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RESEARCH ARTICLE

FACTORS ASSOCIATION WITH THYROID CANCER AMONG ADULT IN AL AHSA, SAUDI ARABIA:A CASE-CONTROL STUDY

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Abstract

Background: Thyroid cancer incidence is increasing globally, with Saudi Arabia experiencing particularly high rates. This study aimed to identify factors associated with thyroid cancer among adults in Al Ahsa, Saudi Arabia.

Methods: A case-control study was conducted involving 108 thyroid cancer cases and 108 matched controls. Participants completed a comprehensive questionnaire covering demographic characteristics, medical history, lifestyle factors, and dietary habits. Logistic regression analysis was used to identify independent risk factors for thyroid cancer.

Results: Significant differences were observed between cases and controls in marital status, education level, employment status, and income (all $p<0.05$). Cases had higher rates of hypertension (31.5% vs 7.4%, $p<0.001$) and elevated cholesterol (19.4% vs 8.3%, $p=0.018$). Family history of thyroid disease (66.7% vs 13.0%, $p<0.001$) and thyroid cancer (22.2% vs 4.6%, $p<0.001$) were strongly associated with thyroid cancer. Dietary factors, including exclusive use of iodized salt (50.9% vs 36.1%, $p=0.028$) and higher sugar consumption ($p=0.024$), were more prevalent among cases. Multivariate analysis revealed that male gender (OR: 0.045, $p=0.007$) and breastfeeding (OR: 0.433, $p=0.041$) were protective factors, while increasing age was associated with higher risk (OR: 1.045, $p=0.016$).

Conclusion: This study identified several demographic, medical, and dietary factors associated with thyroid cancer risk in Al Ahsa. These findings have important implications for public health strategies and clinical practice in the region, highlighting the need for targeted interventions and further research into modifiable risk factors.

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Introduction:-

Thyroid cancer is the most common form of endocrine cancer globally, representing a significant public health concern. Its incidence has been steadily increasing over the past few decades, particularly among women(Pellegriti et al., 2013). Thyroid cancer is classified into several types, with differentiated thyroid cancer (DTC), including papillary and follicular thyroid cancers, being the most prevalent. Despite the rising incidence, the etiology of thyroid cancer remains not fully understood, with both genetic and environmental factors believed to play critical roles(Lesueur & Truong, 2023).

In Saudi Arabia, thyroid cancer has emerged as the second most common cancer among women, following breast cancer, and the ninth most common cancer overall(Chaudhri et al., 2020). The Saudi Cancer Registry report in 2018 indicated that thyroid cancer accounted for 8.4% of all newly diagnosed cancers among Saudi nationals(Flemban et al., 2022). The gender disparity in thyroid cancer incidence is notable, with females being significantly more affected than males. This trend is consistent with global patterns, where the incidence rate among women is three times higher than that among men(LeClair et al., 2021).

The geographic variability in thyroid cancer incidence also highlights the importance of localized studies to understand region-specific risk factors. The Eastern Province of Saudi Arabia, including Al Ahsa, has shown particularly high incidence rates. This suggests that local environmental, dietary, and genetic factors may significantly contribute to the prevalence of thyroid cancer in this region. Understanding these factors is crucial for developing targeted prevention and intervention strategies(Aljabri et al., 2018).

Thyroid cancer risk factors can be broadly categorized into genetic predispositions and environmental exposures(Kruger et al., 2022). Genetic factors include family history of thyroid cancer and inherited genetic mutations, which can increase susceptibility. Environmental factors encompass a range of exposures, including ionizing radiation, dietary iodine intake, and lifestyle factors such as smoking and alcohol consumption(Kalarani et al., 2023). Radiation exposure, particularly during childhood, is a well-established risk factor for thyroid cancer. The thyroid gland is highly sensitive to ionizing radiation, which can induce carcinogenic changes in thyroid cells(Matsuu-Matsuyama et al., 2021).

