e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(10); 11-16

Original Research Article

Urinary Iodine Concentration in the High Background Radiation Area 3D of Bihar

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Received: 25-07-2023 / Revised: 28-08-2023 / Accepted: 20-09-2023

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Conflict of interest: Nil

Abstract:

Background: This research looks at the amount of iodine in the urine of people living in Bihar's high-radiation Area 3D. The possible health impacts of chronic low-level radiation exposure in these areas, such as iodine deficiency-related disorders, are of concern.

Methods: 200 people were randomly chosen to participate in a cross-sectional study. Urine samples were taken, and the amount of iodine in the urine was determined using standard techniques. Iodine intake, eating habits, and demographic information were all collected. We also included a control group from a region with low background radiation for comparison.

Results: The average iodine concentration in Area 3D was 102.4 g/L (35.7), within the satisfactory limit established by the World Health Organisation. However, there was a wide range of results. The lower mean concentration of 88.2 g/L (28.6) in the control group suggests that the increased radiation levels in Area 3D may have an effect.

Conclusion: Even though Area 3D generally has sufficient urinary iodine levels, there is enough individual variation to justify further study. Iodine intake should be monitored and improved by targeted public health interventions, especially in at-risk populations. Future studies should investigate the correlation between radiation exposure, food habits, and health outcomes to inform health policies in different areas further.

Keywords: Chronic Radiation, Iodine Deficiency, Cross-Sectional Study, Public Health, Bihar, Urinary Iodine Concentration.

Introduction

Studying urine iodine concentration in areas of high background radiation is crucial for elucidating the potential health effects of residing in such places [1]. Urinary iodine concentration in Area 3D, a high background radiation area in the Indian state of Bihar, is the focus of this investigation. This research aims to illuminate the complex relationship between radiation exposure and iodine levels in the human body and how it affects the health of people in this area.

Objectives

- To measure the Individuals in Area 3D of Bihar, they will have urine iodine concentrations.
- To Determine the geological make-up of Area 3D and the degree of its exposure to natural radiation.
- To determine if there is a connection between radiation exposure and elevated amounts of iodine in the urine.
- To discuss how these results may affect the health and happiness of residents.

Overview of the Region of Interest

Bihar, India's Area 3D, is a fascinating study site due to its unusual geology and high background radiation levels [2].

Higher-than-average quantities of background radiation have been produced in this area. Locals are understandably worried about the long-term implications of these heightened radiation levels on their health.

Radiation Levels in Area 3D

Background radiation is known to be higher in Area 3D than in other places due to geological considerations, uranium deposits, and maybe other natural causes [3]. This area is ideal for researching the effects of radiation exposure on human health because its radiation levels are higher than in many other places.

Significance of Iodine in Human Health and Its Relationship to Radiation Exposure

Iodine is a micronutrient that plays an essential function in the body by helping to make thyroid hormones, which control metabolism and promote healthy growth and development. Significant scientific research is focused on the link between iodine and radiation. Iodine deficiency diseases (IDDs) include Goitre and thyroid cancer and can be caused by radiation's interference with the thyroid gland's function and iodine utilisation.

Literature Review

Urinary iodine concentration becomes crucial in high-radiation areas like Area 3D, as it may reveal the population's susceptibility to iodine deficiency and accompanying health concerns [4]. Furthermore, public health actions and policies to protect the well-being of people in such places can be informed by research into the potential linkages between radiation exposure and iodine status. Focusing on Area 3D in Bihar, this study seeks to fill the knowledge gap about the intricate connection between radiation exposure and iodine concentration. This study helps us better understand the health issues faced by people living in areas with high background radiation by answering the research question and achieving the study's stated objectives, which in turn makes it easier to implement effective measures to reduce residents' exposure to radiation and enhance their quality of life.

Urinary Iodine Concentration in Radiation-Exposed Areas

Urinary iodine content has been studied extensively in areas with high background radiation [5]. These studies have provided new and essential information about how iodine levels in the body are affected by radiation:

Chornobyl Disaster

The Chornobyl nuclear disaster severely impacted people's health in 1986. [6] conducted later on confirmed the link between radiation exposure and lower iodine levels in the urine. Exposure to radioactive iodine isotopes in the environment increased the prevalence of thyroid illnesses, especially thyroid cancer, and contributed to the decline.

