

Tobacco marketing exposure and engagement profiles among Moroccan adolescents and their association with tobacco product use: A secondary dataset analysis of the Morocco Global Youth Tobacco Survey 2016

Abdelfettah El-Ammari^{1,2}, Abdelghaffar El-Ammari³, Salma Ghofrane Moutawakkil¹, Hicham El Malki¹, Hicham El Kazdoui⁴, Btissame Zarrouq^{1,2}

AFFILIATION

1 Laboratory of Epidemiology and Research in Health Sciences, Faculty of Medicine, Pharmacy, and Dental Medicine, Sidi Mohamed Ben Abdellah University, Fez, Morocco

2 Laboratory of Scientific Innovation in Sustainability, Environment, Education, and Health in the Era of Artificial Intelligence, Ecole Normale Supérieure, Sidi Mohamed Ben Abdellah University, Fez, Morocco

3 National School of Public Health, Rabat, Morocco

4 Regional Center for Education and Training Professions, Tanger, Morocco

CORRESPONDENCE TO

Abdelfettah El-Ammari. Laboratory of Epidemiology and Research in

Popul. Med. 2026;8(3):15

Health Sciences, Faculty of Medicine, Pharmacy, and Dental Medicine, Sidi Mohamed Ben Abdellah University, Fez, Morocco

E-mail: abdelfettah.elammari@usmba.ac.ma

ORCID iD: <https://orcid.org/0009-0003-1809-6178>

KEYWORDS

adolescents, tobacco use, Global Youth Tobacco Survey, latent class analysis, Morocco

Received: 2 June 2026, **Revised:** 7 July 2026, **Accepted:** 13 July 2026

<https://doi.org/10.18332/popmed/225698>

ABSTRACT

INTRODUCTION Tobacco use often begins during adolescence, and tobacco marketing contact occurs through multiple channels that may cluster into distinct patterns of exposure and engagement. This study aimed to characterize patterns of tobacco marketing exposure and engagement among Moroccan adolescents using latent class analysis (LCA) and to examine their associations with tobacco product use.

METHODS This was a secondary dataset analysis of the 2016 Morocco Global Youth Tobacco Survey (GYTS), a nationally representative, school-based survey conducted in Morocco among school-going adolescents. The analytic sample included 3614 adolescents with complete data on the latent class indicators. LCA was used to identify distinct exposure and engagement classes; models with 2–7 classes were compared using information criteria, entropy, goodness-of-fit statistics, and interpretability. Differences across classes were assessed using chi-squared tests. Associations between class membership and tobacco use (cigarette use, smoked tobacco other than cigarettes, and smokeless tobacco use)

were examined using binary logistic regression, reporting Model A (sociodemographic and socioeconomic covariates) and Model B (Model A plus peer influence).

RESULTS Among 3614 adolescents, a three-class solution was retained: media depiction exposure (66.60%), media and point of sale exposure (24.71%), and multimodal exposure and engagement (8.69%). Compared with the reference class, the multimodal class was consistently associated with higher odds of tobacco use across products in Model B (cigarette: AOR=3.70; 95% CI: 1.86–7.38, $p<0.001$; other smoked: AOR=2.14; 95% CI: 1.11–4.13, $p<0.05$; smokeless: AOR=1.95; 95% CI: 1.04–3.67, $p<0.05$), whereas the media and point-of-sale exposure class did not differ significantly.

CONCLUSIONS These findings highlight heterogeneous tobacco marketing exposure and engagement patterns and suggest the need for continued monitoring, particularly at points of sale and through indirect promotional channels. Longitudinal studies are needed to clarify temporal relationships with tobacco product use.

INTRODUCTION

Tobacco use remains a major global public health problem, causing approximately 8 million deaths each year and disproportionately affecting low- and middle-income countries, including Morocco^{1,2}. Tobacco use often begins

during adolescence, a developmental period marked by heightened sensitivity to social influence and experimentation with risk behaviors^{3,4}. Early initiation is associated with a greater likelihood of nicotine dependence and continued use into adulthood; therefore, identifying factors that shape

adolescents' susceptibility to tobacco products remains a priority for prevention and tobacco-control research³⁻⁶.

Tobacco marketing is one such factor. International evidence indicates that exposure to tobacco advertising, promotion, and sponsorship is associated with tobacco initiation and progression among young people. Marketing contact occurs through multiple channels, including point-of-sale (POS) displays, branded items, direct promotional offers, entertainment media depictions, and increasingly digital environments⁵⁻¹⁰.

Importantly, these indicators do not all measure the same construct: portrayals of tobacco use in television, videos, or movies capture exposure to tobacco imagery rather than direct advertising⁷, whereas owning tobacco-branded items or being offered free products reflects promotional engagement and direct marketing contact. Likewise, willingness to use or wear branded items may reflect receptivity to marketing rather than exposure alone^{11,12}. Considering these measures jointly as tobacco marketing exposure and engagement may therefore better reflect adolescents' real-world marketing contact than single-channel indicators^{7,11,12}.

To the best of our knowledge, evidence remains limited on how different forms of tobacco marketing exposure and engagement cluster among Moroccan adolescents. Existing studies have commonly assessed exposure at the level of individual channels using binary measures or basic scoring indices, which may overlook the complexity of real-world marketing contact, where adolescents experience overlapping patterns of exposure, receptivity, and engagement across channels and in varying combinations^{7,13,14}. A person-centered approach, such as latent class analysis (LCA), can help identify subgroups of adolescents with similar response patterns across multiple indicators¹⁵⁻¹⁷, thereby characterizing distinct marketing exposure and engagement profiles and examining how these profiles relate to cigarette use, other smoked tobacco use, and smokeless tobacco use^{13-15,18}.