Dietary factors, especially iodine intake, play a crucial role in thyroid health. Iodine is essential for thyroid hormone synthesis, and both iodine deficiency and excess can influence thyroid cancer risk(Zimmermann & Boelaert, 2015). Iodine deficiency can lead to goiter and hypothyroidism, conditions that may predispose individuals to thyroid nodules and, subsequently, cancer. Conversely, excessive iodine intake has been linked to an increased risk of thyroid autoimmunity and thyroid cancer in certain populations(Teti et al., 2021). Therefore, maintaining an optimal level of iodine intake is vital for thyroid health.

Lifestyle factors such as smoking, alcohol consumption, and physical activity also contribute to thyroid cancer risk. Smoking has been shown to alter thyroid function and hormone levels, potentially increasing cancer risk(Kitahara et al., 2012). Alcohol consumption, although less clearly associated with thyroid cancer, can impact overall health and potentially influence cancer risk through various biological mechanisms. Physical activity, on the other hand, has been generally associated with reduced cancer risk due to its positive effects on immune function and metabolic health(Hong et al., 2017).

In addition to these factors, reproductive and hormonal influences are significant, particularly in explaining the higher incidence of thyroid cancer among women(Rahbari et al., 2010). Hormonal changes during pregnancy, menopause, and the use of hormone replacement therapy (HRT) or oral contraceptives may affect thyroid cancer risk. Estrogen and progesterone receptors have been found in thyroid tissues, suggesting that hormonal fluctuations could influence thyroid cell proliferation and cancer development(Rossing et al., 1998).

Despite the identification of several risk factors, the precise mechanisms underlying thyroid cancer development remain complex and multifactorial. Interactions between genetic susceptibilities and environmental exposures are likely crucial in determining individual risk(Berinde et al., 2022). For instance, genetic predispositions may make certain individuals more susceptible to the carcinogenic effects of radiation or other environmental exposures(Thomas, 1978).

The increasing incidence of thyroid cancer, particularly in regions like Al Ahsa, underscores the need for comprehensive studies to elucidate the specific factors contributing to this trend. This study aims to identify and analyze the factors associated with thyroid cancer among adults in Al Ahsa, Saudi Arabia. By focusing on a well-defined population in a high-incidence area, we hope to gain insights into the relative importance of various genetic, environmental, dietary, and lifestyle factors.

Understanding these associations is critical for several reasons. First, it can inform public health strategies aimed at reducing thyroid cancer risk through targeted interventions. For example, if dietary factors are found to be significant, public health campaigns could focus on promoting optimal iodine intake and healthy dietary habits. If lifestyle factors such as smoking and physical activity are identified as important, interventions could be designed to encourage smoking cessation and increased physical activity. Identifying high-risk populations through genetic and environmental screening could enable more effective surveillance and early detection efforts. Early detection of thyroid cancer significantly improves prognosis and treatment outcomes. By understanding the specific risk factors in the Al Ahsa population, healthcare providers can better tailor their screening and prevention strategies to address the unique needs of this community.

Methods:-

Study Design

This study employs a case-control design to investigate the factors associated with thyroid cancer among adults in Al Ahsa, Saudi Arabia. The case-control design is chosen for its efficacy in studying rare diseases, such as thyroid cancer, by comparing patients who have the disease (cases) with those who do not (controls). This approach allows for the identification of various risk factors by examining and contrasting exposures between the two groups.

Study Setting and Population

The study is conducted in Al Ahsa, Saudi Arabia, a region with notably high thyroid cancer incidence rates. Participants are recruited from various medical institutions within the region, including Hamad Al-Jaber Oncology Center, Al-Afaliq Oncology Center, and the Endocrine and Diabetes Center. The study population includes adults aged 18 and older who are residents of Al Ahsa.

Sample Size and Sampling Technique

The study utilized a universal sampling technique over five years, drawing cases from the histopathology labs at King Fahad Hospital (Aljaber Oncology Center) and Prince Saud Bin Jalewi Hospital (Alafalig Oncology Center) in Hufof. Initially, there were 155 total cases, comprising both living and deceased patients. Out of these, 149 were alive and 6 were deceased. From the 149 living cases, 23 individuals could not be contacted due to a lack of communication information. This left 126 cases. Further, 10 individuals were not reachable or did not answer, reducing the number to 116. Of these, 8 refused to participate in the questionnaire, leaving a final sample size of 108 thyroid cancer cases. The control population was selected from the same demographic area to ensure comparability.

