TPM Vol. 32, No. S9, 2025
ISSN: 1972-6325
https://www.tpmap.org/

CANCER EPIDEMIOLOGY AND HEALTHCARE GAPS IN JAZAN HEALTH CLUSTER, KINGDOM OF SAUDI ARABIA

OTHMAN M. GATAR[1.2], LAILA A. ALJABRI[1.2], NUJUD A. HALAWI[1,3], MONA A. ALFAWD[1,3], AFNAN M. SHAYANI[1,3], AHMAD A. NAHARI[4], HAFIZ M. MALHAN[5,] ABDU R. KURAIRI[6], MOHAMMED A. JAFER[7], LIAQAT A. KHAN[8].

[1]RESEARCH UNIT, JAZAN SPECIALIST HOSPITAL, JAZAN, HEALTH CLUSTER, HEALTH HOLDING CO, KINGDOM OF SAUDI ARABIA.
[2]CLINICAL NUTRITION DEPARTMENT, JAZAN SPECIALIST HOSPITAL, JAZAN, HEALTH CLUSTER, HEALTH HOLDING CO, KINGDOM OF SAUDI ARABIA.
[3]MEDICAL REHABILITATION CENTRE, JAZAN SPECIALIST HOSPITAL, JAZAN, HEALTH CLUSTER, HEALTH HOLDING CO, KINGDOM OF SAUDI ARABIA.
[4]EXECUTIVE VICE PRESIDENT, JAZAN SPECIALIST HOSPITAL, JAZAN, HEALTH CLUSTER, HEALTH HOLDING CO, KINGDOM OF SAUDI ARABIA.
[5]ADULT HAEMATOLOGY DEPARTMENT, JAZAN SPECIALIST HOSPITAL, JAZAN, HEALTH CLUSTER, HEALTH HOLDING CO, KINGDOM OF SAUDI ARABIA.
[6] PATIENT EXPERIENCE DEPARTMENT, JAZAN SPECIALIST HOSPITAL, JAZAN, HEALTH CLUSTER, HEALTH HOLDING CO, KINGDOM OF SAUDI ARABIA.
[7]DENTAL PUBLIC HEALTH DIVISION, DEPARTMENT OF PREVENTIVE DENTAL SCIENCES, JAZAN UNIVERSITY, SAUDI ARABIA.
[8]MINISTRY OF HEALTH, JAZAN BRANCH, KINGDOM OF SAUDI ARABIA.

Abstract
The review aimed to evaluate cancer incidence and types prevalent, assess healthcare systems and preventive strategies, identify risk factors, evaluate awareness and screening practices, and propose demographic-specific improvements. A systematic review of cross-sectional studies, case-control studies, retrospective studies, and qualitative studies published up to the start of 2024, focusing on Jazan and parallel regions of Saudi Arabia, was undertaken. Results indicate a high incidence of oral cancer due to smokeless tobacco, mainly Shamma, plus high colorectal cancer incidence in the country, but low Jazan rates. Knowledge of cancer risks and factors is high to moderate for breast and oral cancers. However, due to cultural barriers and infrastructural limitations, screening rates are dismally low. Evaluations of the healthcare system on its own indicate the absence of targeted screening initiatives, minimal smoking cessation services, low provider-patient engagement, and, particularly, in colorectal and lung cancer. These recommendations are demographic, methodological, and integration of molecular research gaps. Overall, the findings indicate the need for longitudinal studies and improved healthcare systems. Evidence-based policies that address cultural, socioeconomic, and infrastructural obstacles are necessary to augment cancer prevention, early detection, and treatment prognosis among Jazan's disadvantaged populations.
Keywords: Shammah, Oral cancer, Screening gaps, Jazan, Saudi Arabia, Healthcare disparities, Tobacco cessation.

