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Factors associated with khat chewing and tobacco smoking among adult household members in Somaliland using multilevel analysis of the 2020 Somaliland Health and Demographic Survey

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Abstract

Objectives

This study aimed to assess the prevalence, regional variation, and factors associated with smoking cigarettes/tobacco, chewing khat/miraa, and psychoactive substance use among adult household members in Somaliland.

Methods

A total of 5,993 adult household members aged 18 years and above were included. Cigarettes/tobacco smoking, chewing khat/miraa, and psychoactive substance use were examined as outcomes. Multilevel logistic regression was used to identify factors associated with each outcome, with results presented as adjusted odds ratios (AORs) and 95% confidence intervals (CIs). Statistical significance was set at $p < 0.05$.

Results

Khat/miraa chewing was significantly associated with sex and wealth. Females had lower odds of chewing than males (AOR = 0.01, $p < 0.001$), as did those in the highest wealth category compared with the lowest (AOR = 0.21, $p = 0.005$). Smoking was significantly associated with sex, wealth, and region. Females had lower odds of smoking than males (AOR = 0.02, $p < 0.001$), while those in the highest wealth category had lower odds than those in the lowest (AOR = 0.26, $p = 0.006$). Compared with Awdal, lower odds of smoking were observed in Marodijeh (AOR = 0.91, $p = 0.021$), Togdheer (AOR = 0.49, $p < 0.001$), Sool (AOR = 0.39, $p < 0.001$), and Sanaag (AOR = 0.44, $p < 0.001$).

Conclusion

These findings highlight the importance of targeted, region-specific interventions to reduce substance use among high-risk populations.

1.0 Introduction

Substance use refers to the intake of psychoactive substances, including alcohol, tobacco products, inhalants, illicit drugs, and other substances that enter the body through various routes inhaled, injected, or absorbed and may lead to dependence and other harmful consequences (Centers for Disease Control and Prevention, 2024a). According to Galea et al. (2004), substance use continues to contribute substantially to illness, mortality, and social and economic costs despite ongoing efforts to reduce the use of legal substances and prevent illicit drug use. In sub-Saharan Africa, substance use among

adolescents was 32.8% for alcohol use, 23.5% for tobacco product use, and 22.0% for khat use (Olawole-Isaac et al., 2018).

Khat (*Catha edulis*), locally known as "Qaad" or "Jaad," is a plant whose fresh green leaves are chewed for their stimulant effects. Khat is widely consumed in Somalia, Madagascar, Tanzania, Kenya, Djibouti, and Yemen (Elmi, 1983). Historically, khat chewing was uncommon in Hargeisa during the early 1950s. Although the British Administration prohibited khat and implemented measures to prevent its illegal importation, these efforts were unsuccessful, and khat use gradually increased over time (Elmi, 1983). Numan (2012) reported that khat leaves are primarily chewed for cultural and stimulant purposes. From the perspective of khat users, khat is often perceived as a food rather than a drug and is generally believed not to pose health risks, while many users also do not consider it to be addictive (Douglas et al., 2011).

Several studies have identified a range of demographic and socioeconomic factors associated with khat chewing. Regarding gender differences in the prevalence of khat chewing, previous studies have consistently reported that khat chewing is more prevalent among males than females (Alsanosy et al., 2013a, 2013b; Kinoti et al., 2011; Rather et al., 2021). Similarly, being male has been associated with higher odds of khat chewing compared with being female (Alsanosy et al., 2013b; Kassa et al., 2017; Rather et al., 2021). Previous studies on substance use have identified age, religion, marital status, and wealth index as significant factors associated with substance use (Fentaw et al., 2022). Consistent with these findings, studies specifically examining khat chewing have identified age, religion, and wealth index as significant factors associated with khat chewing (Akalu et al., 2020; Haile & Lakew, 2015; Tessema & Zeleke, 2020; Yitayih & van Os, 2021). Consistent with these findings, evidence from Somaliland also indicates that khat chewing is common. A study conducted in Hargeisa reported a khat use prevalence of 17.3% among study participants, with khat use being substantially less common among women (A. M. Ahmed et al., 2024). Likewise, another study conducted in Hargeisa found that 36.6% of men chewed khat, whereas only 0.3% of women chewed khat (S. H. Ahmed et al., 2019).

Another important psychoactive substance is tobacco, which refers to a plant-based product obtained from species within the Nicotiana genus (F. M. A. Ahmed & Peeran, 2016). Tobacco products encompass a wide range of products, including cigarettes, cigarette tobacco, roll-your-own tobacco, smokeless tobacco, electronic cigarettes, cigars, hookahs, pipe tobacco, nicotine gels, and dissolvable tobacco products (Centers for Disease Control and Prevention, 2024b). Among these tobacco products, the World Health Organization (2026) reported that cigarette smoking is the predominant form of tobacco use worldwide. Consequently, tobacco smoking was responsible for an estimated 7.69 million deaths globally in 2019 (GBD 2019 Tobacco Collaborators, 2021). Regarding gender differences in tobacco use, previous research across nine South and Southeast Asian countries has shown that smoking prevalence is substantially higher among men than women (Sreeramareddy et al., 2014). Likewise, another study conducted in Hargeisa reported a smoking prevalence of 12.4% among study participants, with smoking being substantially less common among women (A. M. Ahmed et al., 2024). Furthermore, evidence from Sreeramareddy et al. (2014) indicated that demographic and socioeconomic factors, including age,

education level, wealth index, religion, place of residence (urban/rural), and marital status were associated with tobacco smoking, although the magnitude and direction of these associations varied across countries.

There are no studies examining the factors associated with khat chewing and cigarette/tobacco smoking among adult household members in Somaliland. Therefore, considering the importance of understanding the socioeconomic and demographic factors associated with cigarette/tobacco smoking and chewing khat/miraa, this study aimed to examine the prevalence and determinants of khat chewing, cigarette/tobacco smoking, and psychoactive substance use among adult household members in Somaliland

2.0 Methods

2.1 Study Area

This study was conducted in Somaliland, which is located east Africa. Somaliland is geographically bordering Djibouti to the west, Ethiopia to the south and west and Somalia to the south. The land mass of Somaliland covers an area of 176,119 km^2 with six regions: Awdal, Marodijeh, Sahil, Togdheer, Sool, and Sanaag. As of 2020, the Somaliland population was estimated 4.2 million with the majority of the people primarily dependent on livestock for their livelihoods.

2.2 Data Source

Data for this study were retrieved and downloaded from the Ministry of Planning and National Development, which provides nationally representative data.

2.3 Study Design

This study employed cross-sectional quantitative research using Somaliland Health and Demographic Survey (SLDHS 2020). The data is a secondary that was nationally collected using CSPro Android platform by well-trained interviewers through face-to-face interviews with the respondents. The data provides questionnaires about the maternal mortality, household, ever-married and never-married woman to generate estimates at national and regional level.

2.4 Sampling Procedure

As shown in Fig. 1, the study employed a stratified multistage probability cluster sampling design. The sampling process involved two levels of stratification. First, the sample was stratified into six administrative regions (Awdal, Marodijeh, Sahil, Togdheer, Sool, and Sanaag). Second, each region was further stratified by place of residence into urban, rural, and nomadic areas, resulting in a total of 18 sampling strata (Somaliland Government & UNFPA, 2020).

