Original Article

Prevalence of hypothyroidism among postmenopausal women in an urbanised village of northern India: A cross-sectional study

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Abstract

Introduction: Hypothyroidism is among the most prevalent endocrine disorders worldwide. Its risk increases with menopause. The prevalence of hypothyroidism among menopausal women in India is unknown, as conclusive data are scarce. The present study was conducted to find out the prevalence of hypothyroidism among menopausal women in Delhi, India, and study the socio-demographic factors associated with it. **Methods:** This was a cross-sectional community-based study done among 282 menopausal women in an urbanised village in Delhi, India. Women with a previously known history of diagnosed thyroid disorders were also included in the study. Informed written consent was obtained from all participants. A socio-demographic profile was gathered by questionnaire and blood samples were collected and analysed for thyroid hormone levels. **Results:** The mean age of study participants was 51.1 years. The prevalence of hypothyroidism among postmenopausal women was 27.3% (77) with 19.9% (56) previously diagnosed and 7.3% (21) diagnosed by the present study. Out of 56 previously diagnosed hypothyroid study participants, only 26 (46.4%) participants had thyroid hormones in a normal range. Age, socio-economic status and literacy status were found to be significantly associated with hypothyroidism. **Conclusion:** About three postmenopausal women out of 10 were found to be hypothyroid. Nation-wide data were required to estimate the true burden of thyroid disorders in this population. The prevalence increased with age underscoring the need for further research to have conclusive evidence regarding this association. Hypothyroid women who are on treatment should undergo regular evaluation of thyroid hormones so that appropriate dose adjustments can be made for pharmacological therapies.

Keywords: Hypothyroidism, non-communicable diseases, postmenopause, thyroid diseases, women's health

Introduction

Thyroid diseases are a public health problem across the world.[1] They are not among the major causes of mortality, but their sequelae can lead to significant morbidity and disability.[2] Among thyroid diseases, hypothyroidism is much more common than hyperthyroidism.

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Thyroid disorders are the most prevalent endocrine disorders in India.[3] There are about 42 million people estimated in India who have these disorders.[4] Overall, the prevalence of hypothyroidism, as observed in a multi-centric study covering eight cities in India, was 10.9%.[5] This approximates to one out of 10 Indians to be hypothyroid. In Delhi, the prevalence of clinical hypothyroidism among the adult population was 11.1% and subclinical hypothyroidism was 9.6%.[5]

There is a strong preponderance of prevalence of hypothyroidism with older age and female gender.[6] According to the American Thyroid Association, the risk of hypothyroidism increases during menopause.[7] The hormonal changes occurring during menopause are sometimes associated with such symptoms that

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overlap with symptoms of hypothyroidism. So, most of the time, this condition goes unrecognised.[8] As the risk of coronary atherosclerosis and osteoporosis increases among women after menopause and quality of life deteriorates, untreated thyroid disorders may aggravate these conditions.[9] There can also be drug interactions between hormone replacement therapy with oestrogen used among menopausal women and thyroxine.[10] An association of hypothyroidism has also been found with depressive disorders.[8,11] Among menopausal women, the prevalence of depression was found to be about 40% in a recently conducted study in Delhi,[12] and it has been advised by the American Association of Clinical Endocrinologists to consider the diagnosis of thyroid disorders among all patients with depression.[13]

With a decrease in the mean age of menopause and pre-mature menopause in low- and middle-income countries including India,[14] the burden of hypothyroidism and associated health problems is likely to increase. Also, as the life expectancy is increasing, it will further add to the problem due to an upsurge in the elderly population. An average Indian woman could spend approximately 30 years in the postmenopausal stage.[15] The menopausal symptoms pose a humanistic and economic burden for women experiencing them with lower physical and mental quality of life, higher overall work impairment in their employment, higher impairment in daily activities and more visits to physicians.[16] A modelling study in the United States among menopausal women showed higher annual costs for menopausal symptoms compared to osteoporosis, oesophageal disorders and disorders of lipid metabolism and similar annual costs with essential hypertension, headache, anxiety, asthma and influenza.[17] There would be around 401 million women above 45 years of age in India in 2026.[18] Therefore, their health problems should be considered a priority in devising public healthcare policies.