INTRODUCTION:

Studies on cancer epidemiology in the Jazan region, Saudi Arabia, represent an important area of study given the region's exceptionally high incidence rates as well as distinct cancer profiles in comparison to national and worldwide trends (1, 2). Cancer incidence rates in Saudi Arabia have escalated dramatically in the past few decades, with breast, colorectal, as well as oral cancer representing the most common histotypes (3, 4).
Jazan region, specifically, has exceptionally high rates of oral cancer attributed to local use (Shammah) of smokeless tobacco (1, 5). Increased burden rates of colorectal cancer, particularly early-onset rates, also highlight the region's public health priorities (6, 7). These patterns thus provide significant impetus towards region-specific epidemiological information towards the development of targeted prevention as well as healthcare approaches (8, 9).
Despite increasing studies, important knowledge gaps remain concerning incidence rates, most common cancer types, as well as related risk factors in Jazan (10, 11). Whereas research has reported extensive awareness about specific malignancies such as breast as well as oral cancers, uptake of screening is suboptimal due to obstacles

such as apprehension, embarrassment, as well as restricted medical care access (12, 13). Additionally, psychosocial determinants impacting risk behaviour like use of Shammah are poorly understood, especially among females (4, 14). There is controversy surrounding the effect of demographic variables, such as gender as well as age, on incidence rates as well as stage at diagnosis for cancers, with mixed evidence on whether females rely on later-stage disease presentation (6, 15). The lack of regionally specific, all-grounded data hinders thriving medical care planning as well as resource allocation, thus potentially widening morbidity as well as mortality (9, 10).

This review uses a conceptual model combining epidemiological incidence, behavioural risk, and healthcare infrastructure to explain patterns in Jazan cancer (16, 17). Important concepts are rates of cancer incidence, changeable risk like use of tobacco products and obesity, as well as health system responsiveness, all in mutual relation to affect cancer outcomes (8, 17). The model references psychosocial theories in explaining behavioural determinants as well as disease burden assessment using epidemiological models to inform points for intervention (11, 14).

The objective of this review is to offer integration of current evidence on the epidemiology of cancer in Jazan region, taking into consideration rates of incidence, most frequent cancer patterns, as well as pertinent risk factors, in addition to gaps in health infrastructure among defined populations (9, 18). By filling these gaps, the review is proposed to inform tailored public health strategies as well as policy interventions to improve cancer prevention, early detection, as well as management in Jazan (9, 19)

A systematic search of databases, regional cancer registries, and peer-reviewed journals from 1994 to 2024 was conducted (2, 20). Inclusion criteria applied to include cross-sectional surveys, epidemiological studies, as well as qualitative studies into cancer incidence, risk factors, as well as healthcare in Jazan and other Saudi regions (8, 11). Analytical synthesis was carried out to quantify trends in incidence, prevalence in risk factors, as well as barriers to healthcare, with findings structured thematically to inform targeted recommendations (9, 10).

RESULTS:

Descriptive Summary of the Studies:

This section delineates the research landscape of the literature pertaining to Cancer Epidemiology in the Jazan Region of Saudi Arabia, focusing on incidence rates, types of prevalent cancer, and associated risk factors. It emphasises the identification of gaps and the proposition of enhancements in healthcare infrastructure for specific demographic groups, encompassing a wide array of studies that include cross-sectional surveys, case-control studies, retrospective analyses, and qualitative research. The studies predominantly concentrate on oral cancer, colorectal cancer, breast cancer, and lung cancer within Jazan and other regions of Saudi Arabia, elucidating epidemiological patterns, risk factors such as tobacco use and obesity, and challenges within the healthcare system. This comparative synthesis is vital for addressing the research questions related to incidence rates, risk profiling, healthcare infrastructure, awareness of screening, and programmatic deficiencies, thereby informing targeted interventions and the development of policy.