Inclusion and Exclusion Criteria

Inclusion Criteria for Cases:

- Adults aged 18 years and older.
- Resident of Al Ahsa, Saudi Arabia.
- Diagnosed with thyroid cancer based on histopathological examination.

Inclusion Criteria for Controls:

- Adults aged 18 years and older.
- Resident of Al Ahsa, Saudi Arabia.
- No history of thyroid cancer or other endocrine cancers.

Exclusion Criteria:

- Individuals with recurrent thyroid cancer.
- Incomplete medical records or missing data on key variables.
- Individuals diagnosed with thyroid cancer but not confirmed by histopathological examination.

Data Collection

Data are collected using a structured questionnaire designed to capture comprehensive information on demographics, medical history, lifestyle, dietary habits, and reproductive health (for women). The questionnaire is administered through face-to-face interviews conducted by trained research assistants. Data collection is carried out from December 1, 2023, to January 17, 2024.

Sections of the Questionnaire:

1. **Demographics**: Gender, age, nationality, marital status, education level, employment status, monthly income, insurance status, current and past residency.
2. **Medical History**: Exposure to medical and non-medical radiation, history of hypertension, hyperlipidemia, sickle cell anemia, family history of thyroid disease and cancer, other types of cancer, benign thyroid diseases, obesity, other medical problems, and medication use.
3. **Lifestyle**: Smoking status, physical activity level, and alcohol consumption.
4. **Dietary Habits**: Type of salt and oil used, frequency of consumption of vegetables, fruits, dairy products, red meats, fish, chicken, lean meats, grains, and sugar.
5. **Reproductive and Menstrual Health (for women)**: Age at menstruation onset, regularity and duration of menstrual cycles, age at menopause, history of spontaneous or induced abortion, breastfeeding history, use of exogenous hormones, oral contraceptives, hormone replacement therapy, and fertility problems.

Data Collection Procedure

The questionnaire was administered through face-to-face interviews conducted by trained research assistants. These assistants underwent rigorous training to ensure standardized administration of the questionnaire and to minimize interviewer bias. Participants were recruited from several medical institutions in Al Ahsa, including Hamad Al-Jaber Oncology Center, Al-Afaliq Oncology Center, and the Endocrine and Diabetes Center. Cases were identified from medical records of patients diagnosed with thyroid cancer based on histopathological examination, while controls were matched to cases by age, gender, and residency and selected from the same institutions without a history of thyroid cancer. Informed consent was obtained from all participants prior to the interview. The interviews were conducted in a private setting within the medical institutions to ensure confidentiality and to allow participants to feel comfortable providing honest and accurate responses. Data collection was carried out between December 1, 2023, and January 17, 2024. To ensure data quality and accuracy, the collected data were entered into a secure database with double data entry employed to minimize errors. Regular quality checks were performed throughout the data collection period to address any discrepancies or missing data promptly by re-contacting participants if necessary. This meticulous approach to data collection ensured the reliability and validity of the data gathered for subsequent analysis.

Data analysis

Data analysis was conducted using SPSS version 26 to evaluate the association between various factors and thyroid cancer among the study participants. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were calculated to summarize the demographic, medical, lifestyle, dietary, and reproductive health characteristics of the participants. Comparative analyses between cases (thyroid cancer patients) and controls were performed using chi-square tests for categorical variables and t-tests for continuous variables to identify significant differences. Logistic regression analysis was employed to determine independent risk factors for thyroid cancer, with variables showing significant associations in univariate analyses included in the multivariate model. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to quantify the strength of these associations. The final logistic regression model was refined using a stepwise approach based on the Akaike Information Criterion (AIC), ensuring the most parsimonious model. Interaction terms were also assessed to explore potential interactions between key variables.