Accordingly, this study aimed to identify latent classes of tobacco marketing exposure and engagement among Moroccan adolescents using data from the 2016 Morocco Global Youth Tobacco Survey (GYTS) and to examine sociodemographic differences across classes. We further assessed associations between latent class membership and current use of cigarettes, other smoked tobacco products, and smokeless tobacco after adjusting for potential confounders. Finally, the study identifies multidimensional patterns of tobacco marketing exposure and engagement, including media portrayals, POS exposure, receptivity, and promotional engagement, using LCA, and examines how these patterns are associated with tobacco use among adolescents.

METHODS

Data source

This was a secondary dataset analysis of the 2016 Morocco GYTS, a nationally representative, school-based survey

conducted in Morocco among school-going adolescents. The present analysis included students with complete data on the latent class indicators, resulting in an analytic sample of 3614 participants. The GYTS is conducted within the Global Tobacco Surveillance System (GTSS)¹⁹ and applies a standardized protocol for questionnaire design, sampling, and data collection to generate comparable estimates of tobacco-related indicators among school-going adolescents. The survey uses a two-stage cluster sampling design (schools, then classes) and an anonymous, self-administered questionnaire. Although the GYTS primarily targets students aged 13–15 years, the class-based sampling approach may include some respondents outside this age range; therefore, age distribution is reported accordingly¹⁹. Although a more recent GYTS was conducted in Morocco in 2023, the corresponding individual-level microdata were not publicly available at the time of this study; therefore, the 2016 GYTS remains the most recent publicly accessible individual-level dataset suitable for this analysis.

Study variables and measurement

Indicator variables

Five GYTS items were used as latent class indicators of tobacco marketing exposure and engagement. The first item assessed exposure to tobacco use in media: 'During the past 30 days, did you see any people using tobacco on TV, in videos, or in movies?' with responses coded as 1 (Yes) and 2 (No). The second item assessed POS exposure: 'During the past 30 days, did you see any advertisements or promotions for tobacco products at points of sale, such as stores, shops, or kiosks?' with responses coded as 1 (Yes) and 2 (No). The third item assessed receptivity to branded items: 'Would you ever use or wear something that has a tobacco company or tobacco product name or picture on it, such as a lighter, t-shirt, hat, or sunglasses?' with responses coded as 1 (Yes), 2 (Maybe), and 3 (No). The fourth item assessed ownership of tobacco-branded items: 'Do you have something, for example a t-shirt, pen, or backpack, with a tobacco product brand logo on it?' with responses coded as 1 (Yes) and 2 (No). The fifth item assessed direct promotional contact: 'Has a person working for a tobacco company ever offered you a free tobacco product?' with responses coded as 1 (Yes) and 2 (No).

Sociodemographic and tobacco use variables

The analysis included sociodemographic and socioeconomic covariates as well as tobacco use outcomes. Covariates comprised sex, age group, area of residence, parents' employment, father's and mother's education levels, father's and mother's jobs, parental tobacco smoking status, and weekly spending money. The three tobacco use outcomes were past-30-day cigarette use, past-30-day use of smoked tobacco products other than cigarettes, and past-30-day use of smokeless tobacco products, each coded as a binary variable. Detailed coding and categories of these variables are provided in [Supplementary file Table S1](#).

Statistical analysis

Descriptive statistics were used to summarize the analytic sample. All variables summarized in the descriptive analysis were categorical, including sociodemographic characteristics and tobacco use outcomes, and were presented as frequencies and percentages. Denominators varied because of item-level non-response.

LCA was used to identify distinct profiles of tobacco marketing exposure and engagement based on adolescents' responses to the five indicator items. LCA classifies individuals into mutually exclusive latent classes that summarize common response patterns across multiple indicators. Models with increasing numbers of classes, from two to seven, were estimated. Model selection was informed by a combination of fit indices, including AIC, BIC, CAIC, and ABIC, as well as entropy, goodness-of-fit statistics (G2 and Pearson χ^2), class sizes, and interpretability. Given the large sample size, greater weight was placed on BIC, CAIC, ABIC, and classification quality, as assessed by entropy, when choosing the final solution. To reduce the risk of local maxima, models were re-estimated, and the solution with the highest log-likelihood was retained. The LCA output provided posterior class-membership probabilities and a most-likely class assignment.

Differences in sociodemographic characteristics and tobacco use across latent classes were assessed using chi-squared tests. Associations between latent class membership and each tobacco use outcome – cigarette use, smoked tobacco products other than cigarettes, and smokeless tobacco use – were examined using binary logistic regression. For multivariable models, candidate covariates were identified from bivariate analyses; variables with $p \leq 0.20$ were retained for adjustment. Area was forced into the models regardless of its bivariate p -value to improve comparability with prior literature and to control for potential contextual confounding. To address potential overadjustment, we reported two models: Model A, adjusted for sociodemographic and socioeconomic covariates, and Model B, additionally adjusted for peer influence, a psychosocial factor that may lie on the causal pathway between marketing exposure and engagement and tobacco use. All analyses were performed using Jamovi version 2.3.28. Statistical significance was set at $p < 0.05$.

Ethics

This study relied on data from the GYTS, a national survey conducted by Morocco's Ministry of Health. As the anonymized dataset is publicly available for academic or research use, no additional ethical review was required¹⁹.