For urban and rural areas, the sampling frame was constructed using Geographic Information System (GIS) technology, where Enumeration Areas (EAs) were delineated to include between 50 and 149

dwelling structures. A total of 2,806 EAs, also referred to as Primary Sampling Units (PSUs), were included in the final sampling frame, of which 1,869 were urban and 937 were rural. For the nomadic population, a separate sampling frame consisting of 1,448 Temporary Nomadic Settlements (TNS) was developed with the support of Nomadic Link Workers (NLWs) and community gatekeepers (clan elders). For urban and rural areas, a three-stage stratified cluster sampling design was employed. In the first stage, 35 EAs were selected from each stratum using probability proportional to size (PPS) based on the number of dwelling structures. A complete household listing was then conducted in each selected EA to obtain updated household counts. In the second stage, 10 Secondary Sampling Units (SSUs) were selected from the 35 listed EAs using PPS, based on the number of listed households. In the third stage, 30 households were systematically selected from each SSU to form the final sample for the survey.

For nomadic areas, a two-stage stratified cluster sampling design was applied. In the first stage, 10 Temporary Nomadic Settlements (TNS) were selected from each nomadic stratum using PPS based on the estimated number of households. In the second stage, a complete household listing was conducted in each selected TNS, followed by the systematic selection of 30 households for the main survey interview.

For the present secondary analysis, the household recode dataset of the SLHDS 2020 was used. The original household dataset contained 6,077 household members. The analysis was restricted to adult household members aged 18 years and above, while household members younger than 18 years were excluded. Consequently, the final analytic sample comprised 5,993 adult household members. All analyses were conducted using the sampling weights provided in the Somaliland Health and Demographic Survey (SLHDS) 2020. The weights were applied to account for unequal probabilities of selection and differential non-response arising from the complex multistage sampling design, thereby ensuring that the estimates were representative of the target population.

2.5 Study Variables

2.5.1 Outcome Variables

This study investigated cigarette/tobacco smoking and khat/miraa chewing as the primary outcomes, while psychoactive substance use was included as a secondary outcome. The dependent variables comprised cigarette/tobacco smoking, khat/miraa chewing, and overall psychoactive substance use. First, two individual binary outcome variables were considered: (1) cigarette/tobacco smoking and (2) khat/miraa chewing. Each was coded as "Yes" (1) if the respondent reported the behavior and "No" (0) otherwise. In addition, a composite binary variable representing overall psychoactive substance use was created by combining the two behaviors. Respondents who reported either cigarette/tobacco smoking or khat/miraa chewing were classified as psychoactive substance users ("Yes" = 1), whereas those reporting neither behavior were classified as non-users ("No" = 0). The composite variable was used to estimate the prevalence of psychoactive substance use and to examine its associated factors.

2.5.2 Explanatory variables

Previous studies have identified several demographic and socioeconomic factors associated with khat chewing, and cigarette/tobacco smoking, (Sreeramareddy et al., 2014; Yitayih & van Os, 2021). Building on previous evidence and considering the variables selected from the Somaliland Demographic and Health Survey dataset, this study included a range of individual- and community-level explanatory variables. The individual-level variables were sex of the household member, age of the household member (≥ 18 years), marital status, educational level, relationship to the household head, wealth index, age of the household head, family size, television ownership, mobile phone ownership, handwashing, and roofing material. The community-level variables comprised region and residence type (urban, rural, and nomadic). The conceptual framework of the explanatory variables is presented in Fig. 2

2.6 Data Analysis

The data were cleaned by checking for duplicate records and missing values before analysis. Missing data were handled using complete-case analysis, whereby observations with missing values for variables included in each analysis were automatically excluded. Also, no imputation methods were applied. The dataset was then exported from IBM SPSS Statistics version 20 to Stata version 16 for further analysis. Sampling weights were applied using the DHS household sample weight variable (HV005), which was normalized by dividing by 1,000,000 before analysis. The DHS complex survey design, including sampling weights, clustering at the primary sampling unit (PSU) level, and stratification, was accounted for in the analysis. Descriptive statistical analysis was used to summarize the characteristics of the adult household members.

Due to the hierarchical structure of the DHS data, where adult household members were nested within clusters, a multilevel mixed-effects logistic regression model with random intercepts was fitted to account for intra-cluster correlation and unobserved heterogeneity across clusters. The analysis was conducted using three separate models for cigarette/tobacco smoking, khat/miraa chewing, and overall psychoactive substance use. The random intercept model accounts for variation between clusters and is expressed as:

$$\text{logit}\left(P_{ij}\right) = \beta_0 + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \cdots + \beta_p X_{pij} + u_j$$

where P_{ij}denotes the probability of the outcome for adult household members i in cluster j, $\beta_0$is the overall intercept, $\beta_1, \beta_2, \ldots, \beta_p$ are fixed-effect coefficients for explanatory variables, and $u_j \sim N\left(0, \sigma_u^2\right)$ represents the cluster-specific random effect capturing unobserved heterogeneity between clusters.

Multicollinearity among explanatory variables was assessed using the Variance Inflation Factor (VIF), and all variables had VIF values less than 5, indicating no evidence of multicollinearity. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported, and statistical significance was declared at $p < 0.05$.

3.0 Results

Table 1 presents the weighted socio-demographic and household characteristics of the adult household members included in the study. Of the participants, 65.3% were male and 34.7% were female. Regarding household wealth, 35.6% of participants belonged to the lowest wealth index category, 10.4% to the second, 11.9% to the middle, 17.5% to the fourth, and 24.7% to the highest wealth index category. With respect to marital status, 82.2% of participants were married, 4.7% were divorced, 11.3% were abandoned or widowed, and 1.8% had never married. The mean age of household members was 45.15 years, while the mean age of household heads was 45.50 years. In addition, the average household size was 6.02 members. Regarding household assets, 70.5% of households did not own a television, whereas 29.5% owned one. In addition, 71.1% of household members owned a mobile phone, while 28.9% did not. For educational level, 35.1% had primary education, 46.0% had secondary education, 11.9% had Koranic education, and 7.1% did not know their highest level of education. Regarding relationship to the household head, 89.1% were immediate family members, 10.7% were extended family members, and 0.3% were non-relatives. Concerning household environmental characteristics, 65.0% of households did not have a cleansing agent available at the handwashing place, whereas 35.0% had a cleansing agent available. Most households (89.8%) had improved roofing materials, while 10.2% had unimproved roofing materials. With respect to place of residence, 48.6% of participants lived in urban areas, 26.3% lived in rural areas, and 25.1% lived in nomadic areas. Regionally, 34.4% resided in Marodijeh, 20.8% in Togdheer, 16.8% in Sanaag, 13.1% in Sool, 9.5% in Awdal, and 5.3% in Sahil.

