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Prevalence of Goiter and Household Salt Iodine Status Among Women in Tehsil Katlang, District Mardan, Pakistan: A Community-Based Cross-Sectional Study

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Abstract

Background: Iodine deficiency disorders (IDDs), of which goiter is the most common manifestation, remain an important public health problem in Pakistan, particularly among women.To determine the prevalence of goiter among women of Tehsil Katlang, District Mardan, and to assess the iodine status of salt at the household level. **Methods:** A community-based cross-sectional study was conducted from February to April 2022 among 200 women in Tehsil Katlang using a pre-tested structured questionnaire. Goiter was assessed by physical examination performed by a trained observer, and household salt samples were tested for iodine content using a rapid spot-testing kit. Data were entered and analyzed in Microsoft Excel to generate

frequencies and percentages. **Results:** Visible goiter was identified in 18 women (9%), of whom 8 (4%) had a positive family history of goiter and only 33 (16.5%) had adequate knowledge of goiter prevention. A higher proportion of respondents (n=127, 63.5%) consumed goitrogenic foods. Uneducated respondents (n=142, 71%) lacked information about iodized salt, and 145 (72.5%) could not differentiate iodized from non-iodized salt. Salt was left uncovered in 105 households (52.5%), and 144 salt samples (72%) tested negative for iodine. **Conclusion:** Goiter and inadequate household salt iodization are prevalent among women in Tehsil Katlang and are strongly associated with poor awareness, goitrogenic food consumption, and improper salt storage practices. Community-level education and stricter regulation of salt iodization are recommended.

Keywords: Goiter; Iodine deficiency; Iodine deficiency disorders; Goitrogenic foods; Salt iodization; Rapid testing kit

INTRODUCTION

The thyroid gland is a butterfly-shaped organ located in the anterior neck, comprising right and left lobes joined by the isthmus, and its hormones regulate metabolism, growth, and several other body functions [1]. Iodine is an essential constituent required for the synthesis of thyroid hormones [2], and a daily intake of 100-150 micrograms is recommended for normal growth and development [3]. Because iodine deficiency impairs thyroid hormone production, it gives rise to a spectrum of conditions collectively termed iodine deficiency disorders (IDDs), including cretinism, hypothyroidism, impaired reproduction, neurological dysfunction, and goiter [4], of which goiter remains the most common across all age groups [5]. In recognition of this burden, the World Health Organization (WHO) first recommended universal iodization of salt in 1952 as a cost-effective strategy for the prevention of IDD in iodine-deficient regions [6].

Goiter refers to the enlargement of the thyroid gland and is regarded as an important clinical sign of insufficient iodine intake; it may be associated with either hyperthyroidism or hypothyroidism and is typically diagnosed through physical examination of the neck [7]. Iodine deficiency is the leading cause of goiter worldwide, affecting an estimated 2.2 billion people, and its prevalence rises with the severity of deficiency, ranging from 5-20% under mild deficiency to over 30% under severe deficiency. Women are considerably more susceptible to goiter than men, and metabolic factors such as obesity and insulin resistance have also been implicated in its increasing prevalence.

Tehsil Katlang is situated approximately 19 kilometers north of District Mardan, bordering Districts Buner and Malakand, with a total area of 422.0 km^2 comprising 12 union councils and 31 villages; its population was recorded as 343,225 in the 2017

census. Regional data indicate a considerable burden of household iodine deficiency in Khyber Pakhtunkhwa: a study in District Karak found that 72.3% of 112 household salt samples contained no detectable iodine [4], while a study in Kohat reported that 56.48% of samples lacked iodine at the recommended concentration of 15 ppm [8]. No data, however, were available on the current iodine status of household salt or the prevalence of goiter in Tehsil Katlang prior to this study.

Several studies from South Asia and East Africa provide comparative context. A meta-analysis of high iodine intake and goiter in schoolchildren reported a significant positive association between urinary iodine concentration and goiter risk (OR 1.74, 95% CI 1.50-2.01) [9]. Community-based studies among women of reproductive age in Ethiopia have reported goiter prevalence as high as 43% [10], while school-based surveys have documented total goiter rates ranging from 16% to 50.6%, frequently linked to goitrogenic food consumption, inadequate urinary iodine concentration, and poor household salt iodization [11,12]. In Morocco, only 25% of households were found to use adequately iodized salt [13]. Within Pakistan, goiter prevalence of 35% and 14.2% has been reported from Kohat and Karak districts respectively, with a substantial proportion of household salt samples testing below the recommended iodine threshold [8,4], while surveys in Goba town, Ethiopia and Charsadda district, Pakistan similarly documented high rates of inadequately iodized salt and goiter among vulnerable groups [14,5]. Case series from Bahawalpur and rural Karnataka further indicate a pronounced female predominance in goiter presentation [15,16].

