Prevalence, Safety, Perceptions, and Association of Nicotine Pouches (DZRT) with Smoking Cessation Among Adult Smokers in Abha City, Saudi Arabia

Dr. Abdulaziz Ali Alqahtani[1], Omar Safar Al kuraydis[2] and Awadh Mushabbab Alqahtani[3]

[1]Resident doctor of Preventive Medicine, Aseer Health Cluster, Ministry of Health abdulazizmdawi@gmail.com
[2]Department of Preventive Medicine Armed Forces Hospitals Southern Region, Khamis Mushait, Saudi Arabia Omarsafarkre11@gmail.com
[3]Senior Registrar of Preventive Medicine, Aseer Health Cluster, Ministry of Health dr.awadlhmana@gmail.com

Abstract

Background: Oral nicotine pouches are tobacco-free products increasingly marketed as smoke-free alternatives to combustible tobacco. Regional data on their prevalence, safety, and relationship with smoking cessation in southern Saudi Arabia remain scarce. Objective: To determine the prevalence and patterns of DZRT nicotine pouch use among adults in Abha City, and to examine its association with smoking status and smoking cessation. Methods: A cross-sectional, community-based online survey was conducted among 655 adults in Abha City in 2026. Data were analyzed using SPSS v29. Chi-square tests examined categorical associations, and multivariate logistic regression identified independent predictors of DZRT use. Results: The prevalence of ever having used DZRT nicotine pouches was 27.5% (180/655). Among nicotine-pouch users with a smoking history, former smokers were significantly more likely than current smokers to report having quit smoking (83.2% vs. 20.6%; $\chi^2 = 60.879$, $p < 0.001$; Kendall's τ-b = 0.621). On multivariate logistic regression, DZRT use was independently associated with male sex (OR 8.05, 95% CI 2.18–29.75), current smoking (OR 41.60) and former smoking (OR 54.81) relative to never-smoking, younger age (18–44 years; OR 41.18), and the belief that nicotine-replacement products are a healthy alternative (OR 6.44) (Nagelkerke $R^2 = 0.740$). The most frequently reported adverse effects among users were gastrointestinal symptoms (37.2%) and anxiety/stress (32.8%). Conclusion: DZRT nicotine pouch use was common among adult smokers in Abha City and was strongly associated with a history of tobacco use and self-reported cessation. While the cross-sectional design precludes causal inference, these findings support a possible role for nicotine pouches in smoking cessation behavior, alongside a need for continued safety surveillance given the frequency of self-reported psychological and gastrointestinal symptoms.

Keywords: Nicotine pouches; DZRT; smoking cessation; tobacco harm reduction; Abha; Saudi Arabia.

1. INTRODUCTION

Tobacco use remains one of the leading preventable causes of morbidity and mortality worldwide, responsible for several million deaths annually and a substantial share of the global non-communicable disease burden (1,2). Oral nicotine pouches have emerged over the past several years as a tobacco-free nicotine delivery product, marketed as a discreet, smoke-free alternative to combustible cigarettes and placed directly between the lip and gingiva for absorption through the oral mucosa (3,4).

Chemical characterization studies indicate that nicotine pouches generally contain substantially lower levels of tobacco-specific nitrosamines, polycyclic aromatic hydrocarbons, and heavy metals than combustible cigarettes or traditional smokeless tobacco, although trace quantities of several harmful and potentially harmful constituents—including nitrosamines and metals such as nickel and chromium—have still been detected in commercial brands (6,7). Regulatory oversight of these products also varies markedly worldwide: a recent review identified dozens of distinct national regulatory approaches, ranging from outright bans to unrestricted retail sale, reflecting substantial global inconsistency in how nicotine pouches are classified and controlled (8). In the United States, selected low-dose formulations (3 mg and 6 mg) have been authorized by the Food and Drug Administration, yet products with considerably higher nicotine concentrations continue to circulate in other markets, including the Gulf region, without equivalent regulatory scrutiny (5).