Ethical consideration

This study adheres to the ethical principles outlined in the Declaration of Helsinki and has received ethical approval from the Institutional Review Board (IRB) of King Fahdhospital (IRB: 18A-E-2023). Prior to participation, informed consent was obtained from all participants, ensuring they were fully aware of the study's objectives, procedures, potential risks, and benefits. Participants were assured of the confidentiality of their personal information, with data being anonymized to protect their privacy. The research team emphasized voluntary participation, allowing participants to withdraw at any time without consequence. Rigorous measures were

implemented to secure data storage and handling, ensuring compliance with ethical standards and the protection of participant rights throughout the study.

Results:-

Table 1 presents the demographic characteristics of participants in the study, highlighting significant differences between cases and controls in several aspects. The gender distribution was similar between groups (p=0.850), as was the average age (p=0.684). Marital status showed a significant difference, with a higher proportion of married individuals among cases (p=0.011). Educational level differed notably, with a higher percentage of illiterate and elementary school-educated individuals among cases (p<0.001). Employment status also varied significantly, with more housewives and fewer unemployed individuals among cases (p<0.001). Income levels were significantly lower among cases, with more individuals earning between 3000-7000 SAR (p<0.001). Medical insurance status showed a higher proportion of uninsured individuals among cases (p<0.001). Recent and past residency also differed, with more cases residing or having resided in rural or remote areas compared to controls (p=0.007 and p=0.001, respectively).

Table 1:- Demographic Characteristics of Participants.

		Control		Case		p-value
		n	%	n	%	
gender	Male	16	14.8%	17	15.7%	0.850
	Female	92	85.2%	91	84.3%	
Age (mean ± SD)		33.81±12.7		34.01±10.8		0.684
marital status	Single	29	26.9%	13	12.0%	0.011
	Married	77	71.3%	86	79.6%	
	Widow	1	.9%	5	4.6%	
	Divorced	1	.9%	4	3.7%	
educational level	ILLITERATE	0	.0%	4	3.7%	<0.001
	Elementary School	0	.0%	20	18.5%	
	Intermediate School	1	.9%	20	18.5%	
	High School	19	17.6%	25	23.1%	
	B.S or higher	88	81.5%	39	36.1%	
job	Unemployed	35	32.4%	11	10.2%	<0.001
	Housewife	27	25.0%	60	55.6%	
	Self-employed	6	5.6%	2	1.9%	
	Employed	37	34.3%	28	25.9%	
	Retired	3	2.8%	7	6.5%	
income	<3000	17	15.7%	22	20.4%	<0.001
	3000-7000	25	23.1%	46	42.6%	
	7001-12000	24	22.2%	28	25.9%	
	>12000	42	38.9%	12	11.1%	
medical insurance	Uninsured MOH	20	18.5%	25	23.1%	<0.001
	Uninsured MOH	36	33.3%	71	65.7%	
	Insured Private Insurance	52	48.1%	12	11.1%	
recent residency	Village in desert/ remote area	1	.9%	7	6.5%	0.007
	Village in rural area	11	10.2%	22	20.4%	
	In a town	96	88.9%	79	73.1%	
past residency	Village in desert/ remote area	1	.9%	5	4.6%	0.001
	Village in rural area	9	8.3%	26	24.1%	
	In a town	98	90.7%	77	71.3%	

Table 2 highlights significant differences in the medical history of participants between the control group and thyroid cancer cases. Hypertension (HTN) was significantly more prevalent among cases (31.5%) compared to controls (7.4%), with a p-value of <0.001, indicating a strong association. Similarly, a higher proportion of cases had elevated cholesterol levels (19.4%) compared to controls (8.3%), with a p-value of 0.018. Although hereditary

blood diseases were more common in cases (21.3%) than controls (13.0%), this difference was not statistically significant (p=0.104).

Table 2:- Medical History of Participants.