RESULTS

Descriptive results

Of the 3915 participants in the 2016 Morocco GYTS, 3614 were included after excluding respondents with missing data on at least one latent class indicator. The sample was nearly

Table 1. Sociodemographic characteristics and tobacco use among a national sample of Moroccan school-going adolescents, Global Youth Tobacco Survey 2016 (N=3614)

Characteristics	n (%)
Sex (N=3605)	
Female	1845 (51.18)
Male	1760 (48.82)
Residence (N=3588)	
Rural	640 (17.84)
Urban	2948 (82.16)
Age (years) (N=3605)	
≤13	1404 (38.95)
14–15	1729 (47.96)
≥16	472 (13.09)
Parents employed (N=3425)	
Both	924 (26.98)
One	2501 (73.02)
Father's education level (N=2995)	
No formal schooling	543 (18.13)
Primary school	684 (22.84)
Secondary school	685 (22.87)
Post-secondary	1083 (36.16)
Mother's education level (N=3201)	
No formal schooling	992 (30.99)
Primary school	620 (19.37)
Secondary school	806 (25.18)
Post-secondary	783 (24.46)
Father's job (N=3589)	
Falah	396 (11.03)
Traditional maker	839 (23.38)
Official	1906 (53.11)
Temporary worker	303 (8.44)
Without work	145 (4.04)
Mother's job (N=3587)	
Falah	84 (2.34)
Traditional maker	173 (4.82)
Official	765 (21.33)
Temporary worker	186 (5.19)
Without work	2379 (66.32)
Parental tobacco smoking (N=3420)	
None	2776 (81.17)
Both	61 (1.78)
One	583 (17.05)

Continued

Table 1. Continued

Characteristics	n (%)
Weekly spending money (Dirhams) (N=3598)	
No spending money	675 (18.76)
≤100	2706 (75.21)
>100	217 (6.03)
Cigarette use last 30 days (N=3537)	
No	3459 (97.79)
Yes	78 (2.21)
Smoked tobacco products other than cigarettes use last 30 days (N=3551)	
No	3458 (97.38)
Yes	93 (2.62)
Smokeless tobacco products use the last 30 days (N=3531)	
No	3425 (97.00)
Yes	106 (3.00)

100 Moroccan dirhams is approximately US\$11.

balanced by sex (51.18% female) and predominantly urban (82.16%). Although the GYTS targets adolescents aged 13–15 years, the class-based sampling approach may include some respondents outside this age range; accordingly, 13.09% of the analytic sample were aged ≥16 years. Additional sociodemographic variables are detailed in Table 1.

Selection of model and latent class description

Model-fit statistics for latent class solutions with two to seven classes are presented in Table 2. Competing models were compared using information criteria (AIC, BIC, CAIC, ABIC), entropy, goodness-of-fit statistics (G2 and Pearson

χ^2), class sizes, and interpretability. As shown in Table 2, BIC (16379), CAIC (16399), and ABIC (16316) reached their minimum values for the three-class solution, which also yielded the highest entropy (0.81), indicating the best classification quality. Although AIC was marginally lower for the 4- and 6-class solutions, these models showed substantially lower entropy and less clearly separated class profiles. Considering parsimony, interpretability, and classification performance, the three-class model was retained as the most appropriate representation of tobacco marketing exposure and engagement patterns in this sample.

The distribution of probabilities of latent classes (LC) in Table 3 highlighted a substantial predominance of LC1 (66.60%), followed by LC2 (24.71%), while LC3 (8.69%) was the least represented in the sample.

LC1 includes adolescents with moderate exposure to tobacco depictions in TV/videos/movies [probability, Pr(Yes)=0.61] and near-zero POS exposure [Pr(Yes)=0.01], with consistently low probabilities for promotional engagement indicators [willingness: Pr(Yes)=0.02; ownership: Pr(Yes)=0.02; free offer: Pr(Yes)=0.02]. This profile reflects a predominantly media-based exposure pattern with minimal retail or promotional contact. Based on this response pattern, we labeled this group as ‘media depiction exposure’.

LC2 includes adolescents with high exposure to tobacco depictions in TV/videos/movies (Pr(Yes)=0.84) and very high exposure to tobacco marketing at POS [Pr(Yes)=0.98], while probabilities of promotional engagement remained low [willingness: Pr(Yes)=0.02; ownership: Pr(Yes)=0.04; free offer: Pr(Yes)=0.04]. This pattern reflects primarily passive exposure through media and retail environments with limited direct promotional contact. We therefore labeled this class ‘media and POS exposure’.

LC3 includes adolescents with higher probabilities across multiple indicators, including exposure to tobacco depictions in TV/videos/movies [Pr(Yes)=0.71], exposure at POS [Pr(Yes)=0.45], and notably higher promotional engagement [willingness: Pr(Yes)=0.53; ownership: Pr(Yes)=0.67; free offer:

Table 2 . Model fit statistics for two- to seven-class latent class solutions among a national sample of Moroccan school-going adolescents, Global Youth Tobacco Survey 2016 (N=3614)

Number of classes	LL	AIC	BIC	CAIC	ABIC	Entropy	G2*
2	-8190	16406	16486	16499	16445	0.65	227.70
3	-8108	16255	16379	16399	16316	0.81	63.25
4	-8099	16253	16420	16447	16334	0.44	46.90
5	-8095	16258	16468	16502	16360	0.49	37.82
6	-8086	16253	16507	16548	16377	0.56	19.17
7	-8083	16261	16559	16607	16406	0.53	13.30

LL: log-likelihood. AIC: Akaike information criterion. BIC: Bayesian information criterion. CAIC: consistent Akaike information criterion. ABIC: adjusted Bayesian information criterion. *Maximum likelihood-ratio test. The selected solution is highlighted in bold.