Study / Author	Year	Incidence Rate Metrics	Risk Factor Profiling	Healthcare Infrastructure Assessment	Screening and Awareness Levels	Programmatic Gap Analysis
Dallak et al.	2024	Oral cancer awareness linked to smokeless tobacco use in Jazan	High awareness of Shamma as an oral cancer risk factor	Limited cessation program effectiveness reported	Moderate awareness of oral cancer symptoms	Need for evidence-based cessation programs
Hendi et al.	2024	Breast cancer awareness is high, but screening uptake is low in Jazan	Family history is recognised as a key risk factor	Screening services are underutilised due to fear, embarrassment	High knowledge of self-exam but low mammogram use	Barriers include cultural stigma and access issues
Ghulam & Ramadan	2024	Colorectal cancer mortality rising in Saudi Arabia	Age and gender disparities in mortality risk	National data analysis: infrastructure not detailed	Not assessed	Recommendation for national screening guidelines
Alqarni et al.	2024	CRC screening programs are lacking nationally in Saudi Arabia	Barriers include embarrassment, fear, and pain	Limited equipment and time for physicians	Low public awareness of CRC screening	Urgent need for a national screening program

Al-Sawat et al.	2024	Low CRC screening awareness in Taif City	Family history recognised as a risk factor	Community-based survey; infrastructure not detailed	Poor knowledge of screening tests and age recommendations	Need for targeted education campaigns
Alessy et al.	2024	Cancer research challenges in Saudi Arabia	Data access and funding limitations	Need for improved organisational support	Not assessed	Calls for interinstitutional collaboration and policy clarity
Alsadhan et al.	2024	CRC incidence trends by age and stage in Saudi Arabia	Early-onset CRC increasing	Registry-based cohort; infrastructure not detailed	Not assessed	Highlights the need for comprehensive incidence reporting
Znaor et al.	2024	CRC stage at diagnosis in the MENA region	High proportion diagnosed at late stages	Population-based registry data	Not assessed	Urges harmonisation of staging and data collection
Alamri et al.	2024	Lung cancer knowledge and screening attitudes	High recognition of smoking risk; misconceptions exist	Cross-sectional study	Moderate willingness for screening	Suggests enhanced education and screening programs
Mansour et al.	2024	Modifiable cancer risk factors in MENA adults	Tobacco, obesity, inactivity, and diet are significant	Systematic review	Not assessed	Emphasises research and prevention needs
Alqadheeb et al.	2024	KIR genotype and CRC risk in Eastern Saudi Arabia	Certain KIR and HLA combinations affect CRC susceptibility	Genetic association study	Not assessed	Potential biomarkers for CRC risk assessment
Roshandel et al.	2024	CRC epidemiology, risk factors, prevention	Lifestyle and environmental factors influence CRC	Review of global and regional data	Not assessed	Calls for evidence-based screening strategies
Wardoyo et al.	2023	Lung cancer knowledge gaps in Jazan population	Smoking major risk factor; young, skewed sample	Lack of nationwide lung cancer awareness programs	Low screening awareness and uptake	Need for targeted education for high-risk groups
Alyami et al.	2023	Najran region cancer patient characteristics	Breast, rectum, and colon cancers most common	Hospital records: ICU admission risk factors identified	Not assessed	Emphasises care for elderly and comorbid patients
Basudan et al.	2023	Rising CRC incidence in Saudi Arabia	Obesity, sedentary lifestyle, and diet as risk factors	Registry data analysis: regional disparities noted	Not assessed	Urges better screening and awareness strategies
Ramadan, M.	2023	Risk factors for early-onset CRC in GCC countries	High BMI and low milk intake are major risks	Epidemiological data from GBD	Not assessed	Promotes lifestyle interventions for prevention
Alyabsi et al.	2023	Adjuvant chemotherapy barriers in colon cancer patients	Age and smoking status affect treatment	Hospital-based treatment data	Not assessed	Older patients are less likely to receive oxaliplatin
Alfahed, A.	2023	Molecular pathology of CRC in Saudi Arabia	Limited molecular data available	Review of molecular studies	Not assessed	Calls for large-scale translational research
Alenezi et al.	2023	Psychosocial factors	Low agreement on screening constructs	Survey in Najran region	Low screening uptake among older smokers	Recommends focused health education programs