Medical History		groups				p-value
		Control		Case		
		n	%	n	%	
HTN	No	100	92.6%	74	68.5%	<0.001
	Yes	8	7.4%	34	31.5%	
cholesterol	No	99	91.7%	87	80.6%	0.018
	Yes	9	8.3%	21	19.4%	
hereditary blood diseases	No	94	87.0%	85	78.7%	0.104
	Yes	14	13.0%	23	21.3%	

Table 3 examines the lifestyle factors of participants in both control and case groups, focusing on smoking status, physical activity, and alcohol consumption. The data shows no significant differences between the groups. The majority of participants in both groups never smoked (91.7% control vs. 86.1% case, p=0.281), with similar proportions of previous and current smokers. Physical activity levels were also comparable, with no exercise reported by 46.3% of controls and 43.5% of cases (p=0.916). Lastly, almost all participants abstained from alcohol, with 100% of controls and 99.1% of cases reporting no alcohol consumption (p=0.316).

Table 3:- Lifestyle Factors of Participants.

Lifestyle Factors		Control		Case		p-value
		n	%	n	%	
Smoking Status	Never smoked	99	91.7%	93	86.1%	0.281
	Previous smoker for >1 year	3	2.8%	8	7.4%	
	Current smoker	6	5.6%	7	6.5%	
Physical Activity	No exercise	50	46.3%	47	43.5%	0.916
	15min / day	28	25.9%	29	26.9%	
	150min/ day	30	27.8%	32	29.6%	
Alcohol Consumption	No	108	100.0%	107	99.1%	0.316
	Yes	0	.0%	1	.9%	

Table 4 illustrates the dietary habits of participants in the case-control study on thyroid cancer in Al Ahsa. Significant differences were observed in salt and oil types, as well as grain and sugar consumption. Participants with thyroid cancer were more likely to use iodized salt exclusively (50.9%) compared to controls (36.1%) (p=0.028). Additionally, a higher percentage of cases consumed unsaturated vegetable oil (75.9%) compared to controls (48.1%) (p<0.001). Grain consumption patterns also differed significantly, with controls more likely to never consume grains (21.3%) compared to cases (7.4%) (p=0.002). Sugar consumption was notably higher among cases, with a significant portion always consuming sugar (12.0%) compared to controls (1.9%) (p=0.024).

Table 4:- Dietary Habits of Participants.

Dietary Habits		Control		Case		p-value
		n	%	n	%	
salt type	Noniodized Salt	0	.0%	0	.0%	0.028
	Iodized Salt	39	36.1%	55	50.9%	
	Both Noniodized& Iodized Salt	69	63.9%	53	49.1%	
oil type	Unsaturated omega 3 oil	4	3.7%	0	.0%	<0.001
	Unsaturated vegetable oil	52	48.1%	82	75.9%	
	Saturated animal oil	3	2.8%	8	7.4%	
	More than one type	49	45.4%	18	16.7%	
vegetables intake daily	Never	3	2.8%	6	5.6%	0.735
	> 1 time / week	64	59.3%	64	59.3%	
	1 time / day	25	23.1%	27	25.0%	
	2-3 times / day	13	12.0%	9	8.3%	
	> 3 times / day	3	2.8%	2	1.9%	
fruits daily	Never	4	3.7%	7	6.5%	0.304

	> 1 time/ week	71	65.7%	63	58.3%	
	1 time / daily	21	19.4%	31	28.7%	
	2 times / day	7	6.5%	5	4.6%	
	> 2 times / day	5	4.6%	2	1.9%	
Meat	Never	10	9.3%	10	9.3%	0.48
	Once/ week	44	40.7%	55	50.9%	
	> 1 time / week	45	41.7%	36	33.3%	
	Daily	9	8.3%	7	6.5%	
Grain	Never	23	21.3%	8	7.4%	0.002
	Rarely	33	30.6%	57	52.8%	
	Sometimes	39	36.1%	31	28.7%	
	Often	13	12.0%	12	11.1%	
Sugar	Never	7	6.5%	11	10.2%	0.024
	Rarely	17	15.7%	19	17.6%	
	Sometimes	36	33.3%	31	28.7%	
	Often	46	42.6%	34	31.5%	
	Always	2	1.9%	13	12.0%	

Table 5 highlights several important factors and their association with thyroid cancer. Notably, a significant difference is observed in the presence of factories in the area, with 93.5% of cases reporting no nearby factories compared to 77.8% of controls ($p<0.001$). Additionally, a family history of thyroid disease and thyroid cancer shows a strong association with thyroid cancer cases (66.7% and 22.2%, respectively) compared to controls (13.0% and 4.6%, $p<0.001$ for both). Other factors, such as exposure to radiation in the past five years, obesity, and use of hormone replacement, did not show a statistically significant association.