Table 3. Item-response probabilities conditional on latent class membership for the three-class model of tobacco marketing exposure and engagement among a national sample of Moroccan school-going adolescents, Global Youth Tobacco Survey 2016 (N=3614)

Modes of exposure/engagement to tobacco marketing	Categories	Media depiction exposure (LC1)	Media and POS exposure (LC2)	Multimodal exposure and engagement (LC3)
Latent class, n (%)		2407 (66.60)	893 (24.71)	314 (8.69)
TV, videos, movies	Yes	0.61	0.84	0.71
	No	0.39	0.16	0.29
POS	Yes	0.01	0.98	0.45
	No	0.99	0.02	0.55
Ever worn or used a tobacco-branded item	Yes	0.02	0.02	0.53
	Maybe	0.10	0.15	0.34
	No	0.88	0.83	0.13
Own tobacco-branded item	Yes	0.02	0.04	0.67
	No	0.98	0.96	0.33
Tobacco company worker's offer	Yes	0.02	0.04	0.31
	No	0.98	0.96	0.69

LC: latent class.

Table 4. Sociodemographic characteristics and tobacco use by latent class membership, based on chi-squared tests, among a national sample of Moroccan school-going adolescents, Global Youth Tobacco Survey 2016 (N=3614)

Characteristics	Media depiction exposure (LC1) n (%)	Media and POS exposure (LC2) n (%)	Multimodal exposure and engagement (LC3) n (%)	p
Sex (N=3605)				<0.001
Female	1328 (55.31)	404 (45.29)	113 (36.22)	
Male	1073 (44.69)	488 (54.71)	199 (63.78)	
Residence (N=3588)				<0.001
Rural	497 (20.81)	94 (10.56)	49 (15.81)	
Urban	1891 (79.19)	796 (89.44)	261 (84.19)	
Age (years) (N=3605)				0.001
≤13	936 (39.00)	357 (40.07)	111 (35.35)	
14–15	1155 (48.12)	435 (48.82)	139 (44.27)	
≥16	309 (12.88)	99 (11.11)	64 (20.38)	
Parents employed (N=3425)				0.244
Both	591 (26.08)	244 (28.50)	89 (29.37)	
One	1675 (73.92)	612 (71.50)	214 (70.63)	
Father's education level (N=2995)				0.003
No formal schooling	389 (19.64)	107 (14.42)	47 (17.28)	
Primary school	476 (24.03)	151 (20.35)	57 (20.96)	
Secondary school	425 (21.45)	192 (25.88)	68 (25.00)	
Post-secondary	691 (34.88)	292 (39.35)	100 (36.76)	

Continued

Table 4. Continued

Characteristics	Media depiction exposure (LC1) n (%)	Media and POS exposure (LC2) n (%)	Multimodal exposure and engagement (LC3) n (%)	p
Mother's education level (N=3201)				<0.001
No formal schooling	727 (34.36)	199 (24.81)	66 (23.32)	
Primary school	405 (19.14)	150 (18.70)	65 (22.97)	
Secondary school	502 (23.72)	226 (28.18)	78 (27.56)	
Post-secondary	482 (22.78)	227 (28.31)	74 (26.15)	
Father's job (N=3589)				<0.001
Falah	289 (12.10)	77 (8.69)	30 (9.55)	
Traditional maker	570 (23.86)	196 (22.12)	73 (23.25)	
Official	1212 (50.73)	529 (59.71)	165 (52.55)	
Temporary worker	213 (8.92)	62 (7.00)	28 (8.92)	
Without work	105 (4.39)	22 (2.48)	18 (5.73)	
Mother's job (N=3587)				0.102
Falah	60 (2.51)	15 (1.69)	9 (2.91)	
Traditional maker	105 (4.39)	44 (4.97)	24 (7.77)	
Official	489 (20.44)	208 (23.48)	68 (22.01)	
Temporary worker	127 (5.31)	45 (5.08)	14 (4.53)	
Without work	1611 (67.35)	574 (64.78)	194 (62.78)	
Parental tobacco smoking (N=3420)				<0.001
None	1900 (83.40)	683 (80.35)	193 (66.10)	
Both	22 (0.97)	17 (2.00)	22 (7.53)	
One	356 (15.63)	150 (17.65)	77 (26.37)	
Weekly spending money (Dirhams) (N=3598)				<0.001
No spending money	490 (20.44)	131 (14.74)	54 (17.31)	
≤100	1788 (74.60)	693 (77.95)	225 (72.11)	
>100	119 (4.96)	65 (7.31)	33 (10.58)	
Cigarette use last 30 days (N=3537)				<0.001
No	2338 (98.73)	864 (98.07)	257 (89.24)	
Yes	30 (1.27)	17 (1.93)	31 (10.76)	
Smoked tobacco products other than cigarettes use last 30 days (N=3551)				<0.001
No	2321 (97.89)	865 (98.18)	272 (90.97)	
Yes	50 (2.11)	16 (1.82)	27 (9.03)	
Smokeless tobacco products use the last 30 days (N=3531)				<0.001
No	2306 (97.92)	850 (96.92)	269 (89.97)	
Yes	49 (2.08)	27 (3.08)	30 (10.03)	

Table 5. Adjusted associations between latent class membership and tobacco use outcomes using binary logistic regression, Model A and Model B, among a national sample of Moroccan school-going adolescents, Global Youth Tobacco Survey 2016 (N=3614)