Given the absence of local data and the documented burden of iodine deficiency in neighbouring districts, this study was undertaken to establish baseline evidence on goiter prevalence and household salt iodine status in Tehsil Katlang, with the aim of informing policy makers in the design of iodine prophylaxis programs for the region.

Objectives

1. To determine the prevalence of goiter among women of Tehsil Katlang.
2. To assess the current iodine status of salt at the household level in Tehsil Katlang.

MATERIALS AND METHODS

Study Design, Setting, and Duration

A community-based cross-sectional study was conducted in Tehsil Katlang, District Mardan, Khyber Pakhtunkhwa, Pakistan, from 1st February 2022 to April 2022, to determine the prevalence of goiter among women and to assess the iodine content of salt at the household level.

Sample Size and Sampling

A total of 200 women were enrolled through random sampling. The purpose and objectives of the study were explained to each respondent, and verbal willingness to participate was obtained prior to data collection.

Data Collection Tool

A pre-planned, structured questionnaire was used to collect sociodemographic, anthropometric, and knowledge-attitude-practice (KAP) data. Each participant was physically assessed for the presence of goiter, and a sample of household salt was tested for iodine content using a rapid testing kit.

Anthropometric Assessment

Weight, height, body mass index (BMI), and waist-to-hip ratio (WHR) were assessed using standard procedures. Weight was measured in kilograms using a calibrated weighing scale, with participants asked to remove heavy items and stand still with arms relaxed; measurements were repeated three times to ensure accuracy. Height was measured in centimeters using an inch tape with participants standing barefoot against a wall, heels together, in the Frankfurt plane. Waist and hip circumferences were measured using an inch tape, and WHR was calculated as waist circumference divided by hip circumference. BMI was calculated as weight in kilograms divided by the square of height in meters [17], and participants were categorized according to WHO reference cut-offs: normal (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), obese class I (30.0-34.9 kg/m^2), obese class II (35.0-39.9 kg/m^2), and extremely obese ($\geqslant$40 kg/m^2) [18].

Clinical Assessment of Goiter

Each participant was examined by a trained observer through visual inspection and palpation of the neck; only clinically visible goiter was recorded as a positive case.

Household Salt Iodine Testing

A total of 200 household dietary salt samples were collected from the study population, and iodine content was assessed using a rapid spot-testing kit based on a colorimetric reaction. Each sample was tested three times, and the consistent result was recorded, in accordance with previously validated protocols.

Statistical Analysis

Data were entered and analyzed using Microsoft Excel. Descriptive statistics, including frequencies, percentages, and measures of central tendency (minimum, maximum), were computed for quantitative variables (age, weight, height, BMI, WHR) and qualitative variables (occupation, family type, knowledge, attitudes, and practices).

Ethical Considerations

The objectives of the study were explained to each participant, and informed verbal consent was obtained prior to enrollment. Confidentiality of participant information was maintained throughout data collection, entry, and analysis.

RESULTS

Sociodemographic Characteristics

Of the 200 women enrolled, the majority were housewives (n=161, 80.5%), while 39 (19.5%) were working women (Table 1). Most respondents belonged to nuclear families (n=114, 57%), with the remainder living in joint family systems (n=86, 43%). Family size was most frequently in the range of 6-10 members (n=77, 38.5%), followed by 1-5 members (n=52, 26%), 11-15 members (n=33, 16.5%), 16-20 members (n=29, 14.5%), and 21-25 members (n=9, 4.5%) (Figure 1).