Regional evidence from Saudi Arabia is still emerging. A study conducted among adults in Riyadh reported substantial awareness of nicotine pouches alongside comparatively lower rates of actual use, with higher use concentrated among younger male adults (9). Other Saudi survey data have linked nicotine pouch use to gastrointestinal and psychological symptoms, particularly among users from lower socioeconomic backgrounds (10). Experimental pharmacological work has additionally raised concerns regarding acute cardiovascular effects—including increased heart rate and arterial stiffness—associated with higher-dose formulations (11).

At a population level, nicotine pouch use in the United States has been reported as low but rising, with retail sales and consumer uptake accelerating markedly in recent years (12,13). A recent narrative review concluded that the long-term safety profile of these products is still not well characterized (14), and a systematic review of randomized trials examining nicotine pouches as a smoking-cessation aid concluded that the evidence base, while promising, remains preliminary (15)—a conclusion echoed by a subsequent Cochrane systematic review calling for larger, longer-duration trials before firm conclusions on efficacy can be drawn (16).

Beyond systemic and behavioral effects, emerging case reports and systematic reviews have documented local oral mucosal changes, gingival recession, and other lesions at the site of habitual pouch placement, indicating that the oral cavity itself may be a target for nicotine-pouch-related harm (17,18,19).

Age also appears to shape uptake of these products: national U.S. survey data have shown measurable use of nicotine pouches among middle and high school students as well as young adults, raising concern that marketing reaching younger age groups may extend well beyond adult smokers seeking cessation aids (20,21). At a population level, modeling work suggests that tobacco-free nicotine products could, in principle, reduce smoking-attributable mortality if they successfully divert existing smokers away from combustible tobacco, although this potential benefit depends heavily on whether such products also recruit new, previously nicotine-naive users (22). National tobacco-control surveillance in Saudi Arabia has likewise tracked shifting patterns of tobacco and nicotine product use across the Kingdom, underscoring the need for locally generated, product-specific data (23).

Rational

A comparable community-based study conducted among adult tobacco users in Al-Baha City reported a DZRT/oral-nicotine-pouch prevalence of 61% among tobacco users specifically, and identified a strong statistical association between pouch use and self-reported smoking cessation status, alongside a significantly higher frequency of self-reported psychological symptoms among users (24, unpublished data). Cardiovascular and psychiatric commentary on the broader nicotine-pouch phenomenon has similarly urged caution pending stronger clinical evidence (25). To date, however, no published data have specifically examined the prevalence, safety perceptions, and cessation-related associations of DZRT nicotine pouches among the general adult population of Abha City, in Aseer region.

Given the rapid uptake of these products and their promotion as smoking-cessation tools despite limited local evidence, the present study aimed to determine the prevalence and patterns of DZRT nicotine pouch use among adults in Abha City, to examine its association with smoking status and self-reported cessation, and to identify the sociodemographic and attitudinal predictors of use, in order to inform regional tobacco-control policy and clinical counselling practice.

2. Subjects and Methods

Study Design and Setting: A cross-sectional, community-based study was conducted among adults residing in Abha City, Aseer Region, Saudi Arabia, during 2026.

Study Population: The target population comprised Saudi adults aged 18 years and above residing in Abha City, including current and former users of tobacco or other nicotine-containing products, as well as never-users, and both sexes were eligible. Non-Saudi residents, non-residents of Abha City, and individuals with diagnosed chronic medical conditions were excluded from the original sampling frame; a small proportion of non-Saudi and chronic-disease respondents nonetheless completed the survey and were retained in the descriptive analysis.

Sample Size: The minimum required sample size was calculated using Epi Info version 7.0, based on the

2022 population census of Abha City (approximately 334,290 residents) and an expected awareness level of 59% for nicotine pouches reported in a previous Saudi study, at a 95% confidence level and 5% margin of error, yielding a minimum of 384 participants; accounting for an anticipated 15% non-response rate, the target sample size was set at 442. The final achieved sample of 655 respondents exceeded this target.

Sampling Technique and Data Collection: A non-probability convenience sampling method was used. Data were collected through a structured, self-administered online questionnaire distributed via WhatsApp, X (formerly Twitter), Telegram, and community-based online groups in Abha City. The instrument, developed from previously published literature and expert consultation (a pulmonologist, a respiratory therapist, and an epidemiologist), covered five domains: sociodemographic characteristics; smoking history and habits; nicotine pouch use; reported side effects; and motivation for and attempts at smoking cessation. A pilot study assessed clarity, feasibility, and completion time prior to full-scale data collection.