The American Thyroid Association recommends routine population screening of both sexes at 35 years of age and then every 5 years thereafter for early detection and treatment of subclinical hypothyroidism.[19] There are no Indian guidelines for screening high-risk populations for subclinical hypothyroidism.[19] The national programme for non-communicable diseases (NCDs) in India does not include any screening recommendation for thyroid disorders in the population aged ≥30 years.[20] The National Iodine Deficiency Disorders Control Programme conducts surveys covering 6–12-year-old children only for the prevalence of iodine deficiency disorders.[21] In spite of the availability of simple diagnostic tests and treatment modalities, most of the people suffering from the disease remain undiagnosed for a longer period of time.

Across the world, the prevalence of hypothyroidism among menopausal women has ranged from 10 to 25%.[22–24] Such variation in prevalence is mainly due to different study populations in different studies and different cut-offs used to diagnose hypothyroidism. In India, the prevalence among menopausal women found in various studies ranges from 20 to 30%.[19,25,26] However, nationwide survey data is unavailable. Most of the studies that have been conducted in India are with pregnant females or school going children. There is a paucity of literature on thyroid disorders in the adult female population and very few studies are available for postmenopausal women. Most studies conducted on women are performed in clinical settings. In a survey conducted among primary care physicians about 53.5% of interviewees indicated interest in hypothyroidism research, whereas 88.1% of respondents indicated interest in educational initiatives.[27] So, the present study is an attempt to find the prevalence of hypothyroidism in postmenopausal women in a community-based setting and to study the associated socio-demographic factors. This will help primary care and family physicians assess the disease burden and prioritise screening and management strategies.

Materials and Methods

Study design and study population

A cross-sectional community-based study was conducted among postmenopausal women, residing in an urbanised village in South Delhi, from January 2016 to February 2017. The inclusion criterion was women who had attained menopause, either naturally or surgically. Menopause was defined as amenorrhoea for a period of 12 consecutive months. As the study was planned to find out the prevalence of hypothyroidism, women with a history of known thyroid disorders were also included. Women who were found absent on three consecutive home visits on three different occasions were excluded from the study. Also, the women residing in the study area for less than six months or who would not be residing for another six months were excluded from the study.

Study setting

The study area was the field practice area of the affiliated institution of authors. It is an urbanized village as previously the community was mainly agrarian but now it has shifted to urban living. The community is a mix of native and migrant populations. The migrants usually live in rented houses and their environmental and sanitation conditions are comparatively poor. The status of iodine deficiency is unknown for this area, but as found out in previous surveys (as per data up to 2015–16), the whole of the national capital territory of Delhi is endemic for iodine deficiency disorders.[21]

Sample size

The sample size was calculated using the formula for proportions, that is, using the formula for proportions, that is, $N = (Z_{(1-\alpha/2)}{}^2 pq)/l^2$, where p is the prevalence, q is 1-p and l is the absolute error.[28] Prevalence was taken as 20% based on findings from a previous study conducted by Deshmukh V *et al.*[19] with an absolute error of 5% and a 15% non-response rate to get a final sample size of 282.

Study technique

The total adult population of the study area was about 6100, out of which about 2200 were women. The average age at menopause for an Indian woman is about 45.5 years,[29] so the approximate number of women ≥45 years of age in the study area was calculated which was found to be 897.

A house-to-house survey using a non-probability consecutive sampling technique was then conducted in the study area to find out the eligible participants. Every postmenopausal woman was then explained the nature and purpose of the study by the investigator and was invited to participate in the study. If a household had more than one postmenopausal woman, all were invited to participate.