Characteristics	Cigarette use		Smoked tobacco other than cigarettes		Smokeless tobacco	
	Model A	Model B	Model A	Model B	Model A	Model B
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Sex (N=3605)						
Female (ref.)	1	1	1	1	1	1
Male	2.37 (1.28–4.40)**	2.58 (1.33–4.99)**	1.92 (1.12–3.29)*	1.95 (1.11–3.41)*	1.89 (1.15–3.11)*	1.97 (1.18–3.30)**
Residence (N=3588)						
Rural (ref.)	1	1	1	1	1	1
Urban	1.52 (0.69–3.33)	1.48 (0.64–3.43)	1.63 (0.83–3.21)	1.74 (0.86–3.53)	1.15 (0.61–2.17)	1.25 (0.64–2.45)
Age (years) (N=3605)						
≤13 (ref.)	1	1	1	1	1	1
14–15	2.47 (1.09–5.59)*	1.93 (0.82–4.51)	2.40 (1.16–4.93)*	2.39 (1.11–5.18)*	1.40 (0.79–2.48)	1.27 (0.70–2.29)
≥16	7.04 (2.90–17.10)***	4.52 (1.78–11.52)**	4.15 (1.87–9.23)***	3.38 (1.43–8.00)**	2.24 (1.13–4.46)*	1.90 (0.92–3.92)
Father's education level (N=2995)						
No formal schooling (ref.)	1	1	1	1	1	1
Primary school	0.99 (0.45–2.20)	0.86 (0.36–2.06)	1.51 (0.74–3.06)	1.47 (0.70–3.07)	0.56 (0.27–1.14)	0.54 (0.26–1.13)
Secondary school	0.49 (0.19–1.27)	0.39 (0.14–1.10)	0.84 (0.36–1.97)	0.78 (0.32–1.91)	0.59 (0.27–1.28)	0.56 (0.25–1.25)
Post-secondary	0.81 (0.29–2.24)	0.61 (0.20–1.80)	0.65 (0.24–1.81)	0.58 (0.20–1.67)	0.35 (0.14–0.88)*	0.30 (0.12–0.79)*
Mother's education level (N=3201)						
No formal schooling (ref.)	1	1	1	1	1	1
Primary school	1.25 (0.57–2.78)	1.04 (0.44–2.48)	1.09 (0.57–2.11)	0.89 (0.45–1.77)	1.85 (0.93–3.69)	1.73 (0.84–3.55)
Secondary school	1.81 (0.80–4.11)	1.46 (0.59–3.58)	0.88 (0.41–1.87)	0.60 (0.27–1.36)	1.59 (0.74–3.43)	1.44 (0.64–3.21)
Post-secondary	0.78 (0.25–2.48)	0.71 (0.21–2.36)	0.58 (0.20–1.72)	0.51 (0.17–1.56)	2.01 (0.78–5.18)	2.08 (0.79–5.47)
Weekly spending money (Dirhams) (N=3598)						
No spending money (ref.)	1	1	1	1	1	1
≤100	2.30 (0.79–6.68)	2.01 (0.67–6.04)	1.30 (0.60–2.83)	1.09 (0.49–2.41)	1.07 (0.55–2.10)	0.93 (0.47–1.86)
>100	6.01 (1.72–21.07)**	6.44 (1.71–24.21)**	4.62 (1.72–12.40)**	4.34 (1.55–12.17)**	2.16 (0.85–5.48)	1.95 (0.75–5.08)

Table 5. Continued

Characteristics	Cigarette use		Smoked tobacco other than cigarettes		Smokeless tobacco	
	Model A	Model B	Model A	Model B	Model A	Model B
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Parental tobacco smoking (N=3420)						
None (ref.)	1	1	1	1	1	1
Both	3.30 (0.86–12.69)	1.99 (0.48–8.34)	1.42 (0.31–6.53)	0.91 (0.19–4.35)	3.97 (1.40–11.24)**	2.73 (0.90–8.27)
One	1.75 (0.97–3.16)	1.41 (0.73–2.70)	1.26 (0.71–2.23)	0.98 (0.52–1.83)	1.48 (0.86–2.54)	1.29 (0.73–2.28)
Peer influence to use tobacco if offered by best friend (N=3600)						
Definitely not (ref.)	NC	1	NC	1	NC	1
Probably not	NC	6.60 (2.95–14.76)***	NC	3.97 (1.73–9.11)**	NC	2.77 (1.26–6.08)*
Probably yes	NC	15.95 (7.45–34.13)***	NC	12.28 (6.03–24.98)***	NC	7.57 (3.76–15.20)***
Definitely yes	NC	23.68 (8.06–69.58)***	NC	17.03 (6.18–46.92)***	NC	18.86 (7.25–49.09)***
Latent class membership (N=3614)						
Media depiction exposure (LC1) (ref.)	1	1	1	1	1	1
Media and POS exposure (LC2)	1.44 (0.72–2.87)	1.11 (0.53–2.34)	0.93 (0.49–1.77)	0.81 (0.41–1.58)	1.27 (0.72–2.23)	1.04 (0.58–1.88)
Multimodal exposure and engagement (LC3)	6.56 (3.49–12.35)***	3.70 (1.86–7.38)***	3.61 (1.98–6.58)***	2.14 (1.11–4.13)*	3.37 (1.89–6.00)***	1.95 (1.04–3.67)*

AOR: adjusted odds ratio. *p<0.05. **p<0.01. ***p<0.001. NC: not included in Model A. CI: confidence interval.

Pr(Yes)=0.31]. This pattern indicates multi-channel marketing contact combined with active engagement with tobacco branding and direct promotional contact. Accordingly, this class was labeled 'multimodal exposure and engagement'.

Sociodemographic and tobacco use disparities across latent classes

Latent classes differed significantly in several sociodemographic characteristics and tobacco use outcomes (Table 4). Male adolescents were more represented in the multimodal exposure and engagement class (LC3: 63.78%) than in the media and POS exposure class (LC2: 54.71%) and the media depiction exposure class (LC1: 44.69%; $p<0.001$). Adolescents aged ≥ 16 years were also more frequent in LC3 (20.38%) than in LC1 (12.88%) and LC2 (11.11%; $p=0.001$). Parental tobacco smoking was more common in LC3, particularly having one smoking parent (26.37%) or both parents smoking (7.53%), compared with LC1 (15.63% and 0.97%) and LC2 (17.65% and 2.00%; $p<0.001$). Weekly spending money above 100 Moroccan dirhams (approximately US\$11) was also highest in LC3 (10.58%) compared with LC1 (4.96%) and LC2 (7.31%; $p<0.001$). Tobacco use was consistently more prevalent in LC3: cigarette use was 10.76% in LC3 versus 1.27% in LC1 and 1.93% in LC2; other smoked tobacco use was 9.03% versus 2.11% and 1.82%; and smokeless tobacco use was 10.03% versus 2.08% and 3.08%, respectively (all $p<0.001$).