		affecting CRC screening				
Ramadan et al.	2023	Gender differences in early-onset CRC survival	Higher female mortality-to-incidence ratio in Saudi Arabia	GBD data analysis	Not assessed	Calls for gender-targeted prevention programs
Jamal, BT.	2023	Oral cancer staging in Saudi maxillofacial practice	The majority are present at advanced stages	Clinic-based data	Not assessed	Highlights need for timely diagnosis and referral
Mansour et al.	2023	Modifiable cancer risk factors in MENA region	Tobacco, obesity, inactivity, diet major risks	Scoping review	Not assessed	Highlights need for targeted prevention programs
Elwali et al.	2023	CRC situation and control efforts in Saudi Arabia	Increasing incidence; late-stage diagnosis common	Review of epidemiology and control	Not assessed	Calls for national screening integration
Albenayyan et al.	2023	Cancer stigma in Saudi population	Generally low stigma; severity most prominent	Cross-sectional survey	Not assessed	Older age and males show higher stigma
Elwali et al.	2023	CRC epidemiology and control in Saudi Arabia	Rising incidence; late-stage common	Review article	Not assessed	Recommends strengthening control programs
Alghamdi, S.	2023	CRC patterns in Tabuk region	Right colon most common site; younger patients	Hospital records; demographic data	Not assessed	Notes proximal shift and male predominance
Moafa et al.	2022	Oral cancer linked to Shamma use; qualitative insights	Social acceptability and triggers like Khat chewing	Limited support and unclear cessation program efficacy	Users are aware but lack quitting skills	Calls for mass-reach health campaigns and policy enforcement
Alshamsan	2022	Cancer incidence trends in Qassim region	Colon and rectal cancers are increasing	Registry data with APC analysis	Not assessed	Suggests further risk factor studies
Alharbi et al.	2022	Colonoscopic conditions associated with CRC	Tumours linked to bleeding, polyps	Hospital colonoscopy reports	Not assessed	Recommends pathology reporting standardisation
Younis et al.	2022	Genetic biomarkers for CRC in Saudi patients	Multiple gene variants linked to CRC risk	Genetic studies in Saudi population	Not assessed	Potential for diagnostic and therapeutic targets
Alhomoud et al.	2022	Cancer control progress in GCC countries	National strategies for prevention and management	Policy review	Not assessed	Identifies gaps and recommends capacity building
Balan et al.	2022	Oral cancer prevalence among Saudi women	Tobacco, especially Shamma, dominant risk factor	Systematic review	Not assessed	Emphasises need for continuous vigilance
Akkour et al.	2022	Cancer awareness and carcinogen beliefs in Saudi women	Good knowledge of smoking risks; misconceptions present	Cross-sectional survey	Internet main information source	Calls for targeted awareness campaigns
Alshamsan et al.	2022	Obesity is associated with	Obesity is linked to advanced stage and poor outcomes	Retrospective clinical data	Not assessed	Advocates for screening and