Table 1
Socio-demographic and Household Characteristics of Adult Household Members

Variable	Category	Unweighted frequency (n)	Unweighted percentage (%)	Weighted count (n)	Weighted percentage (%)
Sex of household member	Male	4,004	66.81	3,912	65.29
	Female	1,989	33.19	2,079	34.71
Wealth index	Lowest	2,904	48.46	2,131	35.58
	Second	661	11.03	621.1	10.37
	Middle	744	12.41	709.7	11.85
	Fourth	883	14.73	1,048	17.49
	Highest	801	13.37	1,481	24.72
Marital status	Married	4,966	82.86	4,926	82.22
	Divorced	228	3.80	284.2	4.74
	Abandoned/Widowed	674	11.25	674.5	11.26
	Never married	125	2.09	106.2	1.77
Age of household members (years)	Mean (SE)	44.62 (15.59)	—	45.15 (0.31)	—
Age of household head (years)	Mean (SE)	45.39 (16.31)	—	45.50 (0.36)	—
Family size	Mean (SE)	5.78 (2.76)	—	6.02 (0.09)	—
Television ownership	No	5,056	84.41	4,219	70.47
	Yes	934	15.59	1,768	29.53
Mobile phone ownership	Yes	3,887	64.89	4,255	71.07
	No	2,103	35.11	1,732	28.93
Education level	Primary	612	38.06	700.8	35.06
	Secondary	594	36.94	918.8	45.96

Variable	Category	Unweighted frequency (n)	Unweighted percentage (%)	Weighted count (n)	Weighted percentage (%)
	Koranic	258	16.04	238.2	11.91
	Don't know	144	8.96	141.3	7.07
Relationship to household head	Immediate family	4,855	90.49	4,811	89.06
	Extended family	500	9.32	576.4	10.67
	Non-relative	10	0.19	14.5	0.27
Handwashing	No cleansing agent	3,684	70.74	3,326	64.96
	Cleansing agent present	1,524	29.26	1,795	35.04
Roofing material	Unimproved	771	12.87	611.2	10.20
	Improved	5,222	87.13	5,380	89.80
Residence type	Urban	1,780	29.70	2,913	48.63
	Rural	1,975	32.96	1,573	26.26
	Nomadic	2,238	37.34	1,504	25.11
Region	Awdal	839	14.00	566.3	9.45
	Marodijeh	778	12.98	2,063	34.44
	Sahil	778	12.98	317.0	5.29
	Togdheer	1,006	16.79	1,249	20.84
	Sool	1,258	20.99	787.1	13.14
	Sanaag	1,334	22.26	1,009	16.84

The prevalence of khat/miraa chewing was 23.77% (95% CI: 21.25%–26.49%), while the prevalence of cigarette/tobacco smoking was 17.71% (95% CI: 15.73%–19.87%). After combining adult household members who reported either cigarette/tobacco smoking or khat (miraa) chewing into a single indicator, the prevalence of overall psychoactive substance use was 25.31% (95% CI: 22.77%–28.03%).

Figure 3 shows the prevalence of khat/miraa chewing by region among adult household members in Somaliland. The highest prevalence was observed in Awdal (38.8%), followed by Sahil (35.9%) and Marodijeh (28.5%). The lowest prevalence was reported in Sool (12.9%), while Sanaag and Togdheer had prevalence estimates of 14.7% and 20.1%, respectively.

Figure 4 shows a comparable pattern for cigarette/tobacco smoking, with higher prevalence in Awdal (25.6%), Sahil (25.3%), and Marodijeh (18.9%), and lower prevalence in Togdheer (16.8%), Sanaag (14.2%) and Sool (11.9%),

Figure 5 indicates that psychoactive substance use is most prevalent in Awdal (40.7%), Marodijeh (29.7%), and Sahil (37.3%), while lower levels are observed in Togdheer (21.3%), Sanaag (17.2%), and Sool (14.2%).

Regarding chewing khat/miraa, sex of household member, wealth index, mobile phone ownership, education level, relationship to the household head, handwashing, roofing material, and region of residence were significantly associated with chewing khat/miraa. Female adult household members had significantly lower odds of chewing khat/miraa than males (AOR = 0.01, 95% CI [0.002, 0.07]). Compared with the lowest wealth category, adult household members in the second (AOR = 0.61, 95% CI [0.42, 0.88]), fourth (AOR = 0.36, 95% CI [0.17, 0.75]), and highest wealth categories (AOR = 0.21, 95% CI [0.07, 0.62]) had significantly lower odds of chewing khat/miraa, while the middle wealth category was not significantly associated. Adult household members living in households without a mobile phone had lower odds of chewing khat/miraa compared with those in households with a mobile phone (AOR = 0.68, 95% CI [0.48, 0.95]). Furthermore, education level was significantly associated with chewing khat/miraa; adult household members with secondary and higher education (AOR = 0.58, 95% CI [0.39, 0.85]), Koranic education (AOR = 0.60, 95% CI [0.36, 0.98]), and unknown education status (AOR = 0.48, 95% CI [0.24, 0.96]) had lower odds of chewing khat/miraa compared with those with primary or lower education. Regarding relationship to the household head, extended family members had lower odds of chewing khat/miraa than immediate family members (AOR = 0.71, 95% CI [0.61, 0.83]). Handwashing was also significantly associated with chewing khat/miraa; adult household members living in households with a cleansing agent for handwashing had lower odds of chewing khat/miraa (AOR = 0.60, 95% CI [0.47, 0.76]) compared with those living in households without a cleansing agent. Similarly, roofing material showed a significant association; adult household members living in households with improved roofing materials had higher odds of chewing khat/miraa (AOR = 2.20, 95% CI [1.22, 3.97]) than those living in households with unimproved roofing materials. Finally, regional differences were also observed. Compared with Awdal, adult household members residing in Marodijeh (AOR = 1.13, 95% CI [1.02, 1.25]) and Sahil (AOR = 1.30, 95% CI [1.01, 1.68]) had higher odds of chewing khat/miraa. In contrast, those residing in Togdheer (AOR = 0.29, 95% CI [0.24, 0.35]), Sool (AOR = 0.15, 95% CI [0.12, 0.19]), and Sanaag (AOR = 0.22, 95% CI [0.17, 0.29]) had lower odds.

Regarding smoking cigarettes/tobacco, sex of household member, wealth index, education level, relationship to the household head, handwashing, roofing material, and region of residence were significantly associated with smoking cigarettes/tobacco. Female adult household members had significantly lower odds of smoking cigarettes/tobacco than males (AOR = 0.02, 95% CI [0.01, 0.09]). Furthermore, wealth index was significantly associated with smoking cigarettes/tobacco; adult household members in the second (AOR = 0.68, 95% CI [0.48, 0.97]), middle (AOR = 0.51, 95% CI [0.32, 0.83]), fourth (AOR = 0.49, 95% CI [0.24, 0.98]), and highest wealth categories (AOR = 0.26, 95% CI [0.10,

0.68]) had lower odds of smoking cigarettes/tobacco compared with those in the lowest wealth category. In addition, education level was also significantly associated with smoking cigarettes/tobacco; adult household members with secondary and higher education had lower odds of smoking cigarettes/tobacco compared with those with primary or lower education (AOR = 0.52, 95% CI [0.35, 0.78]). Regarding relationship to the household head, extended family members had significantly lower odds of smoking cigarettes/tobacco than immediate family members (AOR = 0.71, 95% CI [0.59, 0.87]). Moreover, handwashing was significantly associated with smoking cigarettes/tobacco; adult household members living in households with a cleansing agent available for handwashing had lower odds of smoking cigarettes/tobacco compared with those living in households without a cleansing agent (AOR = 0.77, 95% CI [0.61, 0.96]). Similarly, roofing material showed a significant association, with adult household members living in households with improved roofing materials having higher odds of smoking cigarettes/tobacco (AOR = 1.61, 95% CI [1.16, 2.22]) compared with those living in households with unimproved roofing materials. Finally, region of residence was significantly associated with smoking cigarettes/tobacco. Compared with Awdal, adult household members residing in Marodijeh (AOR = 0.91, 95% CI [0.84, 0.99]), Togdheer (AOR = 0.49, 95% CI [0.39, 0.61]), Sool (AOR = 0.39, 95% CI [0.36, 0.43]), and Sanaag (AOR = 0.44, 95% CI [0.35, 0.55]) had lower odds of smoking cigarettes/tobacco.

