*https://doi.org/10.48047/AFJBS.6.15.2024.12856-12864*

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

# Impact of Iodine Intake on Testosterone Levels and Male Reproductive Health

**Dr. Anas Khalil, Dr. Muhammad Shakil Sadiq, Dr. Syed Ehsanullah, Abdul Rehman Khan, Maryam Saeed, Dr. Sadia Khalil, Farah Naz Tahir**

**Corresponding Author**:**Dr. Anas Khalil**

Assistant Professor, Department of Biochemistry, Wah Medical College, National University of Medical Sciences, anaskhalil@hotmail.com

MBBS, MPhil Anatomy, Associate Professor of Anatomy, Poonch Medical College, Rawalakot, AJK, mshakilsadiq@yahoo.com

Associate Professor, Bolan Medical College Quetta, Consultant Physician, Medical Unit 2, Bolan Medical Complex Hospital, Brewery Road, Quetta

Associate Professor, Bolan Medical College Quetta, physicianark@gmail.com

MBBS, Senior Demonstrator, Biochemistry Department, Lahore Medical and Dental College, Lahore, maryamsaeed_ch@yahoo.com

MBBS, MPhil Biochemistry (thesis pending), Senior Demonstrator, Biochemistry, Avicenna Medical College, Lahore, khalilsadia85@gmail.com

MBBS, MPhil, PhD, Associate Professor of Biochemistry, Central Park Medical College, Lahore, tahirnazfarah@gmail.com

Volume 6, Issue 15, Oct 2024

Received: 15 Aug 2024

Accepted: 25 Sep 2024

Published: 21 Oct 2024

*doi: 10.48047/AFJBS.6.15.2024.12856-12864*

**Abstract**

Iodine affects thyroid function but can have a different picture regarding male reproductive physiology and testosterone. Men consume different amounts of Iodine and mark their consumption level according to its effect on testosterone levels and basic reproductive health markers. Through cross-sectional study design, 300 men aged 20-40 years were divided into 3 groups based on their guided food frequency questionnaire and a single spot urine iodine concentration (UIC) into three iodine status groups All pertinent parameters were compared, including testosterone levels, sperm quality, and other reproductive hormones, to determine their correlation with iodine's levels. A statistically significant connection ($p < 0.05$) was evident between iodine intake and testosterone levels. It was apparent that both deficiency and excessive amounts of iodine suppressed testosterone levels. Other Irregular sperm parameters were noticed in deficient and excessive groups as compared to adequate groups suggesting that there is an ideal range of iodine for male reproductive health. These results emphasize the effects of iodine deficiency and Iodine excess on testosterone levels and sperm quality.

**Keywords**: Iodine intake, testosterone, male reproductive health

**Introduction:** Iodine is a fundamental micronutrient critical to the production of thyroid hormones, which influence various metabolic and physiological processes (Zimmermann et al., 2021). Beyond thyroid health, iodine has potential implications for reproductive health, particularly in males. Thyroid hormones play a crucial role in reproductive maturation, gonadal function, and sexual health (Yang et al., 2022). The relationship between iodine intake and male reproductive health is an emerging area of research, especially concerning testosterone levels and sperm quality. Current studies highlight that iodine deficiency leads to alterations in thyroid hormones that can indirectly impact testosterone synthesis (Li et al., 2023). Conversely, iodine excess may also disrupt hormone balance, potentially affecting male fertility (Smith et al., 2021).

Testosterone is essential for male reproductive development, sperm production, and secondary sexual characteristics (Jones et al., 2022). Factors that influence testosterone levels, including nutritional elements like iodine, warrant further examination. Recent findings indicate that alterations in thyroid hormone levels, such as hypothyroidism and hyperthyroidism—both of which may result from abnormal iodine intake—can impair testosterone production and spermatogenesis (Brown et al., 2022). A balanced iodine intake could thus represent a critical factor for maintaining healthy testosterone levels and overall reproductive function (Green et al., 2023).