Table 1. *Sociodemographic characteristics of study participants (n=200)*

Characteristic	Category	Frequency (n)	Percentage (%)
Occupation	Housewife	161	80.5
	Working woman	39	19.5
Family type	Nuclear	114	57.0
	Joint	86	43.0
Family size	1-5 members	52	26.0
	6-10 members	77	38.5
	11-15 members	33	16.5
	16-20 members	29	14.5
	21-25 members	9	4.5

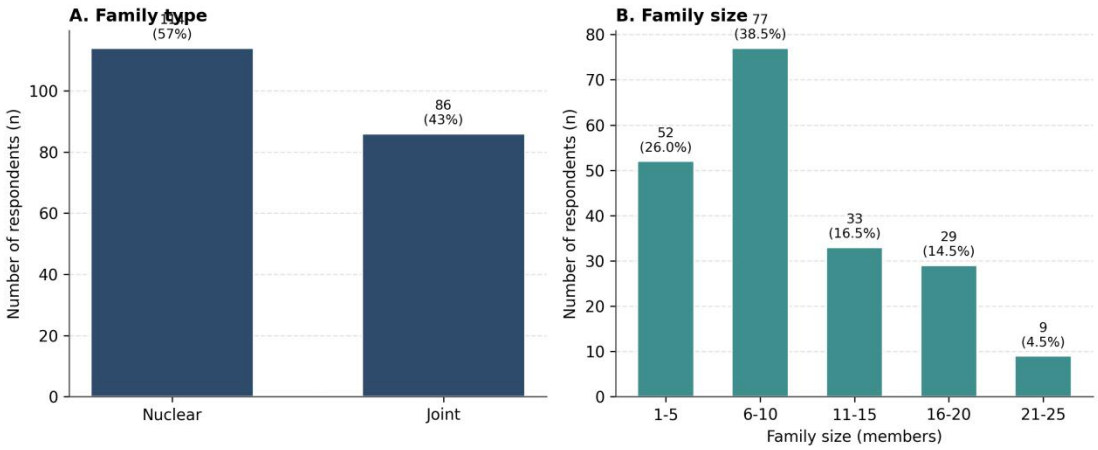

Figure 1. Distribution of study participants by (A) family type and (B) family size.

The age distribution of respondents showed that the largest proportion were between 21-30 years (n=68, 34%), followed by 31-40 years (n=59, 29.5%), 41-50 years (n=32, 16%), 51-60 years (n=21, 10.5%), 10-20 years (n=13, 6.5%), and 61-70 years (n=7, 3.5%) (Figure 2).

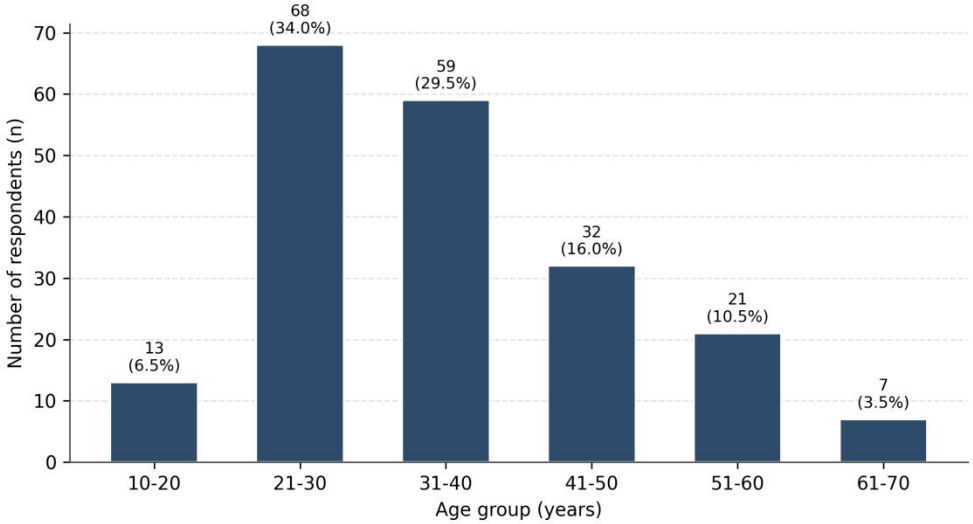

Figure 2. Age distribution of study participants (years).

Regarding height, 105 respondents (52.5%) were in the range of 151-170 cm, 58 (29%) in the range of 131-150 cm, 26 (13%) in the range of 171-190 cm, and 11 (5.5%) in the range of 110-130 cm (Figure 3). Weight varied considerably among respondents, with the highest single frequency (n=53, 26.5%) observed in the 61-70 kg range, reflecting the variable metabolic presentation of hyperthyroidism and hypothyroidism among affected individuals.