		a breast cancer profile				weight management
Alyabsi et al.	2021	Marital status effect on CRC stage and survival	Unmarried more likely to experience late-stage and higher mortality	Registry data analysis	Not assessed	Supports social support in outcomes
Alyabsi et al.	2021	Early-onset CRC is increasing in Saudi Arabia	Age 40-49 highest early-onset rates	National registry data	Not assessed	Recommends screening initiation before age 50
Alharbi et al.	2021	Colon cancer presentation in Northern Saudi Arabia	Younger age and mucinous adenocarcinoma in females	Histopathology data from hospital	Not assessed	Calls for early detection and screening programs
Sindi et al.	2021	Genetic variants and CRC risk in nonsmokers	GSTM1 and TP53 variants increase CRC risk	Case-control genetic study	Not assessed	Suggests gene-environment interaction studies
Al-Qahtani et al.,	2021	Malignant tumour patterns in Najran	Gastrointestinal cancers most frequent	Retrospective pathology data	Not assessed	Women are more affected; age is a risk factor
Almatroudi A.	2020	CRC incidence is lowest in Jazan compared to other regions	Lifestyle factors like inactivity and obesity are implicated	Regional registry data; healthcare access variable	Not assessed	Calls for epidemiological investigations and prevention
Alshehri B. M.	2020	Oral cancer highest incidence in Jazan region	Tobacco use, especially Shamma, major risk factor	Registry-based incidence data	Not assessed	Suggests genetic and lifestyle factors need study
Chaudhri et al.	2020	Trends in common cancers in Saudi Arabia	Leukaemia, breast, and colorectal cancers are prevalent	Registry and SEER data comparison	Not assessed	Highlights rising breast cancer incidence
Alyabsi et al.	2020	CRC healthcare perspective in Saudi Arabia	Environmental and lifestyle risk factors	Review of healthcare system and policies	Not assessed	Advocates for predictive diagnostics and screening
Alyabsi et al.	2020	CRC stage and sex impact in unscreened Saudi population	Women more likely to be diagnosed at metastatic stage	Registry data analysis	Not assessed	Recommends female-targeted screening policies
Al-Hanawi et al.	2020	Socioeconomic inequalities in breast cancer screening	Screening knowledge and use are higher in wealthier women	National survey data	Screening uptake disparities by income and education	Suggests equity-focused policy interventions
Quadri et al.	2019	Meta-analysis of smokeless tobacco and oral cancer	Shamma use increases oral cancer risk nearly 39-fold	Systematic review and meta-analysis	Not assessed	Supports public health prevention strategies
Patil et al.	2019	Shammah chewing and oral cancer risk	Shammah increases risk of oral cancer and OPMD	Systematic review	Not assessed	Supports public health prevention efforts
Alharbi & Quadri	2018	Oral squamous cell carcinoma incidence linked to tobacco	Shamma, shisha, and cigarettes significantly increased risk	Hospital-based data; no infrastructure evaluation	Not assessed	Emphasis on combined risk factor policies

Quadri et al.	2015	Oral cancer cases linked to Shamma and cigarettes in Jazan	Khat chewing showed no significant effect	Hospital-based case-control study	Not assessed	Need for longitudinal studies with larger samples

Incidence Rate Measures:
About 20 studies reported quantitative incidence data, and oral cancer was shown to be very common in Jazan, with a rising incidence of colorectal cancer nationally, but at a lower level than in other areas (2, 7, 18, 21). When stratified based on age and gender, oral cancer is found at higher rates among the elderly and men, and early-onset cases of colorectal cancer are found increasingly often, particularly among adults under 50 (6, 15, 22, 35). Regional variations are found, with the highest oral incidence seen in Jazan and the lowest rates of colorectal cancer demonstrating local profiles of risk factors and access variations to medical care (2, 21).

Risk Factors Profiling:
Tobacco consumption, especially smokeless tobacco (Shamma), is found to be a significant risk factor for oral cancer within Jazan region, and odds ratios show a significant association (5, 16, 18). Lack of physical activity and dietary components are significant modifiable risks for colorectal and breast cancers, and genetic components are found to contribute to susceptibility of colorectal cancers (7, 23, 24). Psychosocial and behavioural aspects like tobacco consumption, social acceptability and low physical carcinogen awareness contribute toward risk profiles (14, 25).

Healthcare Infrastructure Monitoring:
Numerous investigations show low availability and access to cancer screening and cessation services in Jazan and Saudi Arabia, with hospital data showing gaps within early diagnosis and treatment assistance (19, 26, 27). Structural issues are represented by inadequacy of equipment availability, lack of skilled staff, and limited public health education campaigns mainly addressing lung and colorectal cancer screening (28, 29). Organisational boost requirements, collaboration between institutions, and policy clarification are highlighted to enhance cancer care provision (19, 30).

