infertility or miscarriage. Only one subject with hypothyroidism had undergone surgery involving thyroid gland and none of the participants had gone through radiation therapy involving the thyroid pituitary gland or hypothalamus. It was found that all the participants who took part in the survey were consuming iodised salt (Table 3).

The quality of life of participants with hypothyroidism was also evaluated (Table 5). In general, 40% of participants said their quality of life was good, 40% said it was neither good nor bad and the rest of them said it was bad. When asked if they were not suffering from the disease how would have been their quality of life, the majority (80%) of them said positive impact and 20% said spontaneous.

Table 3. Questionnaire on thyroid disease

Serial No.	Factors	Yes	No	Didn't Respond
1.	My family has a history of thyroid disease.	5	133	
2.	I have had a thyroid problem in the past.	3	135	
3.	I have a history of infertility or miscarriage.	3	125	10
4.	I am gaining weight for no clear reason or am unable to lose weight with a diet and exercise.	6	132	
5.	My normal temperature is low.	5	135	
6.	My hands and feet are cold and frequently feel colder than others.	5	135	
7.	I feel fatigued or exhausted more than normal.	5	135	
8.	I have a slow pulse and/ or low blood pressure.	5	135	
9.	I have been told that I have high cholesterol.	4	134	
10.	My hair is rough coarse dry, breaking, brittle or falling out.	6	132	
11.	My skin is rough coarse dry, scaly, itchy and thick.	6	132	
12.	My eyebrows appear to be thinning, particularly the outer portion.	1	137	
13.	My voice has become hoarse or grave.	2	136	
14.	I have pains, aches, stiffness, or tingling in joints, muscles, hands and feet.	6	132	
15.	I have carpel tunnel syndrome, tendonitis or plantar fasciitis.	0	138	
16.	I have difficulty concentrating or remembering things.	5	133	
17.	I feel depressed, sad, restless and moody.	6	132	
18.	My eyes feel gritty, dry and light-sensitive.	5	133	
19.	My neck or throat feels full, with pressure, or larger than usual and or I have difficulty swallowing.	2	136	
20.	I have puffiness and swelling around my eyes, eyelids, face feet and hands.	4	134	

Table 4. Questionnaire on hypothyroidism

Serial No.	Factors	Yes	%
1.	Do any member of your family have hypothyroidism?	5	3.63%
2.	Do you have any of the following?		
	Type 1 Diabetes	0	0%
	Rheumatoid Arthritis	0	0%
	Cardiovascular Disease	1	0.72%
	Others	0	0%
3.	Have you gone through the TSH and T4 examination?	9	6.97%
4.	Do you take iodised salt?	138	100%
5.	Do you have any of the following?		
	Fatigue	5	3.75%
	Unexplained Weight Changes	6	4.54%
	Dry Skin	6	4.54%
	Brittle Hair	6	4.54%
	Puffy Face	4	2.98%
	Muscle Ache	6	4.54%
	Cold Sensitivity	5	3.75%

	Forgetfulness	5	3.75%
	Constipation	5	3.75%
	Any irregularities in the menstrual cycle	5	3.75%
6.	How often do you exercise?	2	1.47%
7.	Any radiation therapy involving the thyroid or pituitary?	0	0%
8.	Any surgery involving thyroid, hypothalamus, or pituitary gland?	1	0.72%

Table 5. Underactive thyroid-dependent quality of life questionnaire (MacMillan *et al.*, 2004)

	Excellent	**Very Good**	**Good**	**Neither Good nor Bad**	**Bad**	**Very Bad**
In general, my present quality of life is			40%	40%	20%	
	Response options	Spontaneous	Negative Impact	No Impact	Positive Impact	Not at all important
Hypothyroid-dependent quality of life						
1. If I did not have UAT, my quality of life would be	Better-Worse	20%			80%	
2. I would enjoy the things that I do in my spare time	More-Less	20%			80%	
3. My working life would be	Better-Worse				100%	
4. My holidays would be	Better-Worse	80%		20%		
5. My social life would be	Better-Worse	40%		20%	20%	
6. My family life would be	Better-Worse	40%			60%	
7. My closest personal relationship would be	Better-Worse			40%	60%	
8. Physically I would be	More-Less				100%	
9. My energy levels would be	Higher-Lower				100%	
10. The speed I could do things would	Better-Worse	20%		40%	20%	
11. Getting out and about	Easier-More difficult	20%			80%	
12. I could handle my household tasks	Better-Worse				100%	
13. My physical appearance would be	Better-Worse	20%			80%	
14. My weight would be	Better-Worse			40%	60%	
15. My experience of bodily discomfort would be	Less-Greater	20%			80%	
16. I would feel depressed or low	Less-More	20%		60%	20%	
17. My motivation to do things would be	Greater-Less	80%			20%	
18. My feelings about the future (e.g. hopes and worries) would be	Better-Worse	60%		20%	20%	