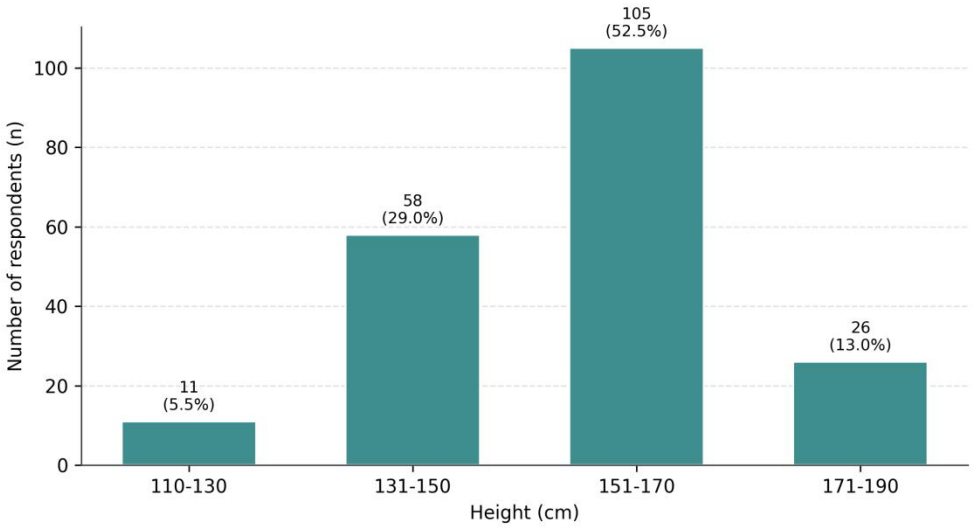

Figure 3. Height distribution of study participants (cm).

Anthropometric status: BMI and waist-to-hip ratio

BMI distribution showed that 71 respondents (35.5%) were within the normal range (18.5-24.9 kg/m^2), 53 (26.5%) were overweight, 41 (20.5%) were obese class I, 15 (7.5%) were obese class II, and 20 (10%) were extremely obese (Table 2, Figure 4A). WHR assessment showed that the majority of respondents fell into the average category (n=96, 48%), followed by good (n=75, 37.5%), at-risk (n=23, 11.5%), and excellent (n=6, 3%) categories (Table 2, Figure 4B). WHR was closely related to body weight, with higher weight associated with a greater likelihood of an above-normal waist-to-hip ratio.

Table 2. *Anthropometric characteristics of study participants: BMI and waist-to-hip ratio (n=200)*

Parameter	Category	Cut-off	Frequency (n)
Body mass index	Normal	18.5-24.9 kg/m^2	71
	Overweight	25.0-29.9 kg/m^2	53
	Obese class I	30.0-34.9 kg/m^2	41
	Obese class II	35.0-39.9 kg/m^2	15
	Extremely obese	⩾40 kg/m^2	20
Waist-to-hip ratio	Excellent	⩽0.75	6
	Good	0.75-0.79	75

Parameter	Category	Cut-off	Frequency (n)
	Average	0.80-0.86	96
	At risk	⩾0.86	23

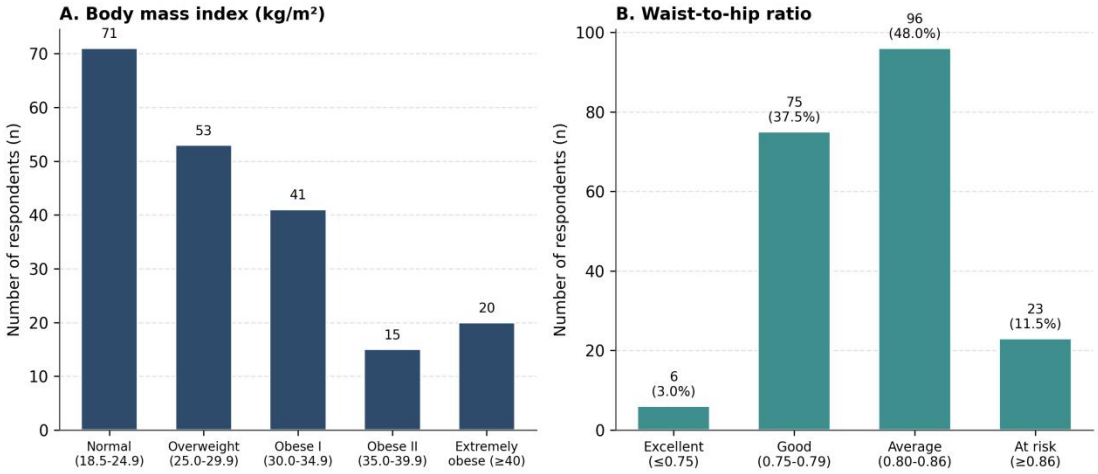

Figure 4. Distribution of study participants by (A) body mass index and (B) waist-to-hip ratio.