Regarding psychoactive substance use, sex of household member, wealth index, mobile phone ownership, education level, relationship to the household head, handwashing, roofing material, and region of residence were significantly associated with psychoactive substance use. Female adult household members had significantly lower odds of psychoactive substance use than males (AOR = 0.01, 95% CI [0.00, 0.07]). Furthermore, wealth index was significantly associated with psychoactive substance use; compared with the lowest wealth category, adult household members in the second (AOR = 0.68, 95% CI [0.50, 0.92]), fourth (AOR = 0.36, 95% CI [0.22, 0.60]), and highest wealth categories (AOR = 0.22, 95% CI [0.09, 0.53) had lower odds of psychoactive substance use, while the middle wealth category was not significantly associated. Moreover, mobile phone ownership was also significantly associated with psychoactive substance use; adult household members living in households without a mobile phone had lower odds of psychoactive substance use compared with those living in households with a mobile phone (AOR = 0.64, 95% CI [0.49, 0.84]). Education level was significantly associated with psychoactive substance use; adult household members with secondary and higher education (AOR = 0.57, 95% CI [0.42, 0.78]), Koranic education (AOR = 0.62, 95% CI [0.40, 0.96]), and unknown education status (AOR = 0.49, 95% CI [0.25, 0.96], p = .036) had lower odds compared with those with primary or lower education. Regarding relationship to the household head, extended family members had significantly lower odds of psychoactive substance use than immediate family members (AOR = 0.72, 95% CI [0.64, 0.81]). Handwashing was also significantly associated with psychoactive substance use; adult household members living in households with a cleansing agent available for handwashing had lower odds of psychoactive substance use compared with those living in households without a cleansing agent (AOR = 0.60, 95% CI [0.47, 0.77]). In contrast, adult household members living in households with improved roofing materials had higher odds of psychoactive substance use compared with those living in households with unimproved roofing materials (AOR = 1.76, 95% CI [1.16, 2.66]).

Finally, region of residence was significantly associated with psychoactive substance use. Compared with Awdal, adult household members residing in Togdheer (AOR = 0.28, 95% CI [0.22, 0.35]), Sool (AOR = 0.16, 95% CI [0.13, 0.21]), and Sanaag (AOR = 0.24, 95% CI [0.19, 0.31]) had lower odds of psychoactive substance use.

Table 2

Multivariable multilevel logistic regression analysis of factors associated with chewing khat/miraa, smoking cigarettes/tobacco, and psychoactive substance use among adult household members in Somaliland

Variable / Category	Chew Khat/Miraa AOR (95% CI), p-value	Smoke Cigarettes/Tobacco AOR (95% CI), p-value	Any psychoactive Substance Use AOR (95% CI), p-value
Sex of household member			
Male	Ref	Ref	Ref
Female	0.01 (0.002–0.07), p < .001	0.02 (0.01–0.09), p < .001	0.01 (0.00–0.07), p < .001
Wealth index			
Lowest	Ref	Ref	Ref
Second	0.61 (0.42–0.88), p = .009	0.68 (0.48–0.97), p = 0.034	0.68 (0.50–0.92), p = .011
Middle	0.60 (0.30–1.21), p = .151	0.51 (0.32–0.83), p = .006	0.60 (0.34–1.07), p = .082
Fourth	0.36 (0.17–0.75), p = .006	0.49 (0.24–0.98), p = .045	0.36 (0.22–0.60), p < .001
Highest	0.21 (0.07–0.62), p = .005	0.26 (0.10–0.68), p = .006	0.22 (0.09–0.53), p = .001
Marital status			
Married	Ref	Ref	Ref
Divorced	0.81 (0.07–9.29), p = .865	0.79 (0.06–10.50), p = .861	0.70 (0.07–7.15), p = .767
Abandoned/Widowed	------	------	------
Never Married	0.76 (0.36–1.60), p = .468	2.24 (0.73–6.83), p = .157	0.98 (0.37–2.60), p = .975
Age of household members	1.01 (1.00–1.03), p = .147	1.00 (1.00–1.01), p = .272	1.01 (0.99–1.02), p = .247
Age of household head	0.99 (0.99–1.00), p = .713	1.00 (0.99–1.01), p = .644	1.00 (1.00–1.01), p = .134
Family size	0.99 (0.92–1.08), p = .864	1.04 (0.91–1.19), p = .559	1.00 (0.93–1.08), p = .953
Television ownership			
No	Ref	Ref	Ref

Variable / Category	Chew Khat/Miraa AOR (95% CI), p-value	Smoke Cigarettes/Tobacco AOR (95% CI), p-value	Any psychoactive Substance Use AOR (95% CI), p-value
Sex of household member			
Yes	1.90 (0.80–4.52), p = .148	1.40 (0.57–3.47), p = .462	1.72 (0.86–3.47), p = .127
Mobile phone ownership			
Yes	Ref	Ref	Ref
No	0.68 (0.48–0.95), p = .024	0.88 (0.61–1.28), p = .509	0.64 (0.49–0.84), p = .002
Education level			
Primary and lower	Ref	Ref	Ref
Secondary and higher	0.58 (0.39–0.85), p = .006	0.52 (0.35–0.78), p = .002	0.57 (0.42–0.78), p < .001
Koranic	0.60 (0.36–0.98), p = .042	0.43 (0.16–1.12), p = .084	0.62 (0.40–0.96), p = .030
Don't know	0.48 (0.24–0.96), p = .037	0.48 (0.22–1.03), p = .058	0.49 (0.25–0.96), p = .036
Relationship to household head			
Immediate family	Ref	Ref	Ref
Extended family	0.71 (0.61–0.83), p < .001	0.71 (0.59–0.87), p = .001	0.72 (0.64–0.81), p < .001
Non-relative	1.99 (0.01–325.30), p = .792	------	1.74 (0.01–232.90), p = .825
Handwashing			
No cleansing agent	Ref	Ref	Ref
Cleansing agent present	0.60 (0.47–0.76), p < .001	0.77 (0.61–0.96), p = .020	0.60 (0.47–0.77), p < .001
Roofing material			
Unimproved	Ref	Ref	Ref
Improved	2.20 (1.22–3.97), p = .009	1.61 (1.16–2.22), p = .004	1.76 (1.16–2.66), p = .007
Residence type			