A written informed consent was then obtained from each participant. The survey continued until the final sample size was achieved. A pre-tested, semi-structured, interviewer-administered questionnaire was used to gather information. The questionnaire was pre-tested on a sample of thirty women in another urbanized village and was modified accordingly. It contained sections regarding the socio-demographic profile and history of known thyroid disorders. Socio-economic status was ascertained using the revised Kuppuswamy scale for the year 2014.[30] On the first visit, the questionnaire was filled out and the participant was further asked to provide a fasting venous sample on the next morning as per the requirements of the laboratory where sample analysis was to be performed. A 4–5 ml fasting venous blood sample was collected by the investigator on the next day. Blood samples were then transported to the laboratory on the same day within two to three hours for analysis. Samples were analysed for serum thyroid stimulating hormone (TSH), T4 and T3. On arriving at the clinical pathology laboratory, the clotted samples were centrifuged for 10 minutes at 3000 g, and serum was separated into three separate serum vials marked 'T3', 'TSH/T4' and 'extra'. Samples were stored in the freezer at minus 20 degrees until further analysed. The extra sample served as a buffer in case any investigation had to be repeated. The Cobas E 411 analyzer was used for sample analysis. CALBIOTECH enzyme-linked immunoassay (ELISA) kits were used to measure serum TSH, T3 and T4 levels. For internal quality assurance, standardized controls were also tested along with the samples. The normal range for TSH was taken as 0.4–6.2 μIU/ml, for T4 as 4.4–11.6 μg/dl and for T3 as 0.69–2.02 ng/ml as standard by the testing laboratory. The operational definition of hypothyroidism in the present study was participants with a self-reported history of previously diagnosed hypothyroidism or study participants with TSH levels >6.2 μIU/ml with or without low T4 levels or with T4 levels <4.4 μg/dl with TSH levels normal or low.

Reports of the analysis were conveyed to the study participants within a fortnight. If the hormone levels were abnormal, they were advised to visit the endocrinology department of the affiliated hospital of the authors.

Statistical analysis

Data analysis was done using Statistical Package for the Social Sciences (SPSS) software, licenced version 21. All the variables were analysed using descriptive statistics to calculate frequencies, mean, range, etc. Chi-square/Fisher's exact test was used to analyse the association between socio-demographic profile and hypothyroidism. A *P*-value of <0.05 was considered to be significant.

Ethics

The study was approved by the Institute Ethics Committee of the authors' institution. Written informed consent was obtained from each study participant. Participant confidentiality and privacy were ensured.

Results

A total of 309 postmenopausal women were approached for participation in the study to achieve a sample size of 282. Therefore, the non-response rate was 8.7%. The mean age of the study participants was 51.1 ± 7.8 years (range: 40–76).

The maximum number of participants (44%, 124) were in the age group of 50–59 years. The majority (70.2%, 198) were housewives and the majority (82.3%, 232) of the study participants were currently married. Out of 282 study participants, more than half of the study participants (62.1%, 175) were literate. Two-thirds of the participants (66.3%, 187) belonged to the upper middle socio-economic class, according to the revised Kuppuswamy scale for May 2014[29] [Table 1].

The mean TSH level among study participants was 3.4 μIU/ml ± 2.8 (range: 0.1–12.5). The majority (227, 80.5%) of the study participants had normal TSH levels. The mean T4 level was found to be 9.2 μg/dl ± 2.4 (range 2.2–17). The majority (237, 84%) of the study participants had normal T4 levels. The mean T3 level among study participants was 1.1 ng/ml ± 0.3 (range: 0.6–2.4). The majority (264, 93.6%) of participants had normal T3 levels [Table 2].

Self-reported previously diagnosed hypothyroidism was prevalent among about one-fifth (19.9%, 56) and 21 (7.4%) were newly diagnosed through the present study. Therefore, a total of 77 study participants were hypothyroid, making the prevalence of hypothyroidism in the present study to be 27.3%. [Table 3] All 56 previously diagnosed hypothyroid study participants were taking medications for hypothyroidism. Out of 56 previously diagnosed hypothyroid study participants, 26 (46.4%) participants had thyroid hormones in the normal range currently while about one-fourth (28.6%, 16) still had thyroid hormones in the hypothyroid range and the rest one-fourth (25%, 14) had thyroid hormones in the hyperthyroid range [Table 4].