Screening and Awareness Level:
Knowledge of cancer types and risk factors is low to moderate for oral and breast cancers, but low because of cultural barriers, fear of embarrassment, and incorrect information (12, 13, 15). Awareness of colorectal cancer screening is low, and knowledge of appropriate methods and ages of recommendation is lacking, especially in the at-risk groups (11, 31). Internet and health workers are dominant sources of information, but myths about the cause of cancer and stigma are common and influence screening practice (25, 32).

Programmatic Gap Analysis:
Identified gaps include insufficient cessation programs for smokeless tobacco users, lack of national screening programs for colorectal and lung cancers, and socioeconomic disparities affecting screening uptake (18, 28, 33). Barriers such as limited healthcare provider recommendations, inadequate public education, and cultural stigma hinder effective cancer control (13, 14). Recommendations focus on evidence-based interventions, mass-reach health campaigns, policy enforcement, and targeted support for vulnerable groups, including unmarried individuals and women (14, 35).

Theoretical and Practical Implications:
The synthesised results affirm the prominent role of regionally-specific lifestyle and environmental risk factors, e.g., use of smokeless tobacco (Shammah), in oral cancer epidemiology within the Jazan region. This confirms previously existing theories of carcinogenesis attributing tobacco exposure to oral malignancies and draws attention to the additive risk when a multiplicity of tobacco products is used simultaneously (5, 16, 26). High incidence rates of CRC (colorectal cancer) within younger ages and rising trends of early CRC (CRC) blur conventional models of age-related cancers and prompt the recalibration of risk stratification schemas to include demographic and lifestyle changes that are unique to Saudi Arabia (6, 36). Genetic work localising polymorphisms within or within proximity to GSTM1, TP53, and KIR-HLA interactions offers molecular clues toward CRC susceptibility within the Saudi population and affirms the role of integrating genetic susceptibility within the context of cancer risk epidemiology (37, 38). Psychosocial determinants and awareness of cancer risk factors and use of screening behaviours document the essential role of integrating theories of behaviours and social influence within the epidemiology of cancers and reinforce multifactorial perspectives toward understanding the aetiology of cancers beyond biological antecedents (11, 14, 25). Marital and gender disparities within the mean stage of cancer at diagnosis prompt attention toward the role of social determinants of health toward being fundamental moderators of the outcomes of cancers and prompt integrated theories that integrate social support and access to healthcare as fundamental variables (15, 35). Stable oral cancer incidence rates when standardised by age and population suggest multifactor interactions of environmental, religious, and cultural elements that can moderate or buffer cancer risk and blur simple exposure-disease models (2).

Practical Implications:
Jazan public health actions must give top priority to special tobacco cessation programs aimed at addressing Shammah consumption, using culturally appropriate measures considering psychosocial determinants and impediments found among the users of Shammah, to significantly lower oral cancer incidence (5, 14, 18). Early-

age CRC incidence on the rise requires adoption of national guidelines encouraging CRC screening, lowering the starting age of CRC screening with special emphasis on high-risk groups to ensure early detection and enhanced survival (9, 20, 35). Upgrades of healthcare infrastructure must give priority access to screening services for cancer of breast, colon, rectum, and lungs while overcoming fear, embarrassment, and ignorance using community education and physician training (12, 29, 33). Genetic screening and molecular pathological services are to be incorporated within cancer treatment routes to permit personalised estimation of risks and adaptive treatments based on identified genetic markers found widespread within Saudi individuals (23, 38, 39). Social determinants of influence on cancer diagnosis and treatment, such as status of being unmarried and gender inequalities, must be catered to by policy initiatives improving the provision of social support and ensuring equal access to healthcare facilities, especially by individuals of the vulnerable kind and those living singly (15, 35). National control strategies of cancers would equally integrate multi-level collaborations toward increased availability of information, conducting of research, and coordination of institutions within the context of Saudi Vision 2030 objectives of promoting evidence-based control and prevention of cancers (19, 30).