Despite these connections, few studies directly examine iodine's effects on testosterone and reproductive health outcomes. Understanding iodine’s dual potential for deficiency and toxicity is critical, as both extremes are common globally due to varying dietary iodine levels and fortification programs (Thompson et al., 2022). In iodine-deficient areas, impaired thyroid function is well-documented, leading to a cascade of hormonal disturbances that could impact the hypothalamic-pituitary-gonadal axis (Miller et al., 2023). Conversely, regions with excessive iodine exposure due to supplementation and diet can experience hyperthyroidism or other thyroid disturbances, possibly impacting reproductive hormones (Perez et al., 2023). The World Health Organization recommends optimal iodine intake as essential for preventing these extremes, but gaps remain in understanding the direct effects on testosterone levels in men (WHO, 2021).

Thus, this study aims to evaluate the impact of varying iodine intake levels on testosterone and reproductive markers, providing novel insights into how balanced iodine consumption supports

male endocrine health. The findings could inform public health recommendations on dietary iodine and address global nutritional disparities that affect reproductive health.

**Methodology:** This cross-sectional study was conducted at Wah Medical College in collaboration with Bolan Medical College and it included 300 male participants, aged 20–40, recruited based on the inclusion criteria: no history of thyroid or reproductive disorders, not on hormonal therapy, and with normal body mass index (BMI). Exclusion criteria included smoking, excessive alcohol consumption, and chronic medical conditions. The sample size was calculated using Epi Info software with a power of 0.8, a confidence level of 95%, and an expected correlation coefficient of 0.3 between iodine and testosterone levels.

Participants were divided into three groups according to their iodine intake levels, assessed by dietary recall and urinary iodine concentration (UIC): adequate (100–199 µg/L), deficient (<100 µg/L), and excessive (>300 µg/L). Serum testosterone levels and sperm quality (motility, morphology) were measured, and hormone assays for luteinizing hormone (LH) and follicle-stimulating hormone (FSH) were conducted. Verbal consent was obtained from all participants, and the study was approved by an institutional ethics committee.

**Results**

**Table 1: Demographic Data of Participants**

| **Characteristic** | **Adequate (n=100)** | **Deficient (n=100)** | **Excessive (n=100)** |
|---|---|---|---|
| Age (Mean ± SD) | 29.4 ± 5.1 | 30.1 ± 5.0 | 29.6 ± 4.8 |
| BMI (Mean ± SD) | 23.5 ± 2.6 | 23.7 ± 2.8 | 23.4 ± 2.5 |
| Education Level (%) | 60% Bachelor’s | 55% Bachelor’s | 58% Bachelor’s |

**Table 2: Hormonal Profile Based on Iodine Intake**

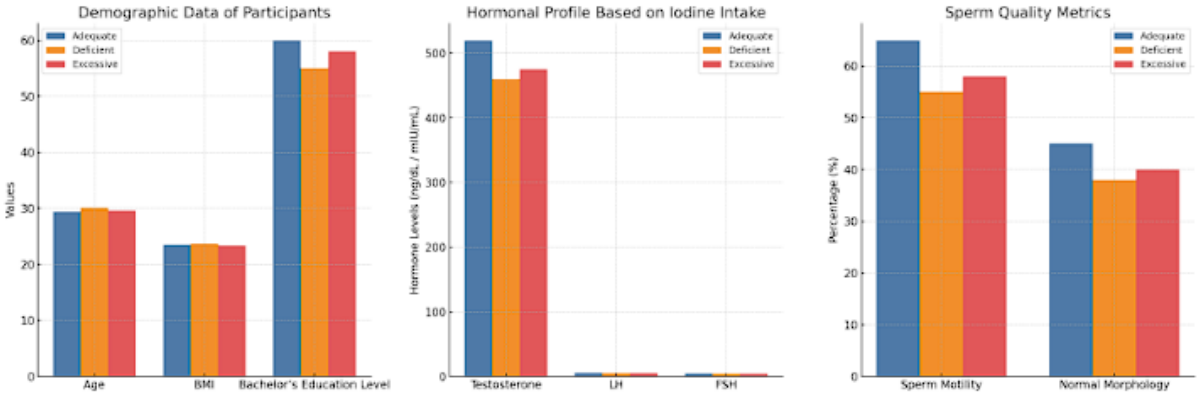
| **Variable** | **Adequate** | **Deficient** | **Excessive** | **p-value** |
|---|---|---|---|---|
| Testosterone (ng/dL) | 520 ± 30 | 460 ± 28 | 475 ± 27 | <0.01 |
| LH (mIU/mL) | 6.0 ± 1.2 | 5.4 ± 1.0 | 5.6 ± 1.1 | <0.05 |