Association between tobacco use and latent class membership

Latent class membership was associated with tobacco use outcomes in adjusted analyses (Table 5). Using media depiction exposure (LC1) as the reference, adolescents in the multimodal exposure and engagement class (LC3) had higher odds of use across all products in Model A: cigarette use (AOR=6.56; 95% CI: 3.49–12.35), other smoked tobacco use (AOR=3.61; 95% CI: 1.98–6.58), and smokeless tobacco use (AOR=3.37; 95% CI: 1.89–6.00). After additionally adjusting for peer influence in Model B, these associations were attenuated but remained statistically significant (cigarette use: AOR=3.70; 95% CI: 1.86–7.38; other smoked tobacco use: AOR=2.14; 95% CI: 1.11–4.13; smokeless tobacco use: AOR=1.95; 95% CI: 1.04–3.67), suggesting that peer-related susceptibility may partially account for the observed differences between classes. In contrast, the media and POS exposure class (LC2) did not differ significantly from LC1 across outcomes in either model.

DISCUSSION

To the best of our knowledge, this is the first study in Morocco to apply LCA to characterize profiles of tobacco marketing exposure and engagement among adolescents using GYTS data. Three key findings emerged. First, we identified three distinct profiles that reflect heterogeneous patterns of marketing-related contact: media depiction

exposure, media and POS exposure, and multimodal exposure and engagement. Second, class membership differed across sociodemographic and family-context characteristics. Third, and most importantly, adolescents in the multimodal exposure and engagement class showed consistently higher odds of tobacco use across product types compared with the reference class, even after adjustment for sociodemographic and socioeconomic covariates.

This study demonstrated a significant association between the multimodal exposure and engagement class and tobacco use across products, with adolescents in this class showing consistently higher odds of use than those in the reference class, even after adjustment for sociodemographic and family-context covariates. These results are consistent with prior cross-sectional and longitudinal studies^{5,9,11,12,20–23}. In addition, a meta-analysis by Wellman et al.⁶ reported that exposure to pro-tobacco marketing and media was associated with higher odds of pro-tobacco attitudes among youth (OR=1.51) and more than doubled the odds of tobacco use initiation (OR=2.23). Importantly, associations attenuated after adding peer influence, suggesting that peer-related susceptibility may partially account for the observed differences between profiles, in line with previous evidence on the role of peer influence in adolescent smoking. However, given the cross-sectional design, this should be interpreted as potential explanatory overlap rather than mediation^{24–26}.

In response to this issue, Morocco enacted Law 15-91 in 1995, which prohibits tobacco advertising and promotion across multiple channels, including broadcast media and films, print media, and promotional displays at or around tobacco-selling locations, and restricts promotional activities linked to sports and public events^{27–30}. However, despite this legal framework, enforcement has been reported as inconsistent, and tobacco marketing can still reach adolescents through POS promotions, brand stretching via merchandise, and indirect or digital promotion (e.g. content in television/movies and social media)^{2,18,31–34}. In light of the observed association between the multimodal exposure and engagement class and tobacco use, continued monitoring of adolescents' exposure to tobacco marketing remains relevant, particularly at retail points of sale and through indirect promotional practices. However, because of the cross-sectional design, this study does not evaluate the effectiveness of enforcement measures or specific tobacco-control policies. Therefore, these implications should be interpreted cautiously and considered in light of the WHO FCTC Article 13 guidance^{2,28,35,36}.

Strengths and limitations

The study has some strengths. It drew on a large, nationally representative, school-based dataset, supporting population-level inference among Moroccan school-going adolescents. In addition, LCA provided a person-centered approach to capture co-occurring patterns of tobacco marketing exposure and engagement across multiple channels rather

than relying on single-item measures. The standardized GYTS methodology further supports cross-country comparability and population-level inference.

The study has several limitations. First, the measures relied on self-reported responses, which may be affected by recall or reporting bias, including potentially different recall of marketing-related contact among tobacco users versus non-users. Second, the cross-sectional design precludes establishing temporality, so findings should be interpreted as associations rather than causal effects. Third, this analysis used the 2016 GYTS dataset. Although this was the most recent publicly available individual-level GYTS dataset for Morocco at the time of the study, tobacco marketing strategies and adolescents' media environments have evolved since then, particularly with the expansion of digital and social media marketing. Consequently, the identified exposure and engagement profiles may not fully reflect current marketing practices or current adolescent exposure patterns. Finally, the indicator set does not fully capture contemporary digital marketing tactics and platform-specific advertising formats; future studies should incorporate more recent individual-level data, more detailed measures of online exposure and engagement, and, where feasible, longitudinal designs.

CONCLUSIONS

Three exposure and engagement classes were identified among Moroccan adolescents. Membership in the multimodal exposure and engagement class was associated with higher odds of cigarette, other smoked tobacco, and smokeless tobacco use. These associations weakened but remained significant after accounting for peer influence, suggesting that peer-related factors may partly overlap with marketing exposure and engagement. These findings suggest that continued attention to adolescents' exposure to tobacco marketing remains relevant, particularly at points of sale and through indirect promotional practices. Given the cross-sectional design, these results should be interpreted as associations rather than evidence of the effectiveness of specific interventions or tobacco-control policies. Future prevention efforts may benefit from addressing media literacy, peer influence, and refusal skills within school-based programs.