Variable / Category	Chew Khat/Miraa AOR (95% CI), p-value	Smoke Cigarettes/Tobacco AOR (95% CI), p-value	Any psychoactive Substance Use AOR (95% CI), p-value
Sex of household member			
Urban	Ref	Ref	Ref
Rural	1.05 (0.47–2.35), p = .910	0.91 (0.51–1.62), p = .747	0.95 (0.43–2.11), p = .907
Nomadic	0.99 (0.34–2.95), p = 1.000	0.86 (0.39–1.90), p = .709	0.95 (0.37–2.45), p = .917
Region			
Awdal	Ref	Ref	Ref
Marodijeh	1.13 (1.02–1.25), p = .024	0.91 (0.84–0.99), p = .021	1.04 (0.96–1.13), p = .320
Sahil	1.30 (1.01–1.68), p = .043	1.12 (0.88–1.43), p = .351	1.25 (0.99–1.57), p = .057
Togdheer	0.29 (0.24–0.35), p < .001	0.49 (0.39–0.61), p < .001	0.28 (0.22–0.35), p < .001
Sool	0.15 (0.12–0.19), p < .001	0.39 (0.36–0.43), p < .001	0.16 (0.13–0.21), p < .001
Sanaag	0.22 (0.17–0.29), p < .001	0.44 (0.35–0.55), p < .001	0.24 (0.19–0.31), p < .001

Table 3 summarizes the model fit statistics and variance components for the multilevel logistic regression models examining chewing khat/miraa, smoking cigarettes/tobacco, and psychoactive substance use among adult household members. The corresponding Akaike Information Criterion (AIC) values were 1500.465 for chewing khat/miraa, 1369.509 for smoking cigarettes/tobacco, and 1553.876 for psychoactive substance use, while the Bayesian Information Criterion (BIC) values were 1525.985 for chewing khat/miraa, 1395.017 for smoking cigarettes/tobacco, and 1584.501 for psychoactive substance use. The intraclass correlation coefficients (ICCs) indicated that the residual clustering attributable to differences between regions was negligible for chewing khat/miraa (ICC = 6.20×10^{-38}), smoking cigarettes/tobacco (ICC = 6.86×10^{-39}), and psychoactive substance use (ICC = 2.18×10^{-35}). These findings suggest that, after accounting for the fixed effects and the nested residence-type random effect, very little unexplained variation remained at the regional level. In contrast, the ICCs for residence type nested within region were 0.032 for chewing khat/miraa, 0.013 for smoking cigarettes/tobacco, and 0.032 for psychoactive substance use. These values indicate modest clustering of the outcomes among adult household members living in the same residence type within a region. Specifically, the clustering was greater for chewing khat/miraa and psychoactive substance use (3.2%) than for smoking cigarettes/tobacco (1.3%). Although the magnitude of clustering was relatively small, the findings

indicate that residence type explained more of the remaining between-group variation than region, supporting the inclusion of the nested random-effects structure in the multilevel models.

Table 3
Model fit statistics and intraclass correlation coefficients (ICCs) for multilevel logistic regression models

Statistic	Chew Khat/Miraa	Smoke Cigarettes/Tobacco	Psychoactive Substance Use
Log likelihood	-745.232	-679.755	-770.938
Degrees of freedom (df)	5	5	6
Akaike Information Criterion (AIC)	1500.465	1369.509	1553.876
Bayesian Information Criterion (BIC)	1525.985	1395.017	1584.501
Intraclass Correlation Coefficient (ICC)			
Region	6.20×10^{-38}	6.86×10^{-39}	2.18×10^{-35}
Residence type within region	0.032	0.013	0.032

4.0 Discussion

In this study, the prevalence of chewing khat/miraa among adult household members in Somaliland was 23.8%. The prevalence of chewing khat/miraa was lower than the 58% reported by Rather et al. (2021) but higher than the 15.3% reported among adults in Ethiopia (Haile & Lakew, 2015). In terms of smoking cigarettes/tobacco, the prevalence observed in the current study was 17.7%, which was higher than the 12.24% prevalence of smoking reported by Moradi et al. (2021). The prevalence of psychoactive substance use was 25.3%, which was lower than the 46.74% reported among youth in Ethiopia by Kassew et al. (2023). The difference in prevalence may be partly explained by variations in the study populations and outcome definitions.

The multilevel multivariable logistic regression model demonstrated that sex of household member, wealth index, mobile phone ownership, education level, relationship to household head, handwashing, roofing material, and region were significantly associated with chewing khat/miraa. Regarding sex, the present study found that female adult household members had significantly lower odds of chewing khat/miraa than males. This finding is consistent with a study among undergraduate students at Jimma University in Ethiopia, which reported that male students had higher odds of current khat chewing than females (Abdeta et al., 2017). Regarding wealth index, adult household members in the second, fourth, and highest wealth categories had significantly lower odds of chewing khat/miraa than those in the lowest wealth category. In contrast, a study among women in Ethiopia reported significantly higher odds of khat chewing among women in the poorer, middle, richer, and richest wealth categories than among

those in the poorest wealth category (Yitayih & van Os, 2021). Regarding relationship to the household head, the current study found a significant association with chewing khat/miraa. In contrast, a previous study did not find a significant association between relationship to the household head and khat chewing (Yitayih & van Os, 2021). This discrepancy may be explained by differences in the study populations, household structure, and sociocultural contexts between Somaliland and Ethiopia. Regarding education level, the present study found that adult household members with secondary and higher education, Koranic education, and those whose educational level was unknown had significantly lower odds of chewing khat/miraa than those with primary education or lower. In contrast, a study among men in Ethiopia found no significant association between educational level and khat chewing, with primary, secondary, and higher education showing no significant differences compared with men who were unable to read and write (Tessema & Zeleke, 2020). This discrepancy may be explained by differences in the study populations, educational classifications, and the cultural acceptance of khat chewing between Somaliland and Ethiopia. The present study also identified significant associations between mobile phone ownership, roofing material, and the availability of a cleansing agent for handwashing and chewing khat/miraa. To the best of our knowledge, previous studies have not examined the associations between these household factors and chewing khat/miraa. Furthermore, region was significantly associated with chewing khat/miraa, with significant differences observed in Marodijeh, Sahil, Togdheer, Sool, and Sanaag compared with Awdal. Similarly, regional variations in khat chewing have been reported among male adults in Ethiopia, where khat chewing differed significantly across regions (Akalu et al., 2020). This regional variation suggests that chewing khat may vary within countries according to regional characteristics.

For smoking cigarettes/tobacco, significant associations were observed with sex of household member, wealth index, education level, relationship to household head, handwashing practices, roofing material, and region among adult household members in Somaliland. Female adult household members had significantly lower odds of smoking cigarettes/tobacco than males in the present study. Similarly, a study among adolescents in India found that females had significantly lower odds of current cigarette smoking than males (Kishun et al., 2021). Regarding wealth index, the present study found that adult household members in the second, middle, fourth, and highest wealth categories had significantly lower odds of smoking cigarettes/tobacco than those in the lowest wealth category. This finding is consistent with a previous study conducted among women of reproductive age in Iran, which reported lower odds of tobacco smoking among individuals in higher wealth categories compared with those in the poorest wealth category (Moradi et al., 2021). Furthermore, adult household members with secondary and higher education had lower odds of smoking cigarettes/tobacco than those with primary and lower education. This finding is consistent with previous research from India among individuals aged 15 years and older, which showed that the odds of tobacco use increased as education level declined across different categories of tobacco use (Prabhakar et al., 2012). The present study further identified significant associations between relationship to the household head, roofing material, and availability of a cleansing agent for handwashing and smoking cigarettes/tobacco. To the best of our knowledge, limited studies have examined these characteristics in relation to smoking cigarettes/tobacco. Furthermore, regional

variation was observed in smoking cigarettes/tobacco use among adult household members in Somaliland. Compared with Awdal, significant differences were observed in Marodijeh, Togdheer, Sool, and Sanaag, while Sahil did not differ significantly. Similarly, regional variations in cigarette smoking have been reported among women of reproductive age in Nigeria, where smoking patterns differed significantly across regions, with women in the South-South region having higher odds of cigarette smoking compared with those in the South-East region (Ogbuabor et al., 2023). These findings suggest that smoking may vary within countries according to regional characteristics.