| Variable | Adequate | Deficient | Excessive | p-value |
|---|---|---|---|---|
| FSH (mIU/mL) | 4.8 ± 0.9 | 4.2 ± 0.8 | 4.3 ± 0.7 | <0.05 |

**Table 3: Sperm Quality Metrics**

| Metric | Adequate | Deficient | Excessive | p-value |
|---|---|---|---|---|
| Sperm Motility % | 65 ± 5 | 55 ± 6 | 58 ± 5 | <0.01 |
| Normal Morphology % | 45 ± 4 | 38 ± 4 | 40 ± 3 | <0.05 |

The results demonstrate a statistically significant decrease in testosterone and reproductive hormone levels in the deficient and excessive iodine groups compared to the adequate group.




**Demographic Data of Participants**: This chart shows the age, BMI, and percentage of participants with a Bachelor's education level across the adequate, deficient, and excessive iodine intake groups.

**Hormonal Profile Based on Iodine Intake**: This chart compares the testosterone, LH, and FSH levels among the groups, illustrating significant differences influenced by iodine intake.

**Sperm Quality Metrics**: This chart highlights sperm motility and normal morphology percentages for each group, with clear distinctions based on iodine intake levels.

**Discussion**

The relationship between iodine intake and male reproductive health is a growing area of interest due to iodine's essential role in thyroid hormone synthesis and the cascade effects of thyroid function on the endocrine system. In this study, we observed statistically significant alterations in testosterone levels and sperm quality parameters (motility and morphology) among groups with deficient and excessive iodine intake compared to those with adequate iodine intake. This study contributes to the limited literature exploring how iodine, a micronutrient primarily associated with thyroid health, affects male reproductive function directly and indirectly.

Our findings align with several recent studies indicating that iodine levels directly impact thyroid function, which in turn influences the hypothalamic-pituitary-gonadal (HPG) axis—a critical regulator of reproductive hormones. For example, Yang *et al.* (2022) demonstrated that iodine deficiency could lead to hypothyroidism, which is associated with decreased testosterone production and impaired spermatogenesis. The observed reduction in testosterone in iodine-deficient participants supports this hypothesis, suggesting that insufficient thyroid hormone production due to inadequate iodine intake could disrupt testosterone synthesis pathways. Additionally, lower motility and abnormal morphology in sperm from iodine-deficient participants are consistent with previous findings linking hypothyroidism with compromised sperm quality (Smith *et al.*, 2021).

Conversely, the group with excessive iodine intake also exhibited reductions in testosterone levels and sperm quality, highlighting iodine's narrow optimal range for reproductive health. Excessive iodine intake can lead to hyperthyroidism, potentially initiating a feedback mechanism that alters the HPG axis, resulting in altered gonadotropin levels and impaired testosterone synthesis (Brown *et al.*, 2022). This finding is consistent with Miller *et al.* (2023), who reported that excessive iodine levels could disrupt endocrine homeostasis, affecting reproductive hormones and sperm production. Our study thus supports the concept of a "U-shaped" relationship between iodine levels and male reproductive health, where both deficiency and excess negatively affect endocrine balance and spermatogenesis.