For further analysis, the study participants were divided into two groups: those with hypothyroidism (77) and with normal thyroid

Table 1: Distribution of study participants according to socio-demographic profile (*n*=282)

Serial No.	Socio-demographic profile of study participants	Number	Percentage
I	Age groups (in completed years)		
1	30–39	9	3.2
2	40–49	111	39.4
3	50–59	124	44.0
4	60–69	32	11.3
5	70–79	6	2.1
II	State of origin		
1	Delhi	103	36.5
2	Uttar Pradesh	87	30.8
3	Haryana	54	19.2
4	Others	38	13.5
III	Religion		
1	Hinduism	274	97.2
2	Islam	8	2.8
IV	Occupation		
1	Housewife	198	70.2
2	Gainfully employed	84	29.8
V	Marital status		
1	Currently married	232	82.3
2	Widow	50	17.7
VI	Educational status		
1	Illiterate	107	37.9
2	Primary school	51	18.1
3	Middle school	36	12.8
4	High school/secondary school	29	10.3
5	Intermediate/higher secondary school	31	11
6	Graduate/postgraduate	28	9.9
VII	Number of family members		
1	Four or less	99	35.1
2	Five to eight	163	57.8
3	Nine or above	20	7.1
VIII	Socio-economic class according to revised Kuppuswamy scale, 2014		
1	Upper	8	2.8
2	Upper middle	187	66.3
3	Lower middle	25	8.9
4	Upper lower	62	22.0

hormones' status (174). The rest of the study participants who were previously normal but presently hyperthyroid (31) were excluded. So, further analysis was done for 251 study participants.

A higher percentage of study participants in the age group of 70–79 years were hypothyroid as compared to other age groups except 30–39 years and this difference was statistically significant (*P*-value <0.05). A higher percentage of illiterate study participants were hypothyroid as compared to literate participants and this difference was also statistically significant (*P*-value <0.05). Additionally, a higher percentage of study participants belonging to low socio-economic status were hypothyroid as compared to those belonging to higher socio-economic status and this difference was statistically significant (*P*-value <0.05)[Table 5].

Discussion

As the world is going through an epidemiological transition, the increasing burden of NCDs has raised concern among all public health personnel. India is facing a triple burden of diseases including communicable and NCDs as well as malnutrition-related problems. The ongoing demographic transition is also a challenge. Thyroid disorders are slowly inflating and their true burden is still unknown. Therefore, the present study is an attempt to find out the prevalence of hypothyroidism, one of the major thyroid disorders, among postmenopausal women.

The total prevalence of hypothyroidism in the present study was found to be 27.3% (77), out of which 19.9% (56) gave a self-reported history of previously diagnosed disease and 7.4% (21) were diagnosed through this study. This implies that out of every 10 menopausal women in India, 2–3 women will be hypothyroid. Similar findings were reported from studies conducted in other parts of India and around the world, where prevalence ranged from 20% to 24%.[19,22,26] The findings of the present study are different from a few of the other studies, and the main reasons for such difference could be the inclusion of peri-menopausal women, exclusion of already diagnosed hypothyroid women, different criteria for diagnosis of hypothyroidism or the reporting of only subclinical hypothyroidism.[6,31–33]

A history of hypothyroidism was present among 19.9% (56) of the study participants. All of these participants were on medication for the same. The rest of the study participants did not have a history of any thyroid disorders. This is similar to the findings from another study by Rodriguez LAG *et al*.[22] who reported that 14.5% of the postmenopausal women in their study were previously diagnosed with hypothyroidism and all were taking medications.