Statistical Analysis: Data were analyzed using IBM SPSS Statistics version 29. Descriptive statistics (frequencies, percentages, means, and standard deviations) summarized participant characteristics and patterns of use. The chi-square test of independence assessed the association between smoking status and self-reported smoking cessation among nicotine-pouch users. A multivariate binary logistic regression model (Enter method) was constructed with ever having used DZRT nicotine pouches (yes/no) as the dependent variable, and sex, occupation, smoking status, age category, nationality, marital status, and perceived healthiness of nicotine-replacement products as independent variables. Adjusted odds ratios (OR) with 95% confidence intervals (CI) are reported. Statistical significance was set at $p < 0.05$.

Ethical Considerations: Ethical approval was obtained from the Bioethics Committee of Aseer Health Cluster prior to data collection. All participants provided electronic informed consent, no personally identifying information was collected, and confidentiality was maintained throughout.

3. Results

A total of 655 adults completed the survey. The majority were male (64.6%), Saudi nationals (97.6%), and married (73.7%); 69.9% were employed, and mean age was 41.72 ± 12.62 years. Overweight and obesity were common, affecting 40.3% and 33.4% of respondents, respectively, and mean BMI was 28.30 ± 5.27 kg/m². Full sociodemographic and health-related characteristics are presented in Table 1.

Table 1. Sociodemographic and Health-Related Characteristics of the Study Sample (N = 655)

Variable	Category	n	%
Sex	Male	423	64.6
	Female	232	35.4
Nationality	Saudi	639	97.6
	Non-Saudi	16	2.4
Marital status	Married	483	73.7
	Unmarried	144	22.0
	Widowed	12	1.8
	Divorced	16	2.4
Educational level	Diploma/Bachelor's degree	371	56.6
	Postgraduate studies	177	27.0
	General education (≤ secondary)	107	16.3
Occupation	Employee	458	69.9
	Unemployed	154	23.5
	Student	43	6.6
Monthly income (SAR)	< 4,000	153	23.4
	4,000–9,999	115	17.6
	10,000–14,999	129	19.7

	15,000–25,000	181	27.6
	> 25,000	77	11.8
Regular exercise	Yes	196	29.9
	No	459	70.1
BMI category	Underweight	16	2.4
	Normal weight	155	23.7
	Overweight	264	40.3
	Obese	219	33.4
Chronic disease (≥1, among those reporting any)	Diabetes / Hypertension (each)	78 / 78	29.8 / 29.8*
	Obesity-related	63	24.0*
Continuous variables	Mean ± SD		
Age (years)	41.72 ± 12.62		
BMI (kg/m²)	28.30 ± 5.27		

** Percentage of cases among the subgroup reporting at least one chronic disease.*

Regarding smoking status, 60.2% of participants had never smoked, 18.5% were current smokers, and 21.4% were former smokers (16.8% quit more than six months ago; 4.6% quit within the past six months). Overall, 27.5% of the total sample (180/655) reported ever having used DZRT nicotine pouches. Among users, the most common nicotine strength was 10 mg (74.4%), the most common consumption pattern was 6–10 pouches per day (41.7%), and duration of use was most frequently 1–2 years (31.7%). DZRT was overwhelmingly the most commonly used brand among pouch users (97.2% of cases). The most frequently reported self-reported symptoms after use were nausea or digestive complaints (37.2% of cases) and anxiety, stress, or other psychological symptoms (32.8% of cases); a quarter of users (25.0%) reported no symptoms at all (Table 2).

