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Original Research

# Sustained Elimination of Iodine Deficiency Within the Third Decade After Compulsory Iodine Supplementation Policy in the South of Iran: A Population-Based Cross-Sectional Study

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A B S T R A C T

**Objectives:** Recently, some studies in Iran have shown mild to moderate iodine concentrations in adult and pregnant women populations despite iodine sufficiency in children. This study aimed to evaluate the urine iodine status and salt intake among adult households in the city of Sadra, Fars province in southern Iran, and to assess its possible influencing factors.

**Method:** Participant households for this cross-sectional study were selected using randomized cluster sampling in the city of Sadra, Fars province, southern Iran from 1 February, 2021 to 30 November, 2021. Two subjects >18 y of age from each household were invited. Ninety-two subjects (24 men, 68 women) were enrolled. The participants were asked to collect their 24 h urine. They were then examined for thyroid disorders and subjected to thyroid ultrasonography and thyroid function tests. Urine samples were tested for iodine, sodium, and creatinine concentrations. Household salt intake was also estimated.

**Results:** Median urine iodine content (UIC) in the participants was 175 (IQR: 117, 250) μg/L, whereas the median salt consumption per person per day was 9.6 (IQR, 7.3-14.5) g. Sex, methods of salt storage, presence of goiter or thyroid nodules, the addition of salt in the cooking stage, and subclinical hypothyroidism had no effect on UIC, whereas individuals with hypertension and lower education had significantly lower iodine concentrations. UIC had a significant positive correlation with urine sodium and thyroid stimulating hormones (TSH) concentrations ($P < 0.001$, 0.046) and a negative correlation with thyroid volume and T4 ($P = 0.029$, 0.018).

**Conclusion:** Iodine status in the adult population of Sadra city was categorized as sufficient, although the iodine concentrations reported in Tehran were insufficient. The contributing factor can be higher salt consumption or possible higher environmental iodine concentrations in Sadra city than Tehran.

*Keywords*: epidemiology, iodine deficiency, urine iodine, thyroid, Iran

## Introduction

Iodine deficiency is the most prevalent preventable cause of mental disability [1]. It has long been recognized as a micronutrient essential for neural development and growth [2]. Iodine deficiency disorders (IDDs) can include symptoms such as hypothyroidism, goiter, spontaneous abortion, and cretinism. Chronic iodine deficiency has also been linked to follicular thyroid carcinoma [3]. Therefore, the maintenance of sufficient iodine concentrations in adults is crucial [1].

Epidemiological criteria for assessing iodine nutrition are based on urinary iodine concentrations of school children and pregnant women. Most iodine absorbed in the body eventually appears in the urine. Therefore, urinary iodine excretion is a good marker of recent dietary iodine intake [4]. Currently, World Health Organization (WHO) has recommended that urine specimens should be collected for urinary iodine assessment in school children and pregnant and lactating women during household-based surveys [5]. In children and non-pregnant women, median urinary iodine concentrations

*Abbreviations used:* IDD, iodine deficiency disorders; IQR, interquartile range; UIC, urine iodine content; USI, universal salt iodization.

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reported in Tehran by Nazeri et al. [10] using univariate logistic regression. However, this statistical significance was diminished when adjusting for household salt-iodine content and daily salt intake, suggesting that these factors were interconnected when leading to lower UIC concentrations [10]. Based on these results, we hypothesize that subjects with higher education levels are more likely to use iodized salt.

In this study, we found a positive correlation between TSH and UIC concentrations and a negative correlation between T4 and UIC concentrations, which contrasts with the negative correlation seen between these 2 factors, especially in iodine-deficient areas [31]. Previous studies showed no association between UIC and serum TSH or T4 [32]. Data from the national health and nutrition examination survey (NHANES) III indicated that higher urinary iodine excretion was significantly related to higher TSH concentration [33]. Although individuals with higher concentrations of urinary iodine excretion in our study had higher TSH and lower T4 concentrations, these concentrations were within the physiological range. The right-shift in the distribution of TSH in iodine-sufficient areas could be affected by hereditary and genetic influences on the set point of thyroid hormones [34].