Knowledge, Attitudes, and Practices Related to Goiter and Iodized Salt

Of the 200 respondents, 18 (9%) reported visible goiter and 8 (4%) had a family history of goiter. Only 33 (16.5%) demonstrated adequate knowledge of goiter prevention, while the remainder were unaware of preventive measures. Goitrogenic food consumption (e.g., cabbage, turnip, cauliflower) was reported by 127 respondents (63.5%), predominantly among those with larger family sizes and lower monthly income. Uneducated respondents (n=142, 71%) lacked information about iodized salt, and 145 (72.5%) were unable to differentiate iodized from non-iodized salt. Although 193 respondents (96.5%) reported access to iodized packed salt, 105 (52.5%) did not keep their salt covered, 27 (13.5%) stored salt with exposure to sunlight or heat, and 69 (34%) used transparent salt containers — all recognized risk factors for iodine loss (Table 3, Figure 5).

Table 3. *Knowledge, attitude, and practices of study participants regarding goiter and iodized salt (n=200)*

Parameter	Yes, n (%)	No, n (%)
Presence of goiter	18 (9.0)	182 (91.0)
Family history of goiter	8 (4.0)	192 (96.0)
Knowledge of goiter prevention	33 (16.5)	167 (83.5)
Goitrogenic food consumption	127 (63.5)	73 (36.5)
Iodine-rich food consumption	124 (62.0)	76 (38.0)
Information about iodized salt	58 (29.0)	142 (71.0)
Able to differentiate iodized salt	55 (27.5)	145 (72.5)
Access to iodized packed salt	193 (96.5)	7 (3.5)
Keeps salt in covered container	95 (47.5)	105 (52.5)
Salt exposed to sunlight	27 (13.5)	173 (86.5)
Salt container is transparent	69 (34.5)	131 (65.5)