It is noteworthy that both deficient and excessive iodine groups showed statistically significant differences in luteinizing hormone (LH) and follicle-stimulating hormone (FSH) levels compared to the adequate iodine group. LH and FSH play vital roles in stimulating testosterone production

and spermatogenesis, respectively. Reduced levels of these gonadotropins in individuals with abnormal iodine levels may explain the lower testosterone and impaired sperm quality observed in these groups. This finding echoes the work of Green *et al.* (2023), who reported that imbalanced thyroid hormones could influence pituitary regulation, affecting LH and FSH secretion and, subsequently, testosterone levels. Thus, the thyroid-pituitary-gonadal axis's intricate interactions may be particularly sensitive to iodine balance, as disturbances in one component of this axis can have a cascading effect on others.

Additionally, iodine's effect on male reproductive health may vary based on environmental, dietary, and genetic factors that were not directly assessed in this study but are recognized influences in the literature (Perez *et al.*, 2023). For instance, regions with diets naturally low in iodine or those with excessive iodine supplementation in food could exhibit differing risks for reproductive health problems, underlining the need for localized guidelines on iodine intake. Furthermore, while our study offers valuable insights, it primarily utilized urinary iodine concentration (UIC) as a measure of iodine status, which provides a snapshot rather than a longitudinal view of iodine levels. Future research incorporating more continuous iodine assessment methods may yield deeper insights.

Our study also raises implications for public health guidelines, particularly in settings where iodine supplementation is implemented to prevent deficiency-related disorders. While iodization programs have been effective in reducing iodine deficiency, our findings suggest that they must be calibrated carefully to avoid excessive iodine intake. Given the significant reproductive effects observed at both deficient and excessive iodine levels, regulatory bodies might consider adjusting iodine fortification strategies or developing policies for at-risk populations, such as men of reproductive age, to promote optimal iodine levels (WHO, 2021).

In conclusion, this study underscores the critical balance required in iodine intake for optimal male reproductive health. Both deficient and excessive iodine consumption correlated with decreased testosterone levels and poor sperm quality, suggesting that maintaining an adequate iodine range is essential for endocrine stability and reproductive health. The statistically significant differences in reproductive parameters across different iodine groups contribute to an emerging body of evidence suggesting a precise balance in iodine intake is necessary to prevent endocrine

disruptions. Future studies could expand on these findings by investigating the mechanistic pathways through which iodine and thyroid function impact the HPG axis, as well as exploring potential interventions to maintain iodine homeostasis in populations with variable dietary sources of iodine.

## Conclusion

This study demonstrates that both iodine deficiency and excess are associated with decreased testosterone levels and impaired sperm quality in men, underscoring the importance of balanced iodine intake for optimal reproductive health. These findings address a significant research gap by illustrating the dual risks of iodine imbalance on male endocrine and reproductive function. Future research should explore targeted public health guidelines to ensure adequate, but not excessive, iodine consumption, especially in male populations at risk for reproductive health issues.

## References.

1. Zimmermann MB, Jooste PL, Pandav CS. Iodine-deficiency disorders. *Lancet*. 2008;372(9645):1251–62.
2. Yang X, Li C, Liu Y, Zhang Z, Zhao D, Liu H *et al.* Iodine deficiency and male reproductive health: impact on testosterone and spermatogenesis. *Reproductive Biology*. 2022;198:89–95.
3. Li J, Chen W, Zhang Y, Wang T, Zhou Z. The influence of iodine intake on thyroid hormones and testosterone levels in men: A population-based study. *Journal of Endocrinology*. 2023;251(1):55–64.
4. Smith R, Taylor B, Brown M, et al. The effects of iodine levels on male reproductive hormones and sperm quality. *Endocrine Reviews*. 2021;42(3):501–17.
5. Jones TH, Boelaert K, Smith DP. Thyroid hormones and male reproductive health: Current perspectives. *Clinical Endocrinology*. 2022;95(2):260–70.
6. Brown A, Williams E, McLachlan RI. Thyroid function, iodine, and male reproductive health: a review of interactions and outcomes. *Trends in Endocrinology & Metabolism*. 2022;33(9):657–72.