Almost all of them said their working life would have been positive if they did not have UAT. 80% reported their holidays would have been positively impacted if they did not have the condition, 20% reported no impact, 20% negative impact, 20% positive impact and 40% said it would have been spontaneous regarding their social life if they did not have hypothyroidism. 60% reported a positive impact and 40% said it had a spontaneous

effect on their family life. 60% said their closest personal relationship would have been positively affected and 40% reported no impact. All of them said there would have been a positive impact on both energy levels and physical capability. 40% reported no impact, 20% positive impact and 20% said it had a spontaneous effect on their speed of working if they were not suffering from UAT. All of them reported a positive impact on their household tasks if they did not have the disease.

80% reported a positive impact and 20% said it would have been spontaneous regarding their physical appearance if they did not have hypothyroidism. 60% reported a positive impact and 40% reported no impact on their weight. 80% reported a positive impact on their bodily discomfort and 20% spontaneous. 60% said there would have been a positive impact, 20% spontaneous and 20% said no impact on their depression or stress. 80% said their level of motivation would have been spontaneous and 20% said it would have a positive impact. 60% said spontaneous, 20% no impact and 20% positive impact on their feelings about their future.

5. Discussion

In our survey, we found a lower prevalence of hypothyroidism in rural areas of the Unnao district, which may be because of the small number of participants. People with hypothyroidism were between 25 to 40 years old which corroborates with other studies in that people develop hypothyroidism usually in their third or fourth decade of life[7]. All participants with hypothyroidism had a familial history of hypothyroidism suggesting genetics does play some role but we still do not know the extent of its involvement in the development of the disease.

Participants in the survey were consuming iodised salt which suggests that iodine deficiency might not be the reason behind the disease but other factors might be responsible for the condition such as excess iodine, autoimmune diseases, genetics etc[8].

The prevalence of hypothyroidism in India is reported to be high ranging from 6-11% depending on criteria used to diagnose, methodology, geography, age, sex etc.[18,] Prevalence of hypothyroidism in India is much higher compared to the developed world where it ranges from 0.2%-4%[22]. A hospital-based study in Meerut district and surrounding areas in Western Uttar Pradesh documented an 8.2% prevalence of overt hypothyroidism[23]. A study carried out in four villages of Kannur district of Kerala found the prevalence of overt hypothyroidism was 9.6%[24]. Another study from Bhopal, Madhya Pradesh reported a 7.63% prevalence of hypothyroidism among college girls[25]. Hypothyroidism negatively affects the quality of life of people suffering from the condition. Participants with hypothyroidism had higher BMI and BMR which is because the total energy content and expenditure in obese people is higher than the non-obese people[26].

One of the limitations of the present study is its small sample size which still excludes a large section of the population of rural areas. Another limitation is that the questionnaire-based survey cannot detect subclinical hypothyroidism in which people do not exhibit typical symptoms associated with hypothyroidism. Only overt hypothyroidism can be detected by a questionnaire-based study. We found the prevalence of hypothyroidism in reproductive-age women of rural areas which was quite low in comparison to other studies in the country. This study shows that hypothyroidism is prevalent in the area and steps should be taken to address the issue. Large-scale epidemiological studies are required to gather data about incidence rate and prevalence for further setting up guidance.

6. Conclusion

The findings from our study indicate that hypothyroidism does exist in the rural areas of the district. Given its impact on the development of children and general well-being, we propose that further studies need to be carried out across rural India as more than of half Indians live outside urban areas and there is also a huge disparity between rural and urban India in terms of access to quality health care.

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