In terms of psychoactive substance use, statistically significant associations were observed with sex of household member, education level, wealth index, mobile phone ownership, handwashing, roofing material, relationship to household head, and region. Regarding sex, the present study found that female adult household members had significantly lower odds of psychoactive substance use than males. This finding is consistent with a study among adolescents in Yemen, which also reported higher khat use and cigarette smoking among males compared with females (Al-Maweri et al., 2024). The lower prevalence of substance use among females may be related to cultural norms, social restrictions, and differences in exposure opportunities between males and females. Regarding education level, the present study found that adult household members with secondary and higher education had significantly lower odds of psychoactive substance use compared with those with primary and lower education. This finding differs from previous research among youth in Ethiopia, which reported no significant association between educational attainment and substance use (Kassew et al., 2023). The differences may be related to variations in study populations, outcome definitions, and contextual factors influencing substance use behaviors. With respect to wealth index, the present study found that the second, fourth, and highest wealth categories were significantly associated with lower odds of psychoactive substance use compared with the lowest category. This finding differs from a previous study that reported no significant relationship between wealth index and substance use (Kassew et al., 2023). The variation may be attributed to differences in study populations, substance-use patterns, and socioeconomic contexts. In terms of mobile phone ownership, the present study found a significant association with psychoactive substance use. This finding is consistent with Girma et al. (2020), who reported that access to media, including newspaper/magazine reading, radio listening, television viewing, internet use, and mobile phone ownership, was significantly associated with polysubstance use among males in Ethiopia. Furthermore, the present study identified regional variation in psychoactive substance use among adult household members in Somaliland. Compared with Awdal, significant differences were observed in Togdheer, Sool, and Sanaag. Similarly, a study among males in Ethiopia by Girma et al. (2020) reported significant regional variations in polysubstance use across different regions. These findings suggest that substance use may vary within countries according to regional characteristics. The present study also found that handwashing, roofing material, and relationship to the household head were significantly associated with psychoactive substance use. To the best of our knowledge, limited studies have examined these characteristics in relation to psychoactive substance use

Although the data were collected at the national level with a large sample size, the study has several limitations. First, the cross-sectional design limits the ability to establish causal relationships between

variables. Second, the study may be subject to self-reporting bias, as some respondents may underreport psychoactive substance use due to social desirability or stigma. Finally, not all types of psychoactive substances were included, as the study focused only on the most common substances khat/miraa and cigarettes/tobacco within the Somaliland context.

5.0 Conclusion and recommendations

The findings of this study highlight the burden of chewing khat/miraa, smoking cigarettes/tobacco, and overall psychoactive substance use among adult household members in Somaliland. For chewing khat/miraa, sex of the household member, wealth index, mobile phone ownership, education level, relationship to the household head, handwashing, roofing material, and region were significantly associated with chewing khat/miraa. Moreover, smoking cigarettes/tobacco was significantly associated with sex of household members, wealth index, education level, relationship to the household head, handwashing, roofing material, and region, while any psychoactive substance use was significantly associated with sex of household members, wealth index, mobile phone ownership, education level, relationship to the household head, handwashing, roofing material, and region. These findings demonstrate the importance of individual, household, socioeconomic, and geographical factors in shaping substance-use behaviors. Coordinated interventions involving communities, healthcare providers, and policymakers are needed, with prevention and awareness programs targeting vulnerable socioeconomic groups and high-risk regions to reduce substance use in Somaliland.

Declarations

Ethics Approval

This study used secondary data from the 2020 Somaliland Demographic and Health Survey (SDHS). The original survey received ethical approval from the relevant ethical review committees, and informed consent was obtained from all survey participants before data collection. The dataset used in this study was anonymized and obtained from the Ministry of Planning and National Development for secondary analysis. No additional ethical approval was required for this secondary data analysis.

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Data Availability Statement

The data used in this study were obtained from the Ministry of Planning and National Development of Somaliland. The 2020 Somaliland Demographic and Health Survey database is available at: https://www.somalilandcsd.org/somaliland-health-and-demography-survey-slhd2020/.

Ethics approval and consent to participate: Not applicable. Secondary data were used.

Clinical trial number: not applicable.

Consent to Participate declaration: not applicable.

Consent to Publish declaration: not applicable.

Conflict of Interest

Authors declare no conflict of interest.

Author Contributions

UHA: conceptualization, data curation, methodology, statistical analysis, interpretation of results, writing – original draft, and writing – review and editing.

AO: methodology, statistical analysis, interpretation of results, writing – original draft, and writing – review and editing.

JM: supervision, methodology, data curation, validation of statistical approach, interpretation of results, writing – original draft, and writing – review and editing.