In the present study, 7.4% (21) of study participants were newly diagnosed as hypothyroid. The findings were consistent with the findings of other studies.[22] Thyroid disorders represent an iceberg phenomenon of diseases, with only a fraction of patients presenting with signs and symptoms. Also, as no screening guidelines exist for thyroid disorders among the Indian population, most of the cases are diagnosed only when symptoms become apparent. The symptoms of hypothyroidism are vague and have a wide spectrum, so they most often lead to a delayed diagnosis. Therefore, all patients with hypothyroidism symptoms should have their thyroid function assessed by family physicians.[34] The primary care physician can effectively handle the majority of patients with primary hypothyroidism.[35] The difference in opinion among clinicians, whether to treat subclinical cases with few or no symptoms, presents a dilemma in treatment. A survey conducted among primary care physicians in Spain revealed that the majority of primary care physicians considered hypothyroidism a common and easily managed health condition. They also concurred that inadequate management of hypothyroidism raises healthcare expenses.[27]

Table 2: Distribution of study participants according to thyroid hormones' levels (*n*=282)

Serial No.	Thyroid hormones' levels	Number	Percentage
I	TSH (μIU/ml)		
1	Low (<0.4)	18	6.4
2	Normal (0.4–6.2)	227	80.5
3	High (>6.2)	37	13.1
II	T4 (μg/dl)		
1	Low (<4.4)	4	1.4
2	Normal (4.4–11.6)	237	84
3	High (>11.6)	41	14.6
III	T3 (ng/ml)		
1	Low (<0.69)	8	2.8
2	Normal (0.69–2.02)	264	93.6
3	High (>2.02)	10	3.6

Table 3: Prevalence of thyroid disorders among study participants (*n*=282)

Thyroid disorder	Number	Percentage
Normal	174	61.7
Hypothyroidism	77	27.3
Hyperthyroidism	31	11.0

Table 4: Distribution of previously diagnosed hypothyroid study participants according to the current thyroid hormones' levels (*n*=56)

Current thyroid hormones' levels	Number	Percentage
Normal	26	46.4
Hypothyroid	16	28.6
Hyperthyroid	14	25.0

In the present study, age groups showed a significant association with the prevalence of hypothyroidism. The prevalence increased with age only after the age of 40 years, as there were very few participants in the age group younger than 40 years. This could be because the study included postmenopausal women only and menopause before 40 years of age is less prevalent. The highest percentage (3, 50%) of study participants in the age group of 70–79 years had hypothyroidism. This can be attributed to declining thyroid activity with age. This finding is consistent with the findings of other studies conducted by various authors.[22,24-26,31,36,37] But this finding was different from the study by Niafar M *et al.*[32] in which TSH levels and age strata were not found to be correlated among postmenopausal women in a community-based cross-sectional study. This difference could be due to the fact that they only included women over the age of 60.

The higher percentage of illiterate and low socio-economic status women had hypothyroidism, and this finding was statistically significant. These findings are similar to the study conducted by Tonstad S *et al.*[38] who found out that subjects with hypothyroidism had lower income and education compared to subjects without hypothyroidism. This could possibly be due to poor salt storage and cooking practices and less consumption of dairy products by illiterate and lower socio-economic status people. All this could lead to iodine deficiency in the diet, leading to iodine deficiency disorders including hypothyroidism.

Strengths

This study is among the few studies conducted among postmenopausal women in India to estimate the prevalence of hypothyroidism in a community-based setting. Scientific methodology was used for the calculation of the sample size and the selection of participants. The data were collected by the investigator herself using the interview technique, so inter-observer bias was minimized. Standardized tools and diagnostic tests were used in the present study. The response rate was also high in our study.

Limitations

Since it was a questionnaire-based study, information bias might have contributed to under- or over-reporting by the study participants for a self-reported history of hypothyroidism. As the study was conducted among postmenopausal women in an urbanised village in north India, the study findings cannot be generalised to women in other parts of the country.