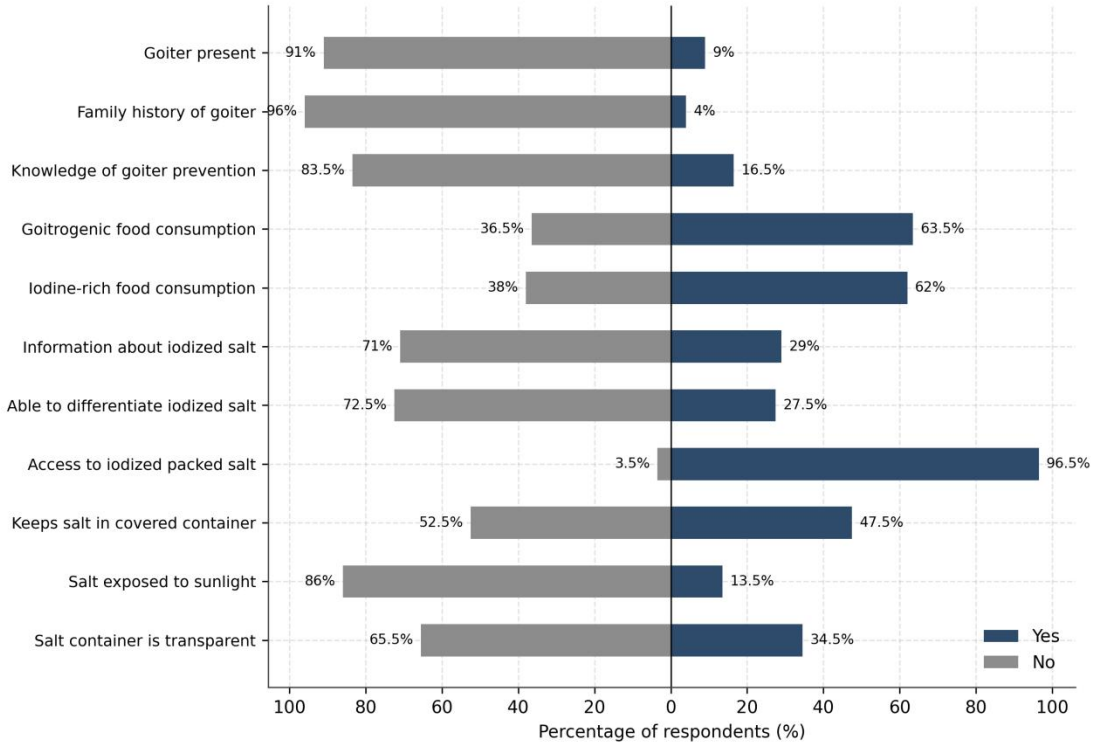

Figure 5. Knowledge, attitude, and practice indicators of study participants regarding goiter and iodized salt.

Health Conditions Associated with Goiter

Among the 18 women with visible goiter, 15 (83%) had co-existing hypertension and diabetes, while 3 (16%) had another medical condition in addition to hypertension. Among the remaining respondents, 124 (62%) reported no additional health problems attributable to younger age, 40 (20%) had hypertension alone, 9 (5%) had diabetes alone, and 27 (13%) had both hypertension and diabetes (Figure 6).

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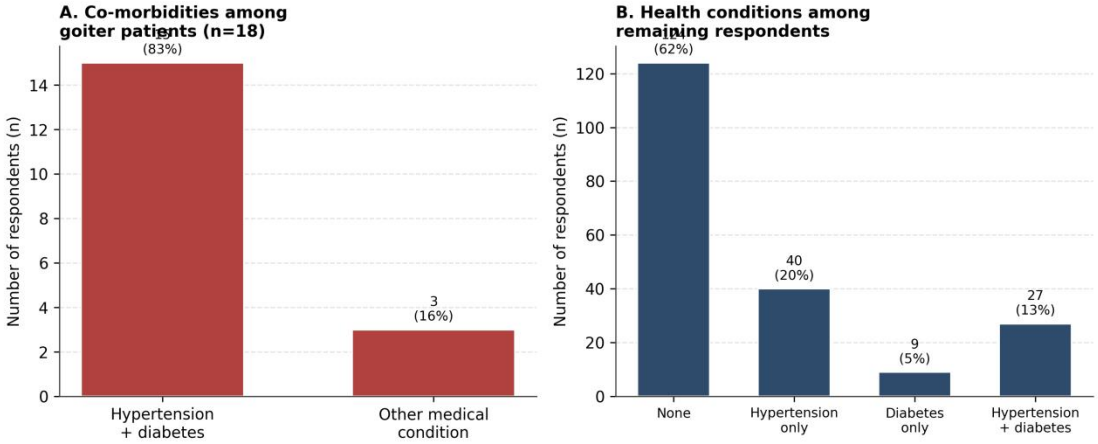

Figure 6. Health conditions among (A) goiter patients and (B) remaining study participants.

Household Salt Handling Practices and Iodine Content

A higher proportion of respondents (n=146, 73%) used pipe water, while 54 (27%) relied on well water as their primary water source. Almost all respondents (n=192, 96%) stored their salt in a dry area, while 8 (4%) stored salt in a moist environment. Plastic containers were the most common storage method (n=119, 59.5%), followed by glass (n=41, 19%), iron (n=38, 20.5%), and packet (n=2, 1%). The majority of respondents (n=172, 86%) added salt during cooking, while 28 (14%) added it at the end of cooking (Table 4, Figure 7). On testing, 144 salt samples (72%) showed no detectable iodine, while 56 (28%) demonstrated adequate iodine content (Figure 8).

Table 4. *Household salt handling practices and iodine testing results (n=200)*

Variable	Category	Frequency (n)	Percentage (%)
Water source	Pipe water	146	73.0
	Well water	54	27.0
Place of salt storage	Dry area	192	96.0
	Moist area	8	4.0
Salt container material	Plastic	119	59.5
	Iron	38	20.5
	Glass	41	19.0
	Packet	2	1.0

Variable	Category	Frequency (n)	Percentage (%)
Timing of salt addition	During cooking	172	86.0
	At the end of cooking	28	14.0
Iodine content after testing	No iodine detected	144	72.0
	Adequate iodine detected	56	28.0