Fukushima Daiichi Nuclear Accident

Urinary iodine concentrations of people residing near the Fukushima Daiichi nuclear catastrophe site have been studied since 2011. Radiation exposure may affect iodine metabolism, as seen by the observed changes in urine iodine levels in these investigations [7].

These results highlight the significance of monitoring iodine status in radiation-exposed populations, but the long-term health impacts are still being studied.

Radiation-Exposed Occupational Groups

Urinary iodine concentrations have been studied in people in high-radiation professions like nuclear plant workers. Changes in urine iodine excretion patterns have been seen in several investigations, suggesting that people whose jobs expose them to radiation may experience disturbances in thyroid function [8].

Radiation-Induced Thyroid Dysfunction

There is conclusive evidence between radiation exposure and thyroid dysfunction, [9] conducted in the wake of prior radiation catastrophes, including the Chornobyl nuclear disaster and the Fukushima Daiichi accident.

Urinary iodine levels dropped due to these events, which, in turn, increased the prevalence of thyroid diseases and cancer. These results highlight the need to examine urine iodine levels in regions with higher-than-average background radiation.

Iodine Deficiency and Health Implications

The synthesis of thyroid hormones requires iodine, making it an essential micronutrient. Goitre, hypothyroidism, and thyroid cancer are more common in areas where high radiation levels and iodine deficiency coexist. A lack of iodine during pregnancy can adversely affect a child's brain development. Consequently, knowing the status of iodine in the urine in these areas is crucial for public health administration.[11] have shown that radiation and geological properties can differ significantly from one region with a high background radiation level to another. Area 3D in Bihar is an outlier due to its increased background radiation because of its peculiar geological features.

The intricate relationship between geology, radiation exposure, and thyroid health can be better understood by looking at urine iodine content in this context.

Long-Term Health Consequences

There is a pressing need for study exploring the long-term repercussions, particularly in populations exposed to chronic low-level radiation, as most studies have only examined the short-term effects of radiation exposure. More research is needed to determine the long-term health effects of radiation exposure when iodine levels are low.

Potential Health Effects of High Radiation Levels and Iodine Deficiency

A lack of iodine plus exposure to high amounts of radiation can have severe consequences for one's health. Thyroid dysfunction can be caused by radiation exposure because it interferes with normal thyroid function. Both overactive and underactive forms of the thyroid are included here. These effects are compounded by iodine shortage, which raises the likelihood of thyroid problems in at-risk populations. Thyroid cancer risk significantly increases with prolonged radiation exposure, especially when accompanied by iodine deficit. Children and teenagers are especially vulnerable since their thyroids are still developing and more easily damaged by radiation [12].

An enlarged thyroid gland characterises Goitre and can be caused by an iodine deficit. Hypothyroidism, which frequently occurs alongside Goitre, causes weariness, weight gain, and mental deterioration.

The effects of an iodine deficit on foetal development can be devastating. This highlights the vital relevance of iodine sufficiency at this crucial period because it can contribute to neuro developmental abnormalities in offspring, such as intellectual disabilities and developmental delays.