Limitations of the Literature:

Cross-sectional study designs were used by most available studies, and hence, limited generalizability of causal associations or temporal associations of risks with outcomes of cancers. This is a limitation of methodology which diminishes insights into the dynamic processes of the epidemiology of cancers (2, 3, 4). Some investigations concentrated on certain governorates or areas of Jazan or Saudi Arabia and limited external validity and generalizability of results to the larger population due to cultural, socioeconomic, and environmental diversity (2, 4, 5). Certain studies had small sample sizes or biased sampling toward younger or other demographic groups, inviting sampling error and restricting the generalizability of findings toward the general population. This diminishes the strength of epidemiological inferences (14, 40, 41). Numerous studies relied on self-administered questionnaires or interviews that are prone to recall and social desirability biases and may therefore undermine data integrity on risk factors, awareness, and behaviour (18, 25, 40). Lack of longitudinal or prospective longitudinal cohort studies deters knowledge of cancer development and trajectory of exposure to risks across time and intervention effectiveness, and prevents establishment of temporal causality and longer-term outcomes (26, 37, 40). Little is available of thorough molecular and gene-specific work relating to the Saudi population and hindering understanding of gene susceptibility and biomarkers useful for tailoring predictive and treatment strategies toward individuals (23, 37, 39).

A few of these studies identified gaps in systematic cancer screening programs and incomplete staging data, which hinder the precise measurement of early detection rates and stage-specific epidemiology, as well as the assessment of healthcare infrastructure performance (15, 28, 42).

A limited number of studies have sufficiently covered psychosocial determinants, stigma, and cultural factors related to cancer awareness, screening uptake, and treatment adherence, which are essential for effective, culturally tailored intervention development (11, 14, 32). Some awareness and behavioural research suffered from a preponderance of female respondents, which may put results at risk of bias and limit the generalizability of results of men-specific cancer epidemiology and of region-specific risks (18, 25, 32). Disparate data sources and a lack of unified national registries of cancers or cohesive research enterprises impair the performance of larger-scale epidemiological examinations and the development of common cancer control strategies.

OVERALL SYNTHESIS AND CONCLUSION:

Cancer epidemiology in Jazan, Saudi Arabia, is dominated by the world's highest oral-cancer incidence, driven almost entirely by the smokeless-tobacco product Shamma; repeated studies identify this single behaviour as the principal, modifiable determinant. While breast-cancer awareness is moderately high, screening uptake remains poor because of cultural embarrassment, fear and stigma, exposing a persistent knowledge-to-action gap. Lung- and colorectal-cancer control are even weaker: no organised screening or public campaigns exist, so most cases present late. Although national colorectal rates are rising, Jazan still records the kingdom's lowest incidence; conversely, early-onset disease is accelerating country-wide, signalling an impending wave among younger adults. Lifestyle risks—obesity, inactivity, low dairy intake—are repeatedly implicated, yet molecular and hereditary data remain scarce. Across the region, healthcare infrastructure is fragmented; provider recommendations are inconsistent and vulnerable groups—women, the unmarried and the poor—face the greatest access barriers. Socio-economic gradients further concentrate screening services among affluent, educated women, while public education campaigns are sporadic and rarely culturally tailored. The literature converges on an urgent need for integrated, evidence-based strategies: comprehensive tobacco-cessation programmes, population-specific screening policies, provider training, and health-system capacity-building. Embedding molecular epidemiology within public-health surveillance will enable precision prevention, while culturally sensitive community engagement and inter-sectoral collaboration are essential to translate awareness into early detection and, ultimately, to reduce Jazan's disproportionate cancer burden.

Conflict of Interest: Nil

Financial Support: Self-Funded

Ethical Approval: Secondary published data, used in this work, thus exempted from Ethical Approval.

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