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Figures

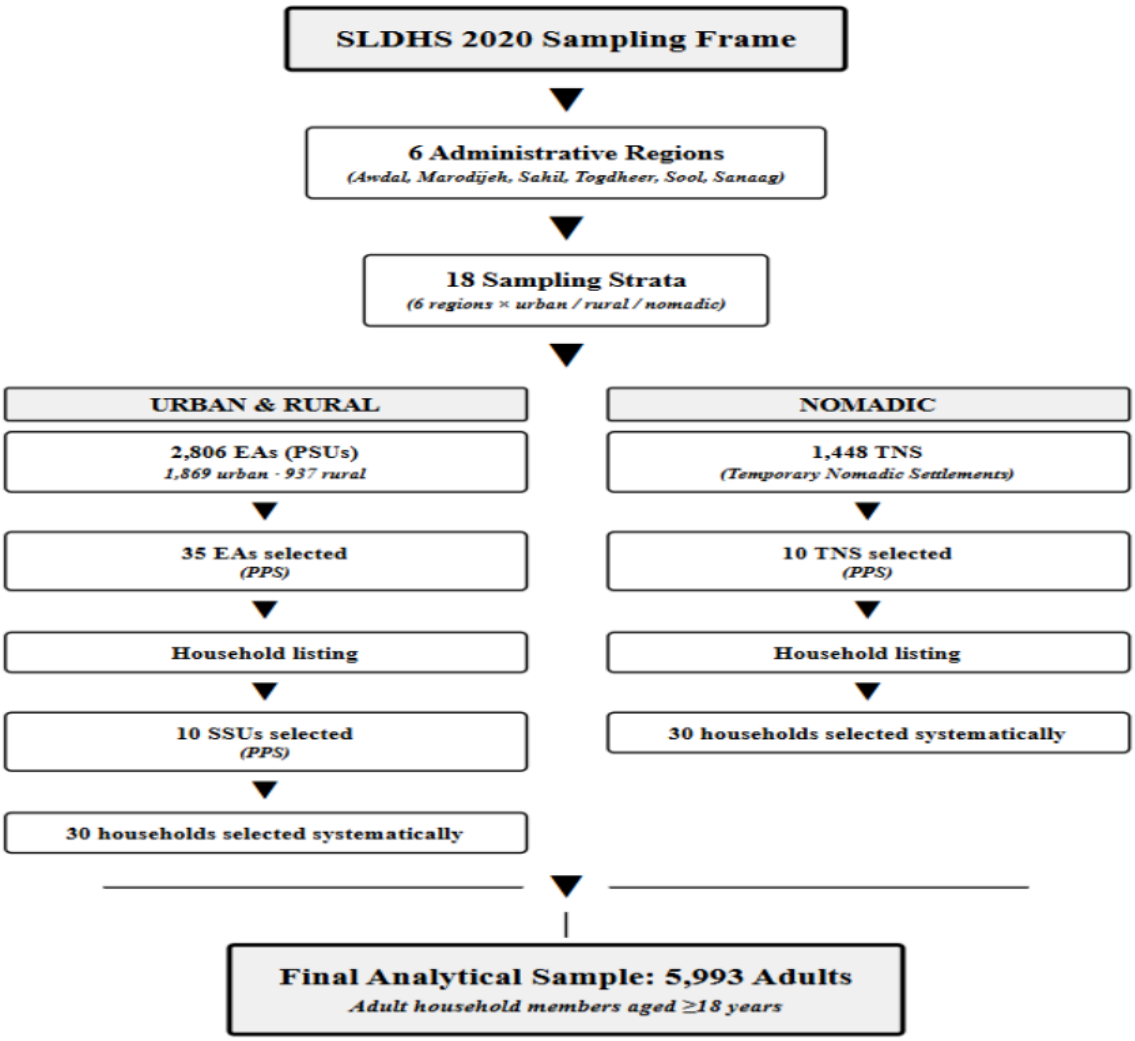


Figure 1

Sampling Procedure

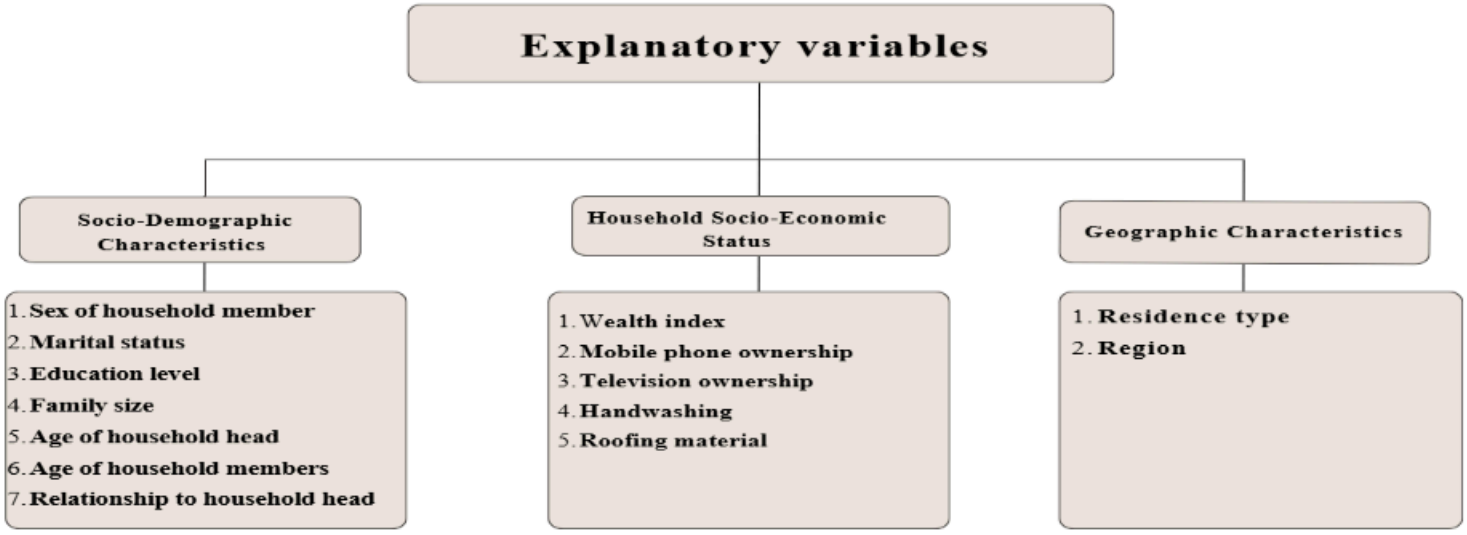


Figure 2

Conceptual framework of the explanatory variables