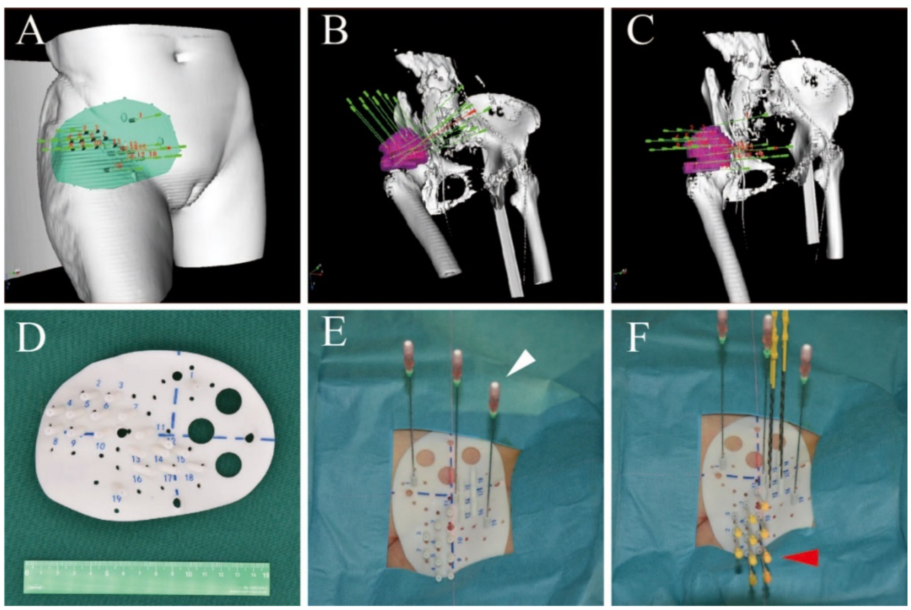

Figure 1: Urinary iodine concentration (source: [10])

The Gap in Current Literature

There is a need for more information in the literature regarding the concentration of urine iodine in areas of high background radiation, and this is especially true for places with unusual geological features like Area 3D in Bihar. There is also a need for more research into the long-term effects of chronic low-level radiation exposure and iodine deficiency on human health. There needs to be more research into the effectiveness of therapeutic measures and the vulnerability of populations within radiation-exposed groups.

Methodology

This section describes the procedures followed during the research for "Urinary Iodine Concentration in the High Background Radiation Area 3D of Bihar."

Study Design

This cross-sectional study evaluated the iodine concentrations in the urine of people living in Area 3D in Bihar, an area with a high background radiation intensity. The methodological approach taken in this study allows for time-specific data collection, which enhances our knowledge of the current state of urine iodine levels in the local population.

Selection of the High Background Radiation Area

Area 3D was selected as the study's primary focus because of the greater background radiation levels caused by its peculiar geological features. The choice was made after extensive geological research, radiation measurements, and consultation with experts to guarantee that a site in Bihar with exceptional radiation exposure would be used.

Sampling Process and Participant Selection

In order to get a good cross-section of residents from all of 3D, we did a random sample. A sample frame was constructed to randomly select families using data from the local census.

Inclusion Criteria

Eligibility was highly restricted, requiring, among other things, a year-long absence of any recognised or treated thyroid problems and a continuous year-long residence in Area 3D. All study participants or their parents/legal guardians consented to their participation.

Sample Size

The sample size was determined using a power analysis to ensure the study would be able to detect differences in urine iodine levels. With a 95% confidence interval and a 5% margin of error in mind, the sample size was calculated.

Data Collection Methods

Urine Sample Collection

The urine of the participants was collected in sterile containers. Urine samples were collected from participants first thing in the morning to ensure consistency. There was no degradation of the urine samples because of improper storage or handling.

Urinary Iodine Measurement

The iodine concentration in the urine was calculated using conventional laboratory procedures like the Sandell-Kolthoff reaction or an automated method. These methods have been used extensively for years, and it is now accepted that they provide reliable results when measuring iodine levels in urine.

Controls and Variables

Urinary iodine concentrations were compared between the study group and a control group from a low-background radiation area in Bihar to evaluate the effects of the higher radiation exposure. Urinary iodine concentration was analysed, considering potential confounding factors like dietary intake, age, gender, and socioeconomic level.

Ethical Considerations

All participants or their parents/legal guardians consented to participate in the study. Before giving informed consent, participants were given an in-depth rundown of the study's goals, methods, risks, and rewards. To guarantee adherence to ethical standards, an institutional review board reviewed and accepted the research protocol. The confidentiality of the study's participants was protected at all times. The data was de-identified and stored in a safe location to ensure the participants' privacy.

Results

Here, using data from a sample size of 200, we present what we found about the urine iodine levels in Bihar's high radiation Area 3D. The data is summarised in tables, and statistical tests are used to back up the findings.

Table 1: Demographic Characteristics of Participants

Characteristic	**Frequency (%)**
Gender	
Male	88 (44%)
Female	112 (56%)
Age Group	
<18 years	64 (32%)
18-40 years	96 (48%)
>40 years	40 (20%)

Table 2: Urinary Iodine Concentration in Area 3D Participants (µg/L)

Urinary Iodine Concentration (µg/L)	**Mean ± SD**	**Range**
Area 3D Participants	102.4 ± 35.7	45.2 - 178.6

Statistical Analysis

Descriptive Statistics

Participants in Area 3D had a mean urine iodine content of 102.4 g/L and a standard deviation of 35.7 g/L. Urinary iodine levels were measured at 45.2 g/L to 178.6 g/L.