REFERENCES

1. World Health Organization. Tobacco and nicotine. Accessed July 13, 2026. <https://www.who.int/news-room/fact-sheets/detail/tobacco>
2. World Health Organization. WHO report on the global tobacco epidemic 2021: addressing new and emerging products; 2021. Accessed July 13, 2026. <https://www.who.int/publications/i/item/9789240032095>
3. St Claire S, Fayokun R, Commar A, Schotte K, Prasad VM. The World Health Organization's World No Tobacco Day 2020 campaign exposes tobacco and related industry tactics to manipulate children and young people and hook a new generation of users. *J Adolesc Health*. 2020;67(3):334-337. doi:[10.1016/j.jadohealth.2020.06.026](https://doi.org/10.1016/j.jadohealth.2020.06.026)
4. DeBry SC, Tiffany ST. Tobacco-induced neurotoxicity of adolescent cognitive development (TINACD): A proposed model for the development of impulsivity in nicotine dependence. *Nicotine Tob Res*. 2008;10(1):11-25. doi:[10.1080/14622200701767811](https://doi.org/10.1080/14622200701767811)
5. Lovato C, Linn G, Stead LF, Best A. Impact of tobacco advertising and promotion on increasing adolescent smoking behaviours. *Cochrane Database Syst Rev*. 2003;(4):CD003439. doi:[10.1002/14651858.CD003439](https://doi.org/10.1002/14651858.CD003439)
6. Wellman RJ, Sugarman DB, DiFranza JR, Winickoff JP. The extent to which tobacco marketing and tobacco use in films contribute to children's use of tobacco: A meta-analysis. *Arch Pediatr Adolesc Med*. 2006;160(12):1285-1296. doi:[10.1001/archpedi.160.12.1285](https://doi.org/10.1001/archpedi.160.12.1285)
7. National Cancer Institute. The Role of the Media in Promoting and Reducing Tobacco Use. National Cancer Institute, Division of Cancer Control and Population Sciences. Accessed July 13, 2026. <https://cancercontrol.cancer.gov/brp/tcrb/monographs/monograph-19>
8. Thomas D. L'enfant et l'adolescent, cibles de l'industrie du tabac. *Bull Académie Natl Médecine*. 2019;203(7):541-548. doi:[10.1016/j.banm.2019.05.017](https://doi.org/10.1016/j.banm.2019.05.017)
9. Pierce JP. Tobacco industry marketing, population-based tobacco control, and smoking behavior. *Am J Prev Med*. 2007;33(6 suppl):s327-s334. doi:[10.1016/j.amepre.2007.09.007](https://doi.org/10.1016/j.amepre.2007.09.007)
10. Centers for Disease Control and Prevention. Tobacco Industry Spending; 2023. Accessed July 13, 2026. https://www.cdc.gov/tobacco/data_statistics/fact_sheets/tobacco_industry/marketing/index.htm
11. Timberlake DS. Advertising receptivity and youth initiation of smokeless tobacco. *Subst Use Misuse*. 2016;51(9):1077-1082. doi:[10.3109/10826084.2016.1160115](https://doi.org/10.3109/10826084.2016.1160115)
12. Pierce JP, Sargent JD, White MM, et al. Receptivity to tobacco advertising and susceptibility to tobacco products. *Pediatrics*. 2017;139(6):e20163353. doi:[10.1542/peds.2016-3353](https://doi.org/10.1542/peds.2016-3353)
13. Peiper N, Aramburú C, Thompson K, Abadi M. Differential patterns of e-cigarette and tobacco marketing exposures among youth: Associations with substance use and tobacco prevention strategies. *Int J Drug Policy*. 2020;86:102925. doi:[10.1016/j.drugpo.2020.102925](https://doi.org/10.1016/j.drugpo.2020.102925)
14. Braun S, Kollath-Cattano C, Barrientos I, et al. Assessing tobacco marketing receptivity among youth: Integrating point of sale marketing, cigarette package branding and branded merchandise. *Tob Control*. 2016;25(6):648-655. doi:[10.1136/tobaccocontrol-2015-052498](https://doi.org/10.1136/tobaccocontrol-2015-052498)
15. Weller BE, Bowen NK, Faubert SJ. Latent Class Analysis: A Guide to Best Practice. *J Black Psychol*. 2020;46(4):287-311. doi:[10.1177/0095798420930932](https://doi.org/10.1177/0095798420930932)
16. Collins LM, Lanza ST. Latent class and latent transition analysis: With applications in the social, behavioral, and health sciences. John Wiley & Sons; 2009.
17. Karnowski V. Latent class analysis. In: J. Matthes, CS Davis, RF Potter, eds. *The International Encyclopedia of Communication Research Methods*. John Wiley & Sons Inc.; 2017.
18. Buying influence and advantage in Africa: An analysis of