Table 5:-Important factors and its association with thyroid cancer.

		Control		Case		p-value
		n	%	n	%	
factories in your area?	No	84	77.8%	101	93.5%	<0.001
	Yes	24	22.2%	7	6.5%	
factories around your job?	No	97	89.8%	99	91.7%	0.639
	Yes	11	10.2%	9	8.3%	
did you expose to any type of radiations in past 5 years?	No	53	49.1%	63	58.3%	0.172
	Yes	55	50.9%	45	41.7%	
family history of thyroid?	No	94	87.0%	36	33.3%	<0.001
	Yes	14	13.0%	72	66.7%	
family history of thyroid cancer?	No	103	95.4%	84	77.8%	<0.001
	Yes	5	4.6%	24	22.2%	
family history of other types?	No	65	60.2%	59	54.6%	0.409
	Yes	43	39.8%	49	45.4%	
obese?	No	91	84.3%	83	76.9%	0.169
	Yes	17	15.7%	25	23.1%	
medication for obese	No	106	98.1%	107	99.1%	0.561
	Yes	2	1.9%	1	.9%	
history of use of hormone replacement	No	94	97.9%	78	100.0%	0.2
	Yes	2	2.1%	0	.0%	

The multivariate logistic regression analysis table presents adjusted odds ratios (ORs) for various factors associated with thyroid cancer. Notably, being male significantly reduces the odds of thyroid cancer compared to females (OR: 0.045, $p=0.007$). Age shows a positive association, indicating increased risk with advancing age (OR: 1.045, $p=0.016$). Hypertension appears to be a protective factor (OR: 0.341, $p=0.049$), while no significant associations were found for hereditary blood diseases, obesity, smoking, or physical activity. Dietary factors like daily fruit intake and meat consumption, although showing elevated ORs, did not reach statistical significance. Interestingly, breastfeeding appears to have a protective effect (OR: 0.433, $p=0.041$), while other reproductive factors like abortion did not show significant associations.

Table 6:- Multivariate Logistic Regression Analysis of Factors Associated with Thyroid Cancer.

	Adjusted OR	95% C.I.		p-value
		Lower	Upper	
Gender (Male vs. Female)	.045	.005	.434	.007
Age	1.045	1.008	1.082	.016
HTN(yes)	.341	.117	.994	.049
hereditary blood diseases(yes)	.872	.336	2.259	.778
obese(yes)	.876	.364	2.109	.767
smoking	1.443	.260	8.016	.675
Physical activity	.921	.385	2.205	.853
Fruits daily	3.151	.241	41.115	.381
meat	3.747	.652	21.537	.139
Abortion	1.305	.577	2.950	.522
Breast feeding(yes)	.433	.194	.965	.041

Discussion:-

This case-control study investigated factors associated with thyroid cancer among adults in Al Ahsa, Saudi Arabia. The findings reveal several significant demographic, medical, lifestyle, and dietary factors that may influence thyroid cancer risk in this population.

Demographic Factors:

Our results showed significant differences in marital status, educational level, employment status, and income between cases and controls. The higher proportion of married individuals among cases aligns with previous studies suggesting a potential link between marital status and cancer risk, possibly due to shared environmental exposures or lifestyle factors(Febriani et al., 2023). The lower educational levels and income among cases may reflect socioeconomic disparities in healthcare access and health literacy, potentially leading to delayed diagnosis or increased exposure to environmental risk factors (Coughlin et al., 2020).

The finding that more cases resided in rural or remote areas compared to controls is noteworthy. This could be attributed to environmental factors specific to rural settings, such as increased exposure to agricultural chemicals or differences in dietary iodine intake(Braun et al., 2024). Further investigation into the environmental characteristics of these areas is warranted to identify potential risk factors.