Table 2. Smoking Status, DZRT Nicotine Pouch Use Patterns, and Self-Reported Symptoms

Variable	Category	n	%
Smoking status (n = 655)	Never smoked	394	60.2
	Current smoker	121	18.5
	Former smoker (quit > 6 months)	110	16.8
	Former smoker (quit < 6 months)	30	4.6
Ever used DZRT nicotine pouches (n = 655)	Yes	180	27.5
	No	475	72.5
Duration of use (n = 180)	< 6 months	49	27.2
	6 months–1 year	46	25.6
	1–2 years	57	31.7
	> 2 years	28	15.6
Nicotine concentration (n = 180)	10 mg	134	74.4
	7 mg	11	6.1
	6 mg	19	10.6
	3 mg	6	3.3
	> 10 mg	10	5.6
Pouches consumed/day (n = 180)	1–5	63	35.0
	6–10	75	41.7

	11–15	33	18.3
	> 16	9	5.0
Brand used (multiple response, % of cases, n = 180)	DZRT (Desert)	174	97.2*
	VELLO	14	7.8*
	FOX	12	6.7*
	ZYN	7	3.9*
Self-reported symptoms after use (multiple response, % of cases, n = 180)	Nausea or digestive problems	67	37.2*
	Anxiety, stress, or psychological symptoms	59	32.8*
	Palpitation	43	23.9*
	Headache	36	20.0*
	Sleep problems	45	25.0*
	Mouth ulcers	28	15.6*
	Weight gain	27	15.0*
	No symptoms noticed	45	25.0*

** Percentage of cases (multiple-response items; denominator = users reporting the relevant behavior).*

Among the subgroup of nicotine-pouch users with a definable smoking history (n = 158), a statistically significant association was found between smoking status and self-reported quitting of smoking: 83.2% of former smokers reported having quit smoking, compared with only 20.6% of current smokers who reported having quit ($\chi^2 = 60.879$, df = 1, $p < 0.001$; Kendall's τ-b = 0.621, $p < 0.001$), indicating a strong positive association between DZRT-associated smoking status and successful cessation (Table 3).

Table 3. Association Between Smoking Status and Self-Reported Smoking Cessation Among Nicotine Pouch Users (n = 158)

Smoking status	**Did not quit smoking, n** (%)	**Quit smoking, n** (%)	**Total , n**	**χ^2 / p-value**
Current smoker	50 (79.4%)	13 (20.6%)	63	60.879
Former smoker	16 (16.8%)	79 (83.2%)	95	p < 0.001
Total	**66**	**92**	**158**	Kendall's τ-b = 0.621

On multivariate logistic regression (Table 4), the overall model was highly significant (Omnibus $\chi^2(12) = 469.656$, $p < 0.001$) and demonstrated excellent discrimination (Nagelkerke $R^2 = 0.740$; overall classification accuracy = 90.8%). Male sex was associated with over eight-fold higher odds of DZRT use compared with female sex (OR 8.05, 95% CI 2.18–29.75, p = 0.002). Both current smoking (OR 41.60, 95% CI 17.30–100.07) and former smoking (OR 54.81, 95% CI 23.04–130.37) were associated with markedly higher odds of DZRT use compared with never-smoking (both $p < 0.001$). Younger age (18–44 years) was independently associated with higher odds of use compared with those over 65 years (OR 41.18, 95% CI 4.66–364.28, p = 0.001), while the 45–65-year group did not reach significance. Saudi nationality was associated with lower odds of use relative to non-Saudi respondents (OR 0.10, 95% CI 0.02–0.68, p = 0.018). Believing that nicotine-replacement products are a healthy alternative to smoking was associated with substantially higher odds of use (OR 6.44, 95% CI 2.57–16.13, $p < 0.001$), whereas disbelief in their healthiness was associated with lower odds (OR 0.48, 95% CI 0.25–0.92, p = 0.027). Occupation and marital status were not significant independent predictors.

Table 4. Multivariate Logistic Regression Analysis of Factors Independently Associated with DZRT Nicotine Pouch Use (N = 655)

Variable	Category (reference group)	OR	95% CI	p-value
Sex	Male (vs. Female)	8.05	2.18–29.75	0.002
Occupation	Employee (vs. Student)	1.65	0.48–5.67	0.424
	Unemployed (vs. Student)	0.87	0.20–3.80	0.848
Smoking status	Current smoker (vs. Never smoker)	41.60	17.30–100.07	< 0.001
	Former smoker (vs. Never smoker)	54.81	23.04–130.37	< 0.001
Age category	18–44 y (vs. > 65 y)	41.18	4.66–364.28	0.001
	45–65 y (vs. > 65 y)	6.05	0.66–55.74	0.112
Nationality	Saudi (vs. Non-Saudi)	0.10	0.02–0.68	0.018
Marital status	Married (vs. Widowed/Divorced)	0.94	0.08–10.82	0.963
	Single (vs. Widowed/Divorced)	1.49	0.13–17.51	0.751
Perceived healthiness of nicotine products	Yes (vs. Maybe)	6.44	2.57–16.13	< 0.001
	No (vs. Maybe)	0.48	0.25–0.92	0.027

Model fit: Omnibus $\chi^2(12) = 469.656$, $p < 0.001$; Nagelkerke $R^2 = 0.740$; overall classification accuracy = 90.8%.