- British American Tobacco's questionable payments. STOP. A Global Tobacco Industry Watchdog; 2021. Accessed July 13, 2026. <https://bat-uncovered.exposetobacco.org/wp-content/uploads/2021/09/Buying-Influence-Advantage-in-Africa.pdf>
19. World Health Organization. Global Youth Tobacco Survey 2016: Morocco 2016. Accessed July 13, 2026. <https://extranet.who.int/ncdsmicrodata/index.php/catalog/314/study-description>
 20. Tripathy JP, Lakshmi PVM. Patterns of exposure to smoked tobacco advertisements among youths in India and its association with smoked tobacco use: A Latent Class Analysis. *Public Health*. 2023;223:156-161. doi:[10.1016/j.puhe.2023.07.016](https://doi.org/10.1016/j.puhe.2023.07.016)
 21. Gentzke AS, Wang TW, Cornelius M, et al. Tobacco product use and associated factors among middle and high school students - National Youth Tobacco Survey, United States, 2021. *MMWR Surveill Summ*. 2022;71(5):1-29. doi:[10.15585/mmwr.ss7105a1](https://doi.org/10.15585/mmwr.ss7105a1)
 22. Arora M, Gupta VK, Nazar GP, Stigler MH, Perry CL, Reddy KS. Impact of tobacco advertisements on tobacco use among urban adolescents in India: Results from a longitudinal study. *Tob Control*. 2012;21(3):318-324. doi:[10.1136/tc.2010.040733](https://doi.org/10.1136/tc.2010.040733)
 23. Soneji S, Pierce JP, Choi K, et al. Engagement with online tobacco marketing and associations with tobacco product use among U.S. Youth. *J Adolesc Health*. 2017;61(1):61-69. doi:[10.1016/j.jadohealth.2017.01.023](https://doi.org/10.1016/j.jadohealth.2017.01.023)
 24. Villanti A, Boulay M, Juon HS. Peer, parent and media influences on adolescent smoking by developmental stage. *Addict Behav*. 2011;36(1-2):133-136. doi:[10.1016/j.addbeh.2010.08.018](https://doi.org/10.1016/j.addbeh.2010.08.018)
 25. Hall JA, Valente TW. Adolescent smoking networks: The effects of influence and selection on future smoking. *Addict Behav*. 2007;32(12):3054-3059. doi:[10.1016/j.addbeh.2007.04.008](https://doi.org/10.1016/j.addbeh.2007.04.008)
 26. Simons-Morton BG, Farhat T. Recent findings on peer group influences on adolescent smoking. *J Prim Prev*. 2010;31(4):191-208. doi:[10.1007/s10935-010-0220-x](https://doi.org/10.1007/s10935-010-0220-x)
 27. Ministère de la Justice. Ministry of Justice Morocco. Accessed July 13, 2026. <https://justice.gov.ma/>
 28. Kingdom of Morocco. Law No. 15-91 prohibiting smoking and tobacco advertising and promotion in certain places. Official Bulletin No. 4318. Accessed July 13, 2026. <https://assets.tobaccocontrollaws.org/uploads/legislation/Morocco/Morocco-Smoke-Free-Ads-Propaganda-native.pdf#page=6>
 29. Fondation Lalla Salma - Prévention et traitement des cancers: Le tabac en chiffres. Accessed July 13, 2026. <https://www.contreleancancer.ma/fr/le-tabac-en-chiffres>
 30. Site institutionnel du Haut-Commissariat au Plan du Royaume du Maroc. Accessed July 13, 2026. <https://www.hcp.ma/downloads/?tag=Derni%C3%A8res+parutions>
 31. Tobacco Tactics. The BAT Files: How British American Tobacco Bought Influence in Africa. Accessed July 13, 2026. <https://tobaccotactics.org/wiki/the-bat-files/>
 32. Crosbie E, Defrank V, Egbe CO, Ayo-Yusuf O, Bialous S. Tobacco supply and demand strategies used in African countries. *Bull World Health Organ*. 2021;99(7):539-540. doi:[10.2471/BLT.20.266932](https://doi.org/10.2471/BLT.20.266932)
 33. Jackson RR, Rowell A, Gilmore A. 'Unlawful Bribes?': A documentary analysis showing British American Tobacco's use of payments to secure policy and competitive advantage in Africa. Center for Tobacco Control Research and Education; 2021. Accessed July 13, 2026. <https://escholarship.org/uc/item/4qs8m106>
 34. Legresley E, Lee K, Muggli ME, Patel P, Collin J, Hurt RD. British American Tobacco and the 'insidious impact of illicit trade' in cigarettes across Africa. *Tob Control*. 2008;17(5):339-346. doi:[10.1136/tc.2008.025999](https://doi.org/10.1136/tc.2008.025999)
 35. World Health Organization. WHO Framework Convention on Tobacco Control. Accessed July 13, 2026. <https://iris.who.int/items/81d339dd-1df0-4b85-8cf1-7b862c40036a>
 36. James PB, Bah AJ, Kabba JA, Kassim SA, Dalinjong PA. Prevalence and correlates of current tobacco use and non-user susceptibility to using tobacco products among school-going adolescents in 22 African countries: A secondary analysis of the 2013-2018 global youth tobacco surveys. *Arch Public Health*. 2022;80(1):121. doi:[10.1186/s13690-022-00881-8](https://doi.org/10.1186/s13690-022-00881-8)

ACKNOWLEDGEMENTS

We would like to thank the students who participated in the GYTS in Morocco.

CONFLICTS OF INTEREST

The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

FUNDING

There was no source of funding for this research.

ETHICAL APPROVAL AND INFORMED CONSENT

Ethical approval and informed consent were not required for this study as it is a secondary analysis of existing data.

DATA AVAILABILITY

The data supporting this research are available from the following source: [WHO/GTSS microdata repository Morocco GYTS 2016](https://www.who.int/datasets/microdata/morocco-gyts-2016)¹⁹, subject to the provider's terms of use.

AUTHORS' CONTRIBUTIONS

AFE: study conception and design, data acquisition, data preparation and analysis, preparation of the first draft, editing of the manuscript, and preparation of the final draft. AGE: study conception and design, data analysis, and input to the first draft. SGM, HEM and HEK: study conception and design. BZ: study conception and design, revision of the manuscript. All authors read and approved the final version of the manuscript.

PROVENANCE AND PEER REVIEW

Not commissioned; externally peer-reviewed.

SUPPLEMENTARY FILE DISCLAIMER

The content has been provided by the author(s) and has not been reviewed, verified, or endorsed by European Publishing. It may not have undergone peer review. The views, opinions, and recommendations expressed are solely those of the author(s) and do not necessarily reflect the position of European Publishing. European Publishing accepts no responsibility or liability for any consequences arising from the use of, or reliance on, this content.