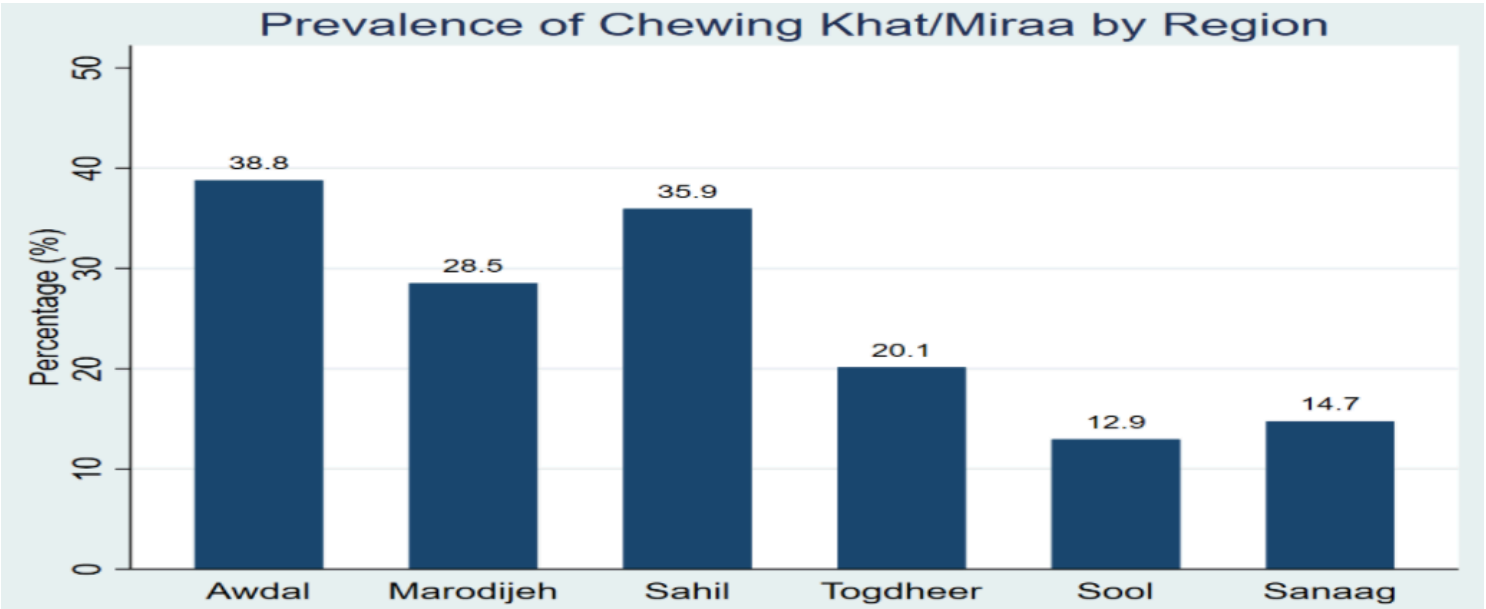


Figure 3

Prevalence of khat/miraa chewing

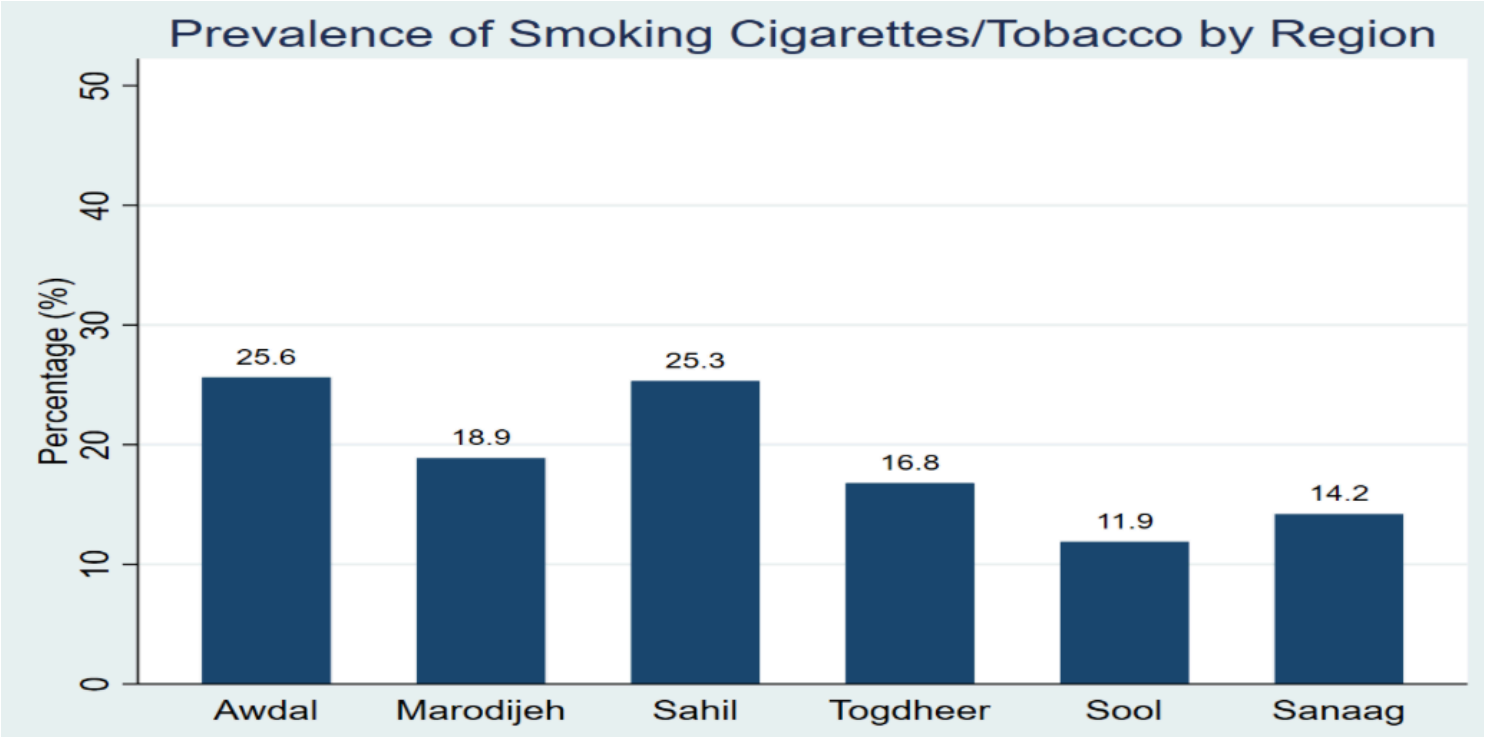


Figure 4

Prevalence of smoking cigarettes/tobacco use

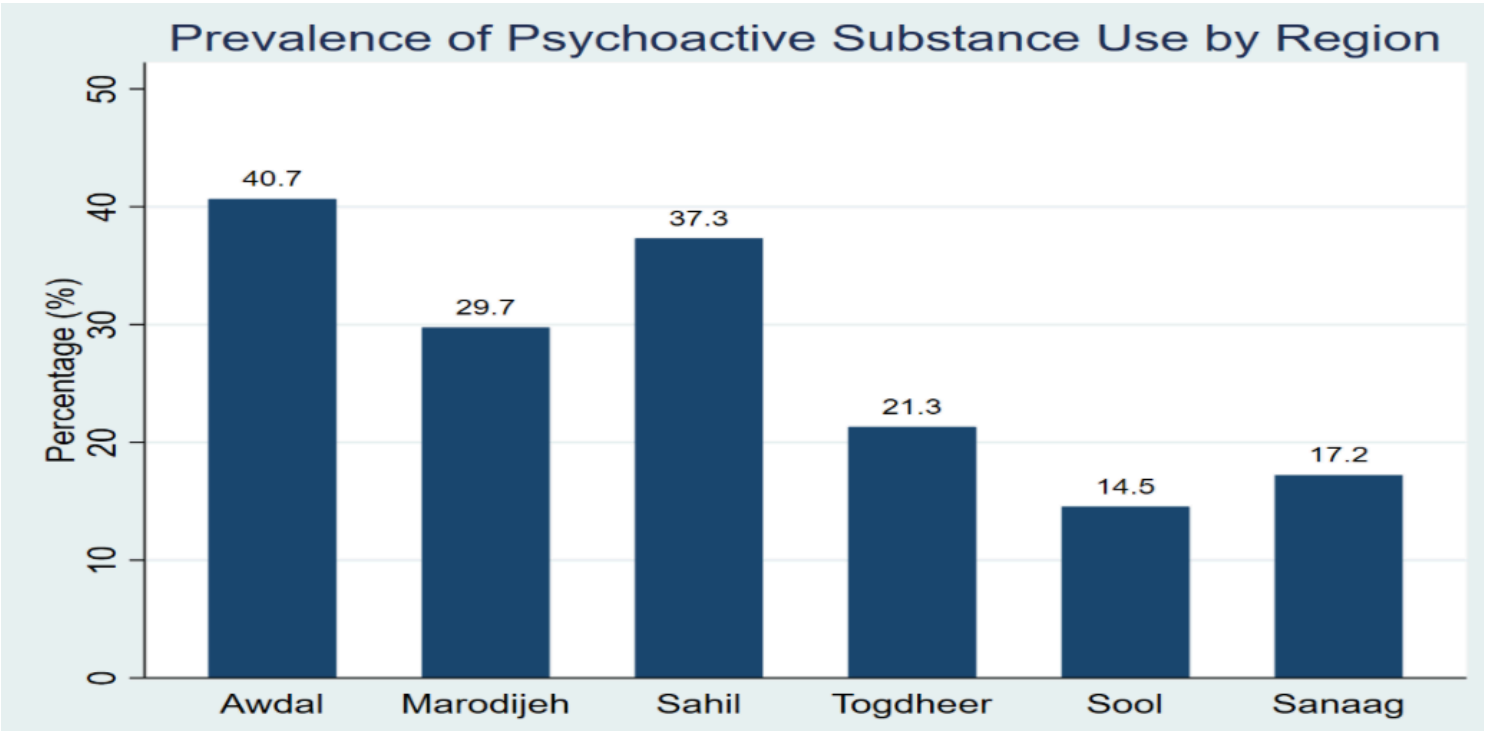


Figure 5

Prevalence of psychoactive substance use