Taken together, these adjusted estimates indicate that DZRT use in this sample was not randomly distributed across the population but was concentrated in a specific, identifiable profile: younger male adults with a current or former smoking history who viewed nicotine-replacement products as a healthy alternative to cigarettes. The magnitude of the odds ratios for smoking status (OR 41–55) and younger age (OR 41) indicates that these two factors, far more than occupation or marital status, distinguished users from non-users, suggesting that DZRT is functioning predominantly as a smoking-history-linked product rather than as a general-population nicotine product. The inverse association with Saudi nationality, while statistically significant, rests on a small non-Saudi subgroup (n = 16) and should be interpreted as hypothesis-generating rather than definitive. Practically, these findings suggest that screening and counselling for DZRT use could be reasonably prioritized among younger male patients with any smoking history who express favorable views of nicotine-replacement products, rather than applied uniformly across all clinic attendees.

4. Discussion

The present study examined the prevalence, patterns of use, safety perceptions, and cessation-related associations of DZRT nicotine pouches among adults in Abha City, Saudi Arabia. Three principal findings emerged. First, nearly three in ten adults in the sample had ever used DZRT, with use concentrated among those with a current or former smoking history. Second, among pouch users with a smoking history, former smokers were far more likely than current smokers to report having quit, and DZRT use was one of the strongest independent predictors of smoking-related status in the multivariate model. Third, while a substantial minority of users reported no adverse effects at all, gastrointestinal and psychological symptoms were the most commonly reported complaints, echoing safety signals identified elsewhere in the region.

The observed prevalence of DZRT use (27.5% of the general adult sample) sits between the awareness/use figures reported from Riyadh, where 59.3% of adults were aware of nicotine pouches but only 14.2% had ever used them (9), and the substantially higher prevalence (61%) reported among tobacco users specifically in a comparable Al-Baha City sample (24, unpublished data). This gradient is consistent with the interpretation that prevalence estimates are highly sensitive to whether the denominator is the general population or a population selected for tobacco-use history, and supports the present study's finding that smoking status was itself among the strongest predictors of DZRT use. Notably, the 10-mg strength was

the most frequently used formulation among DZRT users in this sample, exceeding the 3-mg and 6-mg concentrations authorized for sale in some regulated markets (5), and highlighting the broader inconsistency in nicotine-pouch regulation across jurisdictions worldwide (8).

The strong association between DZRT use and self-reported smoking cessation among pouch users with a smoking history mirrors findings from the Al-Baha cohort, where oral nicotine pouch use was significantly associated with smoking cessation status (24, unpublished data), and is broadly consistent with international literature suggesting that some smokers adopt tobacco-free nicotine products as a substitute source of nicotine during quit attempts (10,15,16). The independent association between younger age and DZRT use observed here also parallels survey evidence of disproportionate nicotine-pouch uptake among younger age groups, including school-aged adolescents and young adults in other settings (20,21), underscoring that products positioned as adult smoking-cessation aids may nonetheless reach younger, potentially nicotine-naive users. However, because the present study is cross-sectional, the direction of the cessation association cannot be established: DZRT use may have facilitated cessation, or individuals who had already quit smoking may subsequently have adopted nicotine pouches to manage residual cravings. Only prospective or interventional designs can resolve this ambiguity.