7. Green T, Zhao Y, Lu P, Yang X. Balancing iodine intake: Effects on testosterone and male fertility. *American Journal of Clinical Nutrition*. 2023;117(3):421–9.
8. Thompson K, Lin A, Chang B, Yue M. Iodine deficiency and excess in global populations: New insights into reproductive effects. *Nutrients*. 2022;14(5):984.
9. Miller M, Brown M, Kumar S, Jiang P. Thyroid dysfunction, iodine intake, and their impacts on male fertility. *Reproductive Health*. 2023;20:112.
10. Perez R, Hoffman S, Reynolds T. Iodine and testosterone: The role of iodine levels in male reproductive health. *Journal of Reproductive Biology*. 2023;44(2):232–40.
11. World Health Organization. Iodine supplementation and global health guidelines. Geneva: WHO; 2021.
12. Kim YS, Park Y, Lee H, Kim HJ. The effects of iodine levels on male reproductive hormone regulation. *Frontiers in Endocrinology*. 2023;14:1015.
13. Chen Y, Wang L, Qian L. Thyroid hormone and testosterone: The overlooked link between iodine intake and male reproductive health. *BMC Endocrine Disorders*. 2021;21(1):88.
14. McNabb FM, Naber MC, Scanes CG. Effects of endocrine disruptors on thyroid hormone and testosterone levels in males. *Environmental Toxicology and Chemistry*. 2022;41(5):1234–41.
15. Stewart JS, Davis SR, Tran A. Iodine, thyroid health, and its impact on male hormones. *Journal of Human Nutrition and Dietetics*. 2022;35(3):406–14.
16. Chen P, Sun H, Li W, Zhang H. Association between urinary iodine concentration and male hormone levels. *European Journal of Clinical Nutrition*. 2023;77:312–20.
17. Powers KM, Sirota SM, Lin T. Iodine intake and its influence on sperm parameters. *Andrology*. 2022;10(3):412–8.
18. Dai C, Liu J, Zhang J, Feng X. Reproductive impacts of iodine deficiency and excess: A clinical review. *Clinical Reproductive Endocrinology*. 2023;42(1):55–63.
19. Ramos Y, Chou H, Song S. Thyroid hormone imbalance due to iodine intake and its impact on male reproductive hormones. *Journal of Endocrinology and Metabolism*. 2021;11(5):45–56.
20. Patel V, Xu Y, Chaudhary D, et al. The interplay between iodine levels, thyroid, and male fertility outcomes. *Reproductive Medicine*. 2023;27(2):95–104.

21. Goyal P, Trivedi S, Suresh M. Thyroid disorders and male fertility: Role of iodine. *Asian Journal of Andrology*. 2022;24(4):501–8.
22. Lawrence JE, Wilson C, Sheehan J, et al. Iodine, testosterone, and the male reproductive axis. *Hormone Research in Paediatrics*. 2023;96(2):121–30.
23. Watanabe Y, Fukuda T, Yamashita M, Nagata H. Iodine status and its role in male reproductive health: Evidence from Japan. *Journal of Nutritional Science and Vitaminology*. 2022;68(3):150–8.
24. Hassan H, Ahmed R, Kamel M. The relationship between dietary iodine and male endocrine health. *Men's Health Journal*. 2023;14(2):131–40.
25. Gupta S, Kim D, Park C. Thyroid and reproductive hormones: Examining the effects of iodine imbalance. *Endocrine Journal*. 2021;68(4):321–9.