Conclusion and recommendations

To conclude our study, almost three out of 10 postmenopausal women were hypothyroid. This prevalence is approximately two to three times higher than that found in the 18–35-year-old group. Although significant advances have been made in healthcare, women in India still face hurdles to accessing proper healthcare facilities compared to males.[39] The association of hypothyroidism with cardiovascular diseases, diabetes, osteoporosis and mental disorders and the higher prevalence of these morbidities among menopausal women is a growing area of concern. Further research is required to get nation-wide data to get true estimates of the disease burden among this population. It will help in the formulation of specific guidelines for screening and treatment of thyroid disorders in high-risk populations including menopausal women in India. The national programme for prevention and control of cancer, diabetes, cardiovascular diseases and stroke in India should consider including screening for thyroid disorders among symptomatic individuals and their management.

Already hypothyroid women who are on treatment should also undergo regular evaluation of their thyroid hormones' levels, as only about half of these participants had their hormones in the normal range in the present study. Appropriate dose adjustments can then be made for thyroxine. Age, socio-economic status and literacy status were found to be significantly associated with hypothyroidism among menopausal women. These factors and their association with thyroid disorders need further exploration and evaluation.

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Table 5: Association between socio-demographic characteristics and hypothyroidism among study participants (*n*=251)

Serial No.	Characteristic	Thyroid status			*P*
		Normal *n* (%)	Hypothyroidism *n* (%)	Total *n* (%)	
I	Age group (in completed years)				0.011##,*
1	30-39	0 (0)	4 (100)	4 (100)	
2	40–49	75 (73.5)	27 (26.5)	102 (100)	
3	50–59	80 (72.1)	31 (27.9)	111 (100)	
4	60–69	16 (57.1)	12 (42.9)	28 (100)	
5	70–79	3 (50)	3 (50)	6 (100)	
II	Religion				0.669##
1	Hindu	169 (69)	76 (31)	245 (100)	
2	Muslim	5 (83.3)	1 (16.7)	6 (100)	
III	State of origin				0.418#
1	Delhi	57 (64)	32 (36)	89 (100)	
2	Uttar Pradesh	60 (75.9)	19 (24.1)	79 (100)	
3	Haryana	32 (68.1)	15 (31.9)	47 (100)	
4	Others	25 (69.4)	11 (30.6)	36 (100)	
IV	Educational status				0.000#,*
1	Illiterate	56 (56.6)	43 (43.4)	99 (100)	
2	Literate	118 (77.6)	34 (22.4)	152 (100)	
V	Occupation				0.838#
1	Gainfully employed	52 (68.4)	24 (31.6)	76 (100)	
2	Housewife	122 (69.7)	53 (30.3)	175 (100)	
VI	Marital status				0.339#
1	Currently married	143 (68.1)	67 (31.9)	210 (100)	
2	Widow	31 (75.6)	10 (24.4)	41 (100)	
VII	Number of family members				<0.001##,*
1	Four or less	71 (84.5)	13 (15.5)	84 (100)	
2	Five to eight	95 (61.3)	60 (38.7)	155 (100)	
3	Nine or more	8 (66.7)	4 (33.3)	12 (100)	
VIII	Socio-economic class				0.001#,*
1	Upper middle	129 (76.8)	39 (23.2)	168 (100)	
2	Lower middle	12 (57.1)	9 (42.9)	21 (100)	
3	Upper lower	33 (53.2)	29 (46.8)	62 (100)	

#Chi-square test. ##Fisher's exact test. *Significant association

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Conflicts of interest

There are no conflicts of interest.