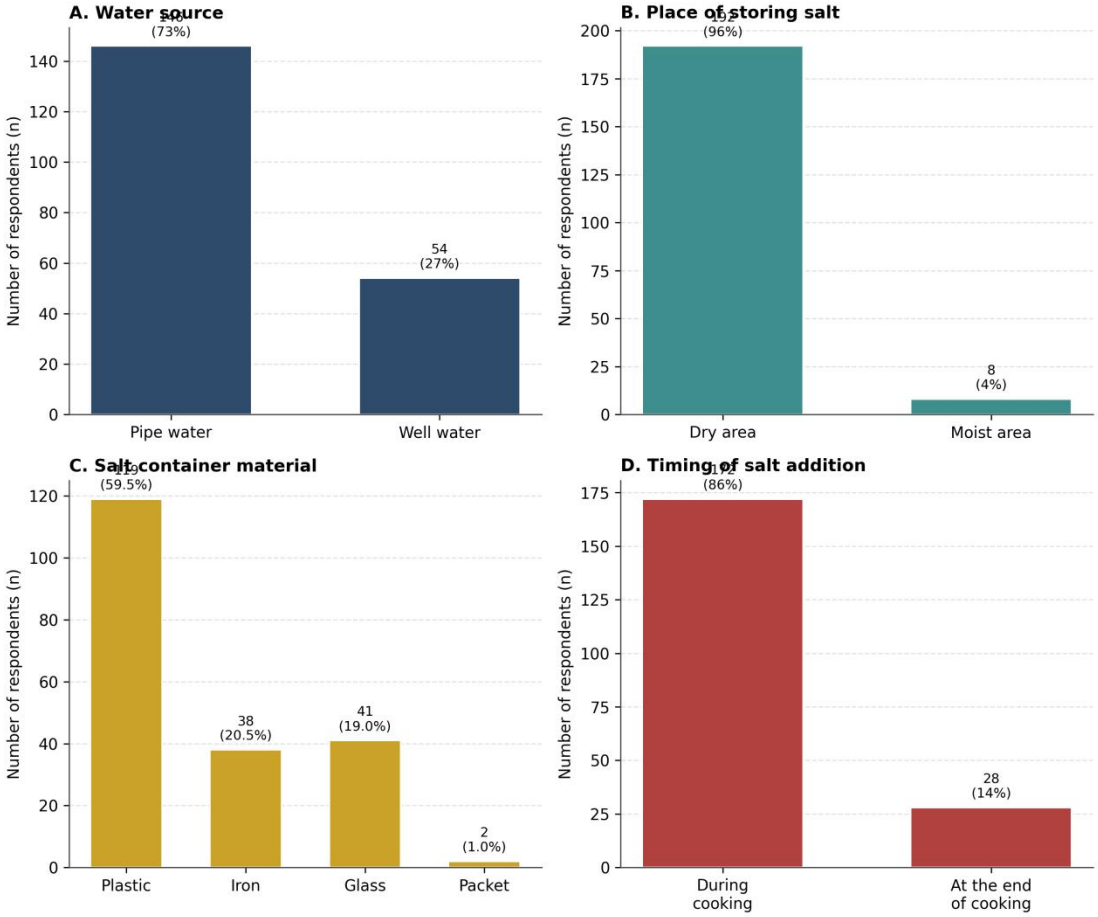

Figure 7. Household salt handling practices: (A) water source, (B) place of storage, (C) container material, and (D) timing of salt addition during cooking.

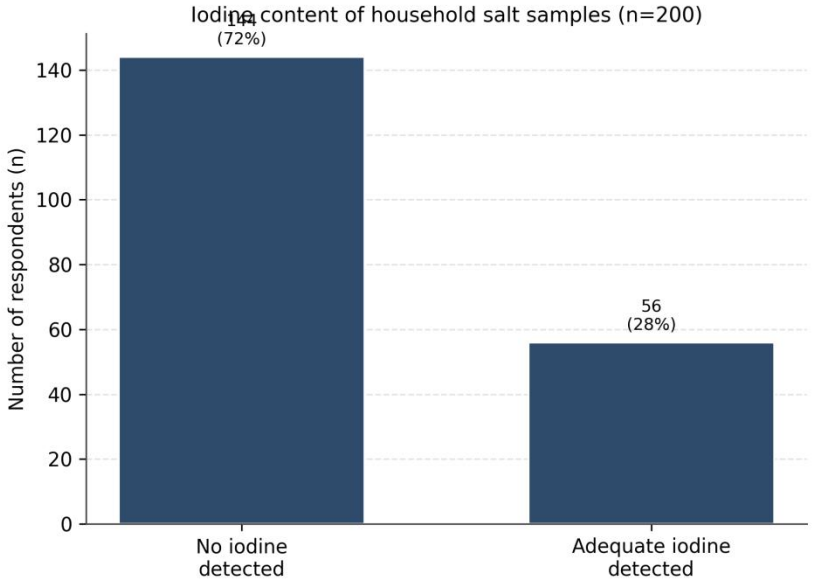

Figure 8. Iodine content of household salt samples after rapid spot testing (n=200).