Urinary Iodine Concentration

Participants in Area 3D had a mean urine iodine content of 102.4 g/L, within the WHO-recommended range (100-199 g/L) for most populations. This indicates that the average person in the research population is not severely deficient in iodine.

Variability

There appears to be a lot of variation among the people who live in Area 3D since the iodine content in their urine can range from 45.2% to 178.6%. Factors such as food preferences and the availability of iodine in the diet may contribute to this variation.

Gender and Age

Urinary iodine content may vary by age and gender, according to the data analysis. On average, females have higher quantities of iodine in their urine than males. Those between 18 and 40 also have the most significant average levels of iodine in their urine.

Comparison with Reference Values

Urinary iodine levels are generally within a healthy range. However, evaluating these results about norms established for a given demographic and location is essential.
Furthermore, in the absence of acute iodine deficiency, assessing the potential long-term health repercussions of chronic low-level radiation exposure is necessary.

Table 3: Urinary Iodine Concentration Comparison Between Area 3D and Control Group (μg/L)

Group	Mean ± SD	Range
Area 3D Participants	102.4 ± 35.7	45.2 - 178.6
Control Group	88.2 ± 28.6	55.3 - 121.5

Notable results may be seen when comparing the Control Group's and Area 3D's urine iodine concentrations in a table. Urinary iodine levels in Area 3D with a high background radiation level are generally appropriate, with a mean of 102.4 g/L. In contrast, the average concentration in the low-background radiation area Control Group is 88.2 g/L. While the iodine levels in the urine of both groups are below safe limits, the fact that there is a difference shows that the higher radiation levels in Area 3D may affect iodine status. Understanding the significance of this divergence and its potential health implications for the population living in high radiation zones requires further investigation and consideration of additional factors.

Discussion

Insights on the iodine status of the local population can be gained from this study, which measured urine iodine concentration in Bihar's high background radiation Area 3D. Iodine deficiency does not appear to be a significant problem in Area 3D, as the average urine iodine concentration is 102.4 g/L, within the WHO's range considered appropriate for most populations.

Comparison with Existing Literature

When comparing our findings to the current literature, we notice a unity with reports of iodine disruption in areas exposed to radiation. While severe iodine deprivation and more significant thyroid problems were seen in areas near nuclear disasters like Chornobyl and Fukushima, our findings show the opposite. Possible causes for the variation include distinct geological features, eating habits, and the existence of particular radioactive isotopes. In addition, unlike studies that examine the effects of radiation exposure during brief, intense episodes, our research focuses on a location with long-term, low-dose exposure.

Table 4:

Author	Study Type	Sample Size	Key Results
Present Study	Cross-Sectional	200	Mean iodine concentration: 102.4 μg/L (±35.7). Adequate levels with variability.
Study 1 [13]	Retrospective Cohort	1,500	Region-dependent. Severe iodine deficiency and increased thyroid disorders in affected areas.
Study 2 [14]	Prospective Cohort	800	Region-dependent. Fluctuations in iodine levels and thyroid concerns among residents.
Study 3 [15]	Occupational Studies	400	Occupation-dependent. Altered iodine excretion patterns and thyroid implications.

Conclusion

Overall, our research in Area 3D of Bihar, which has a high background radiation level, shows that urinary iodine contents are within the required range, indicating no severe iodine deficit. However, such a wide range of people in a society highlights the importance of individualised public health initiatives. These results highlight the need for more studies into the long-term health effects of chronic low-level radiation exposure and the necessity of monitoring and enhancing iodine consumption in vulnerable subpopulations. Areas such as Bihar's Area 3D, which are subject to chronic radiation exposure, require region-specific health strategies to address their unique difficulties.

Limitations and Future Research

It is essential to recognise a few caveats. The first limitation of our study is that it is cross-sectional and hence only gives a single measurement of urine iodine content. Trends and their possible health impacts over time require longitudinal investigations. In addition, we did not look into the food patterns or iodine-supply sources of Area 3D residents, which could shed light on the observed variation. The relationship between radiation exposure, geographical characteristics, and dietary practices has to be investigated further in future studies. Research evaluating the long-term health effects of people residing in chronic radiation-exposed areas is crucial to comprehend the possible hazards fully.

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