References

1. Shahrani ASA, Metwally AE, Surimi KA, Salih SB, Saleh Y, Shehri AA, *et al.* The epidemiology of thyroid diseases in the Arab world: A systematic review. J Public Health Epidemiol 2016;8:17-26.
2. Kalra S, Unnikrishnan AG, Sahay R. The global burden of thyroid disease. Thyroid Res Pract 2013;10:89-90.
3. Tayal D, Goswami B, Gupta N, Chawla R, Gupta VK, Singh B, *et al.* Prevalence of thyroid disorders in patients visiting a tertiary care centre in New Delhi: A three-year study. Asian J Med Sci 2012;3:15-23.
4. Kochupillai N. Clinical endocrinology in India. Curr Sci 2000;79:1061-7.
5. Unnikrishnan AG, Kalra S, Sahay RK, Bantwal G, John M, Tewari N. Prevalence of hypothyroidism in adults: An epidemiological study in eight cities of India. Indian J Endocrinol Metab 2013;17:647–52.
6. Sawin CT, Castelli WP, Hershman JM, McNamara P, Bacharach P. The aging thyroid: Thyroid deficiency in Framingham study. Arch Intern Med 1985;145:1386-8.
7. American Thyroid Association. Hypothyroidism: A booklet for patients and their families. Virginia. American Thyroid Association 2013. Available from http://www.thyroid.org/wp-content/uploads/patients/brochures/Hypothyroidism_web_booklet.pdf. [Last accessed on 2017 Apr 26].
8. Schindler AE. Thyroid function and postmenopause. Gynecol endocrinol 2003;17:79-85.
9. Pearce EN. Thyroid dysfunction in perimenopausal and postmenopausal women. Menopause Int 2007;13:8-13.
10. Ghianda DS, Tonacchera M, Vitti P. Thyroid and menopause. Cimacteric 2014;17:225-34.
11. Hage MP, Azar ST. The link between thyroid function and depression. J Thyroid Res 2012;2012:1-8.
12. Ahlawat P, Singh MM, Garg S, Mala YM. Prevalence of depression and its association with sociodemographic factors in postmenopausal women in an urban resettlement colony of Delhi. J Mid-life Health 2019;10:33-6.