DISCUSSION

This study found a goiter prevalence of 9% among women in Tehsil Katlang, all with clinically visible goiter, of whom 4% had a family history of goiter and 71% lacked knowledge of iodized salt — factors that were prominently linked with goiter occurrence. This is broadly consistent with a community-based study among women of reproductive age in Ethiopia, which reported a total visible goiter rate of 11%, with family history of goiter (AOR 4.6, 95% CI 1.4-15.8) and poor knowledge of iodized salt (AOR 2.7, 95% CI 1.4-5.5) identified as significant associated factors [10]. Similarly, a study among adolescents reported a goiter prevalence of 42.5% (95% CI 38.4-46.7%), with family history of goiter, goitrogenic food consumption, and inadequate iodine content of household salt all significantly associated with goiter [19].

In the present study, a higher frequency of respondents (63.5%) consumed goitrogenic vegetables such as cabbage, cauliflower, and turnip, particularly within larger, lower-income families, alongside inadequate consumption of iodine-rich foods such as fish, meat, and dairy products. Family history of goiter was also identified as an important risk factor, consistent with prior findings linking frequent vegetable consumption and family history to elevated goiter risk in children.

Household salt testing revealed that 72% of the 200 samples had no detectable iodine, while 28% had adequate iodine content. This absence of iodine was significantly associated with uncovered salt storage (52.5%), sun or heat exposure (13.5%), and storage in moist areas (4%). These findings are comparable to a Northwest Ethiopian

study in which 3.6% of 1,194 salt samples completely lacked iodine and 40.6% had less than 15 mg/kg, with uncovered storage significantly associated with iodine loss (AOR 1.5, 95% CI 1.03-2.14) [20]. Similarly, a Kohat-based study reported a goiter prevalence of 35%, with 56.48% of 108 salt samples showing no detectable iodine content [8], closely paralleling the present findings.

In contrast, a study in Gujarat, India reported a lower goiter prevalence of 23.2% (grade 1: 17.4%; grade 2: 5.8%), with adequate iodine content (>15 ppm) detected in 93% of household salt samples [21], suggesting comparatively better salt iodization coverage in that setting. Likewise, another Pakistani study reported a goiter prevalence of 14.2% (95% CI 11.2-17.2), with 80% of salt samples meeting the recommended iodine threshold [22], again indicating more favourable salt iodization status than observed in Tehsil Katlang. The comparatively poorer iodine status found in the present study may reflect region-specific gaps in salt quality regulation, packaging standards, and household awareness regarding proper storage.

Overall, the findings reinforce previous evidence from Ethiopia showing that family history of goiter, goitrogenic food consumption, and inadequate household salt iodization are consistently and significantly associated with goiter development across diverse populations [19].

CONCLUSION

Iodine deficiency represents a considerable public health problem among women in Tehsil Katlang, which can reasonably be classified as an endemic area for goiter. Goitrogenic food consumption, inadequate dietary iodine intake, and poor knowledge regarding goiter prevention were significantly associated with goiter occurrence, while poor packaging and improper storage of household salt substantially compromised its iodine content.

RECOMMENDATIONS

Improved access to iodine-rich foods and consistent use of properly stored iodized salt should be promoted at the community level. Public health education on the benefits of iodized salt, correct storage practices, and the effects of goitrogenic foods should be disseminated through community advertisements and local health facilities. Regular, government-led monitoring of household and market salt iodine concentrations is recommended, alongside stronger regulatory action on substandard salt packaging.

LIMITATIONS

This study was unable to assess gender-based differences in goiter prevalence due to ethical constraints within the region. Responses from elderly participants may have been subject to recall bias. Additionally, urinary iodine concentration was not measured,

which would have provided a more direct assessment of the population's current iodine nutritional status.

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