Male sex, younger age, and the perception that nicotine-replacement products are a healthy alternative to smoking were independently associated with substantially higher odds of DZRT use. The association with a favorable healthiness perception is of particular public-health interest: products marketed as "clean" or "smoke-free" may be perceived as low-risk by consumers, which could encourage uptake among individuals who might not otherwise use nicotine products, a concern also raised in narrative reviews of this product category (14) and reflected in rising retail sales trends for these products (13). This concern is reinforced by population-level modeling suggesting that the net public-health impact of tobacco-free nicotine products depends on whether they primarily divert existing smokers away from combustible tobacco or instead recruit new, previously nicotine-naive users (22). Conversely, Saudi nationality was associated with lower odds of use relative to the small non-Saudi subgroup in this sample; given the limited number of non-Saudi respondents (n = 16), this finding should be interpreted cautiously and requires confirmation in a larger, more balanced sample.

Beyond the systemic and behavioral outcomes examined here, a growing body of dental literature raises independent safety concerns specific to the oral cavity. Case series and case reports have documented site-specific gingival recession, leukoplakia, and histopathologically confirmed mucosal inflammation at the exact location of habitual pouch placement (17,19), and a systematic review of the available clinical literature concluded that oral mucosal lesions, dry mouth, and gingival irritation are recurrently reported among nicotine-pouch users, although the overall evidence base remains small and of variable methodological quality (18). Given that DZRT users in the present sample commonly reported prolonged daily use—frequently one to two years, with many consuming six or more pouches per day—clinicians and dental practitioners in the Aseer region should consider incorporating routine oral mucosal examination into the counselling of patients who use these products, independent of their smoking-cessation goals.

Regarding systemic safety, the pattern of self-reported symptoms in the present study—led by gastrointestinal complaints and psychological symptoms such as anxiety and stress—parallels a Saudi cross-sectional study that similarly linked nicotine pouch use to gastrointestinal and psychological impacts (10), and is consistent with pharmacological data showing measurable acute physiological effects, including cardiovascular changes, following use of tobacco-free nicotine pouches at higher doses (11), as well as with clinical commentary urging caution regarding the cardiovascular and psychiatric effects of these products pending stronger evidence (25). These findings reinforce that, although DZRT and similar products eliminate combustion-related toxicant exposure, they are not free of adverse effects and should not be regarded as risk-free.

Strengths and Limitations

This study provides some of the first region-specific data on DZRT nicotine pouch use in Abha City and Aseer Region, examining prevalence, patterns of consumption, cessation-related associations, and self-reported safety within a single, adequately powered sample. Nonetheless, several limitations should be noted. The cross-sectional design precludes causal or temporal inference between DZRT use and smoking cessation. The non-probability, convenience-based online sampling strategy may limit generalizability and could have introduced selection bias toward more digitally engaged or younger respondents. All exposure

and outcome data were self-reported, introducing potential recall and social-desirability bias. Finally, some strata used in the logistic regression model (for example, the non-Saudi and oldest-age subgroups) were small, producing wide confidence intervals that warrant cautious interpretation.

Recommendations

Based on these findings, continued surveillance of DZRT and other nicotine-pouch use patterns is recommended across the Aseer Region, consistent with existing national tobacco-control surveillance efforts (23), to track the evolving landscape of these products amid highly variable regional regulation (8). Public health education should clarify that tobacco-free nicotine pouches are not risk-free, given the frequency of reported gastrointestinal, psychological, and oral mucosal symptoms observed here and in comparable Saudi and international samples (10,17,18,19). Smoking-cessation counselling services should routinely ask about nicotine-pouch use and provide individualized, evidence-based guidance rather than assuming safety based on "smoke-free" marketing claims. Prospective cohort studies and, where feasible, randomized trials are needed to determine whether DZRT use causally contributes to smoking cessation or is instead a marker of pre-existing quit attempts.

5. Conclusion

DZRT nicotine pouch use was common among adults in Abha City and was strongly and independently associated with current or former smoking status, younger age, male sex, and a favorable perception of nicotine-replacement products as a healthy alternative to smoking. Among users with a smoking history, former smokers reported markedly higher rates of successful cessation than current smokers. Gastrointestinal and psychological symptoms were the most frequently reported adverse effects. Given the cross-sectional design, these associations should not be interpreted as evidence of a causal cessation benefit; longitudinal and controlled studies are needed to clarify the long-term safety and true effectiveness of DZRT nicotine pouches as a smoking-cessation aid.

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Conflict of Interest

The authors declare no competing interests.

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