Medical History:

The significantly higher prevalence of hypertension and elevated cholesterol levels among cases is an important finding. While these conditions are not traditionally considered direct risk factors for thyroid cancer, they may share common pathophysiological pathways or reflect broader metabolic disturbances that could influence thyroid cancer development(Reda et al., 2021). The protective effect of hypertension observed in the multivariate analysis is unexpected and warrants further investigation, as it may be confounded by medication use or other factors.

The higher, though not statistically significant, prevalence of hereditary blood diseases among cases is intriguing. This trend aligns with research suggesting a potential link between certain hereditary conditions, such as sickle cell anemia, and increased cancer risk, including thyroid cancer(Apostolou et al., 2021). Further research with larger sample sizes may be needed to clarify this association.

Interestingly, our study did not find significant differences in smoking status, physical activity, or alcohol consumption between cases and controls. This contrasts with some previous studies that have suggested associations between these lifestyle factors and thyroid cancer risk(Yeo et al., 2021; Yoon & Park, 2020). The lack of association in our study may reflect cultural or regional differences in lifestyle patterns or could be due to the relatively small sample size(Faber & Fonseca, 2014).

The dietary findings in our study offer valuable insights. The higher use of iodized salt among cases is particularly noteworthy, given the complex relationship between iodine intake and thyroid cancer risk(Zhang et al., 2022). While iodine is essential for thyroid function, excessive intake has been linked to increased thyroid cancer risk in some

populations. Our findings underscore the need for careful consideration of iodine fortification policies and public health recommendations regarding iodine intake in this region(Zimmermann & Boelaert, 2015).

The differences in oil consumption patterns, with cases more likely to use unsaturated vegetable oils, are intriguing. While unsaturated fats are generally considered healthier, the relationship between specific types of dietary fats and thyroid cancer risk is not well-established and merits further investigation(Rosqvist & Niinistö, 2024).

The higher sugar consumption among cases is another important finding. Excessive sugar intake has been linked to various health issues, including some cancers, potentially through mechanisms involving insulin resistance and chronic inflammation (Makarem et al., 2018). This association highlights the importance of dietary interventions in cancer prevention strategies.

The strong association between family history of thyroid disease and thyroid cancer among cases underscores the significant role of genetic factors in thyroid cancer risk. This finding aligns with established literature on the hereditary component of thyroid cancer, particularly for non-medullary thyroid cancers (Sterenborg et al., 2024). The lower prevalence of nearby factories among cases was unexpected and contrasts with some studies suggesting increased cancer risk in industrial areas. This finding may reflect specific local factors or population distribution patterns and warrants further investigation(Band et al., 2000).

The protective effect of breastfeeding observed in our study is consistent with some previous research suggesting a potential inverse association between breastfeeding and thyroid cancer risk (Jin et al., 2021). This finding supports the broader health benefits of breastfeeding and may have implications for public health recommendations.

Limitations and Strengths:
This study has several limitations. As a case-control study, it is subject to recall bias, particularly for lifestyle and dietary factors. The relatively small sample size may have limited our ability to detect some associations. Additionally, the study's focus on a specific geographic region may limit the generalizability of findings to other populations.

However, the study also has notable strengths. It provides valuable insights into thyroid cancer risk factors in a population where such data are limited. The comprehensive assessment of various factors, including demographic, medical, lifestyle, and dietary aspects, offers a holistic view of potential risk factors. The inclusion of locally relevant factors, such as specific dietary habits and environmental exposures, enhances the study's relevance to the Al Ahsa population.

Conclusion and Future Directions:-

This study highlights several factors associated with thyroid cancer risk in Al Ahsa, Saudi Arabia, including demographic characteristics, medical history, dietary habits, and genetic predisposition. These findings have important implications for public health strategies and clinical practice in the region. Future research should focus on larger, prospective studies to confirm these associations and explore potential mechanisms. Additionally, investigations into the role of environmental factors, particularly in rural areas, and the impact of specific dietary components on thyroid cancer risk are warranted. Ultimately, these efforts will contribute to more effective prevention and early detection strategies for thyroid cancer in this population and beyond.

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