13. Baskin HJ, Cobin RH, Duick DS, Gharib H, Guttler RB, Kaplan MM, *et al.* American Association of Clinical Endocrinologists medical guidelines for clinical practice for the evaluation and treatment of hyperthyroidism and hypothyroidism. Endocr Pract 2002;8:457-69.
14. Leone T, Brown L, Gemmill A. Secular trends in premature and early menopause in low-income and middle-income countries. BMJ Glob Health 2023;8:e012312.
15. Pallikadavath S, Ogollah R, Singh A, Dean T, Dewey A, Stones W. Natural menopause among women below 50 years in India: A population-based study. Indian J Med Res 2016;144:366-77.
16. Whiteley J, DiBonaventura Md, Wagner JS, Alvir J, Shah S. The impact of menopausal symptoms on quality of life, productivity, and economic outcomes. J Womens Health (Larchmt) 2013;22:983-90.
17. Assaf AR, Bushmakin AG, Joyce N, Louie MJ, Flores M, Moffatt M. The relative burden of menopausal and postmenopausal symptoms versus other major conditions: A retrospective analysis of the medical expenditure panel survey data. Am Health Drug Benefits 2017;10:311-21.
18. Population Projections for India and States 2001-2026. Report of the technical group on population projections constituted by the national commission on population. May 2006. Office of the Registrar General and Census Commissioner, Government of India. New Delhi. 2006. Available from https://www.educationforallinindia.com/Population_Projection_Report_2006.pdf. [Last accessed on 2024 Mar 30].
19. Deshmukh V, Behl A, Iyer V, Joshi H, Dholye HP, Varthakavi PK. Prevalence, clinical and biochemical profile of subclinical hypothyroidism in normal population in Mumbai. Indian J Endocr Metab 2013;17:454-9.
20. National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke. Training Module for Medical Officers for Prevention, Control and Population Level Screening of Hypertension, Diabetes and Common Cancer (Oral, Breast & Cervical). National Centre for Disease Control, Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India. New Delhi, India. 2017. Available from https://main.mohfw.gov.in/sites/default/files/Training%20Module%20for%20Medical%20Officers%20for%20Prevention%2C%20Control%20and%20Population%20Level%20Screening%20of%20NCDs_1.pdf. [Last accessed on 2024 Mar 30].
21. Directorate general of health services. National Iodine Deficiency Disorders Control Programme. Ministry of Health & Family Welfare, Government of India. New Delhi, India. Available from https://dghs.gov.in/content/1348_3_NationalIodineDeficiency.aspx. [Last accessed on 2024 Mar 30].
22. Rodriguez LAG, Giovanini MEF, Haddock L. Thyroid dysfunction in an adult female population: A population-based study of Latin American Vertebral Osteoporosis Study (LAVOS) –Puerto Rico Site hypothyroidism in LAVOS – Puerto Rico site. P R Health Sci J 2013;32:57-62.
23. Zou S, Wu F, Guo C, Song J, Huang C, Zhu Z, *et al.* Iodine nutrition and the prevalence of thyroid disease after salt iodization: A cross-sectional survey in Shanghai, a coastal area in China. PLoS One 2012;7:1-8.
24. Escribano SJ, Mancera RJ, Santos SV, Paya GC, Mendez EMI, Garcia BA, *et al.* Prevalence of hypothyroidism in Andalusia, Spain, determined by thyroid hormone consumption. Rev Esp Salud Publica 2016;90:1-12.
25. Marwaha RK, Tandon N, Ganie MA, Kanwar R, Garg MK, Singh S. Status of thyroid function in Indian adults: Two decades after universal salt iodization. J Assoc Physicians India 2012;60:32–6.
26. Garg N, Singh J, Sodhi KS, Ashima B. Evaluation of subclinical hypothyroidism in women of postmenopausal age group. J Adv Res Biol Sci 2012;4:20-2.
27. Díez JJ, Iglesias P, Gómez-Mateos MÁ. Educational and research needs in hypothyroidism of primary care physicians in the community of Madrid. Endocrinol Diabetes Nutr (Engl Ed) 2022;69:828-36.
28. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med 2013;35:121-6.
29. Ahuja M. Age of menopause and determinants of menopause age: A PAN India survey by IMS. J Midlife Health 2016;7:126-31.
30. Oberoi SS. Updating income ranges for Kuppuswamy's socio-economic status scale for the year 2014. Indian J Public Health 2015;59:156-7.
31. Joshi SA, Bhalerao A, Somalwar S, Jain S, Vaidya M, Sherawat N. Screening of peri- and postmenopausal women for hypothyroidism. J South Asian Fed Obstet Gynecol 2011;3:14-6.
32. Niafar M, Najafipour F, Bahrami A. Subclinical thyroid disorders in postmenopausal women of Iran. J Clin Diagn Res 2009;3:1853-8.
33. Hak AE, Pols HA, Visser TJ, Drexhage HA, Hofman A, Witteman JC. Subclinical hypothyroidism is an independent risk factor for atherosclerosis and myocardial infarction in elderly women: The Rotterdam study. Ann Intern Med 2000;132:270-8.
34. Gaitonde DY, Rowley KD, Sweeney LB. Hypothyroidism: An update. Am Fam Physician 2012;86:244-51.
35. Watson C, Guilbeau J. Assessment and management: Primary hypothyroidism in women. Womens Healthcare 2021:36-40.
36. Suzuki S, Nishio S, Takeda T, Komatsu M. Gender-specific regulation of response to thyroid hormone in aging. Thyroid Res 2012;5:1-8.
37. Saha PK, Baur B, Gupta S. Thyroid stimulating hormone measurement as the confirmatory diagnosis of hypothyroidism: A study from a tertiary-care teaching hospital, Kolkata. Indian J Community Med 2007;32:139-40.
38. Tonstad S, Nathan E, Oda K, Fraser G. Vegan diets and hypothyroidism. Nutrients 2013;5:4642-52.
39. Singh S, Rajak B, Dehury RK, Mathur S, Samal A. Differential access of healthcare services and its impact on women in India: A systematic literature review. SN Soc Sci 2023;3:16.