During food preparation, some methods such as heating and washing can decrease the amount of salt-iodine content. Microwaving, boiling, washing, and poor salt preservation conditions including storage in sunlight can decrease the effective iodine content [35]. The WHO estimates a salt-iodine loss of ~20% from retail until the food is served on the table [5]. Nevertheless, we found no significant difference in UIC between subjects who stored salt in the dark and those who did so in direct sunlight. Moreover, there was no difference in UIC between subjects that added salt before food preparation, during food preparation, or after the food was fully prepared.

We found no significant correlation between daily per capita salt intake and UIC concentrations. However, we found a significant positive correlation between UIC and urine sodium content, which is a more accurate method for measuring salt consumption [14, 36]. Similar results were found by Nazeri et al. [10]. These results along with those of other studies [10, 37, 38] and the WHO declaration [5] illustrate the link between salt consumption and iodine status. This can also further link the higher UIC concentrations found in Sadra city and the higher salt consumption than the results from Tehran [10].

In this study, we found a negative correlation between thyroid volume and UIC. Iodine deficiency has a goitrogenic effect and this negative correlation was anticipated. Some previous studies [39, 40] explained that the association between iodine status and thyroid volume was inconsistent; there was no correlation between thyroid volume and UIC in iodine-sufficient areas. The volume of the thyroid gland may be population-specific and some genetic and environmental factors may contribute to variations in thyroid volume, especially in iodine-sufficient areas [41].

This study has some limitations. The first limitation is its cross-sectional design and limited population in one city in the Fars province of Iran. Another possible limitation is that the iodine concentrations in the salt used by these study subjects were not measured.

In conclusion, iodine status in the adult population in the city of Sadra was categorized as sufficient, whereas it was insufficient in the adult and pregnant women populations of Tehran, the capital city of Iran. A significant contributing factor can be the higher use of salt among the population of Sadra than that of Tehran. High iodine concentrations in the environment, such as water and earth, can also hypothetically influence the iodine status. Studies with larger sample sizes and in other parts of the country are warranted.

## Author disclosures

MJ, AH, AS, no conflicts of interest.

## Data availability

Data described in the manuscript, codebook, and analytic code will be made available upon request to AS pending application and approval.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cdnut.2022.100013.

## References

[1] P. Panth, G. Guerin, N.M. DiMarco, A review of iodine status of women of reproductive age in the USA, Biol Trace Elem Res 188 (1) (2019) 208–220.
[2] L.E. Braverman, D.S. Cooper, Werner, Ingbar's the thyroid: a fundamental and clinical text, 10th ed, Wolters Kluwer/Lippincott Williams & Wilkins, Philadelphia, 2012.
[3] Iodine – fact sheet for health professionals [Internet] U.S. Food and Drug Administration: National Institutes of Health – office of dietary supplements, c2021 [updated April 28, 2022; cited February 2021]. Available from: https://ods.od.nih.gov/factsheets/Iodine-HealthProfessional/.
[4] S.K. Nath, B. Moinier, F. Thuillier, M. Rongier, J.F. Desjeux, Urinary excretion of iodide and fluoride from supplemented food grade salt, Int J Vitam Nutr Res 62 (1) (1992) 66–72.
[5] World Health Organization, Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers –, 3rd ed., 2007 [cited February 2021]. Available from: whqlibdoc.who.int/publications/2007/9789241595827_eng.pdf.
[6] Iodine Global Network (IGN), annual report, 2019 [cited February 2021]. Available from: https://www.ign.org/cm_data/2019_IGN_Annual_Report_051820.pdf.
[7] H.R. Shamsollahi, M. Nadarloo, N. Rastkari, M. Sillanpää, M. Yousefi, H. Pasalari, et al., Monitoring of salt iodisation programme in Iran: