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Determinants of ever smoking and active smoking among school-aged children in Jeddah

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المخلص

أهداف البحث: قدرت هذه الدراسة انتشار وبحثت محددات التدخين المستمر والتدخين النشط بين الأطفال في سن المدرسة في جدة. هذه البيانات ضرورية لتطوير الاستراتيجيات الوقائية والتصحيحية المثلى للتدخين بين الشباب.

طرق البحث: أجريت دراسة مقطعية مدرسية في مدينة جدة، المملكة العربية السعودية، من سبتمبر 2020 إلى ديسمبر 2020. وشملت 6770 طفلاً في الصفوف من الرابع إلى الثاني عشر، تم اختيارهم من بين 60 مدرسة ابتدائية ومتوسطة وثانوية حكومية وخاصة. من خلال أخذ العينات العنقودية العشوائية متعددة المراحل. تم استخدام نسخة عربية من استبيان مسح التبغ العالمي للشباب لتقييم انتشار تعاطي التبغ والتنبؤ به.

النتائج: كان معدل انتشار التدخين على الإطلاق 14.1٪، وكان متوسط العمر الذي يدخن فيه الأطفال سيجارتهم الأولى أو يأخذون أي نقت 13.76 سنة. كان انتشار التدخين النشط 3.8٪، وكانت كميات وتواتر تدخين السجائر في الثلاثين يوماً الماضية بين المدخنين منخفضة نسبياً. وكانت أكثر منتجات التبغ استهلاكاً هي السجائر (47.2٪) والشيشة (42.9٪). في معظم الحالات، كان المدخنون النشطون يشتركون السجائر بأنفسهم من محلات البقالة أو المتاجر، أو يستلمونها من شخص قريب منهم. كان التدخين مرتبطاً بشكل مستقل بالعمر الأكبر سناً وجنس الذكر والمدارس الخاصة وحالة عمل الأم والتعرض للتدخين السلبي في الداخل أو في الهواء الطلق. ارتبط التدخين النشط بشكل مستقل بالعمر الأكبر سناً وجنس الذكور والمدارس الخاصة ومبلغ كبير من مصروف الجيب وسهولة الحصول على منتجات التبغ والتعرض للتدخين السلبي.

الاستنتاجات: تتوافق أنماط التدخين الملحوظة بين الأطفال في سن المدرسة في جدة مع التدخين العرضي، وكانت المحددات المتعلقة بالأسرة من العوامل الرئيسية المساهمة. تسلط النتائج الضوء على أهمية تنفيذ تدخلات الإقلاع عن التدخين وحملات التوعية، على مستوى المدرسة والمجتمع، لتحقيق أقصى فائدة.

الكلمات المفتاحية: أطفال؛ تدخين؛ مدرسة؛ تبغ؛ شباب؛ سعودي

Abstract

Objectives: This study estimated the prevalence and investigated the determinants of ever-smoking and active smoking among school-aged children in Jeddah. Such data are crucial for developing optimal preventive and corrective strategies to address smoking among youth.

Method: A school-based, cross-sectional study was conducted in Jeddah City, KSA, from September 2020 to December 2020. It included 6770 children attending grades 4–12, who were selected from 60 public and private elementary, middle, and secondary schools through multistage random-cluster sampling. An Arabic version of the Global Youth Tobacco Survey questionnaire was used to assess the prevalence and predictors of tobacco use.

Result: The prevalence of ever smoking was 14.1% (95% CI = 13.2–14.9%), and the mean age at which children smoked their first cigarette or took any puffs was 13.76 years (SD = 2.23). The prevalence of active smoking was 3.8% (95% CI = 3.3–4.3%), and the amounts and frequency of cigarettes smoked in the past 30 days among smokers were relatively low. The most commonly consumed tobacco products were cigarettes (47.2%) and hookah (42.9%). In most cases, active smokers bought cigarettes by themselves from groceries or convenience stores, or received them from a person to whom they were close. Ever smoking was independently associated with older age, male gender, private school, the mother's working status, and exposure to passive smoking indoors or outdoors. Active smoking was independently associated with older age, male gender, private school, a high amount of pocket money, perceived ease of obtaining tobacco products, and exposure to passive smoking.

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Conclusion: The observed smoking patterns among school-aged children in Jeddah corresponded to occasional smoking, and family-related determinants were significant contributors. The findings highlight the relevance of implementing smoking cessation interventions and awareness campaigns, at both the school and community levels, to achieve maximal benefit.

Keywords: Children; Saudi; School; Smoking; Tobacco; Youth

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Introduction

Smoking is considered an epidemic responsible for premature deaths: 1 in 10 people are estimated to die from smoke-associated health problems.¹ The various adverse health consequences of tobacco smoking and involve multiple organs and systems, including an elevated risk of sudden death and neurobehavioral disorders in children exposed to passive smoking.² The risk of alcohol and substance use is also higher among tobacco users than nonsmokers.³ Consequently, smoking and its associated health disorders pose a substantial financial burden on health care systems, with an estimated cost exceeding \$300 billion per year in the USA.⁴

Smoking in childhood is a gateway to adult smoking. Younger smokers are more likely to become regular adult smokers and are unlikely to quit.⁵ Youth exposed to secondhand smoking are more likely to start smoking than non-exposed youth,⁶ thus resulting in considerable health effects.^{7,8} In KSA, the overall prevalence of smoking ranges between 12% and 30%, and shows a substantial gender discrepancy.^{9,10} In younger groups, the prevalence of ever smoking and active smoking varies across regions. A survey from the Riyadh region has shown that 34.5% of male students 13–15 years of age have tried smoking at least once in their lifetime, and 10.8% are current smokers.¹¹ In Almadinah Almunawwarah, a higher prevalence (15%) of active smoking has been found among youth, reaching 21.3% in boys.¹² In Jazan, the overall prevalence of tobacco use by youth is 10.7%, and the prevalence is higher in boys (16.2%) than girls (3.8%).¹³ In the Jeddah region, a study published in 2013 including only male secondary schools has indicated a prevalence of active smoking as high as 37%.¹⁴

Several smoking cessation programs have successfully decreased the burden of smoking by increasing awareness, encouraging and assisting in smoking cessation, and promoting healthy lifestyles. Since the implementation of the WHO's Monitor, Protect, Offer, Warn, Enforce, Raise (MPOWER) program, the prevalence of smoking has markedly declined among individuals ≥ 16 years of age, particularly in high-income countries.¹⁵ Interventions may be most effective and of interest when implemented among youth, particularly to prevent the first exposure to cigarettes. A 1% decrease in the prevalence of smoking

among adolescents has been estimated to prevent approximately 44,318 individuals from becoming daily smokers globally and to decrease lifetime medical care costs by \$1.2 billion.¹⁶ KSA started an antismoking program started in 2002 and joined the WHO MPOWER program in 2005. Beyond stringent anti-smoking regulations, several initiatives have been undertaken, such as the implementation of taxation of tobacco products, with substantial taxation rates that resulted in a three-fold increase in the number of people seeking assistance for tobacco cessation. Other initiatives have included the establishment of approximately 160 smoking cessation clinics throughout the Kingdom, in which anti-smoking therapeutic and educational services are provided. More relevantly, a smart application was launched by the Saudi Government to report and monitor antismoking violators, including those related to the sale of tobacco products to children.¹⁷ Despite these measures, the rates of smoking continue to increase in the country,¹⁰ particularly among young age groups.¹⁵

To elucidate the mechanisms of smoking in children, to guide development of optimal preventive and corrective strategies, this study was aimed at estimating the prevalence, and investigating the determinants, of ever smoking and active smoking among school-aged boys and girls in Jeddah City.

Materials and Methods

Design and setting

A school-based, cross-sectional study was conducted in Jeddah City, KSA, between September 2020 and December 2020. Jeddah City is located in Makkah Province, in the western region of KSA, on the coast of the Red Sea. It has a total surface area of 1686 square kilometers and is the second most populated city in the Kingdom after the capital, Riyadh.¹⁸

Population

The study involved school-aged children and adolescents attending 4th to 12th grade classes in elementary, middle, or secondary schools in the City of Jeddah in any sectors, including private, government, and international schools. Students >18 years or <8 years of age, as well as those with intellectual disability or difficulty in understanding the questionnaires were excluded.

Sampling

Schools in KSA are divided by gender (male vs. female), status (governmental, private, and international), and level (elementary [4th to 6th grade], intermediate [7th to 9th], and secondary [10th to 12th]). In Jeddah City, schools are classified by geographic sectors, each under the direction of an Education Office (EO). Ten EOs exist in Jeddah: six for male schools and four for female schools.

A multistage stratified-cluster sampling method was used to achieve a sampling representative of all sectors and educational levels. Initially, within each of the ten EOs,

schools were stratified by status \times level ($3 \times 3 = 9$ strata), and one school (cluster) was randomly selected from each stratum, thus resulting in 90 schools (clusters). However, owing to very low participation from international schools, the stratification plan was reviewed to include only governmental and private schools, thereby resulting in six strata and participation of 60 schools, by keeping one school (cluster) from each stratum.

The target sample size was calculated at the EO level, and a potentially infinite number of students per EO was considered, to achieve maximal power. Using the Population Survey calculator from Epi Info version 7.2.5.0, to achieve 80% statistical power with a 5% margin of error in detecting unknown prevalence of ever smoking or smoking ($P = 50\%$) with a 95% confidence interval (95% CI), the target sample size per sector was estimated to be 384 students. Thus, the total required sample size was estimated to be $384 \times 10 = 3840$ participants, which was increased by 50% (target = 5760 participants) to account for potentially incomplete participation. Theoretically, $5760/10 = 576$ students from each EO, $576/6 = 96$ by stratum, and $96/3 = 32$ by grade would be enrolled. To achieve balanced representativeness by grade, a minimum of 25 students by grade by stratum was required.

Data collection

The study used the WHO Global Youth Tobacco Survey (GYTS) questionnaire, as provided by the Centers for Disease Control and Prevention.¹⁹ The original questionnaire comprised 43 items including a background section for demographics and school-associated data, as well as seven other domains. In the present study, only the background section and four domains (1, 2, 4, and 6) were used, in accordance with the study objectives: 1) knowledge of, and attitudes toward, smoking; 2) assessment of smoking and tobacco use; 4) youth access to cigarettes; and 6) environmental tobacco smoke. Additionally, a question was added to determine self-identified smoking status, including all tobacco types. The questionnaire was translated into the Arabic language and back-translated by two independent professional translators.

Pilot study

A pilot study was performed among 118 students to test the clarity of the questionnaire, and the responsiveness and engagement of the participants in completing the questionnaire. These 118 students were not included in the parent study.

Procedure

The GYTS questionnaire is designed for self-administration. Hence, the questionnaire was self-administered for reliability of the answers and to prevent social desirability bias. Additionally, because the study period coincided with COVID-19 restrictive measures, the questionnaire was administered online. The translated

version was edited electronically with an online platform (<https://nsbstat.com/surveys/>). Afterward, the link was disseminated to the targeted schools in coordination with the EOs, which transferred the link to all eligible students. Reminders were sent to schools on a regular basis to prompt participation. In the event of low participation from a sector (<576 students) or within a given grade (<25 students), after two reminders, a second school was randomly selected from the relevant sector, and so forth, until the target sample size was achieved for each sector and grade.

Ethical clearance

Parental consent was obtained from all participants by the school administrators. All data were collected by maintaining anonymity, confidentiality, and voluntary participation. Thus, the questionnaire contained no identifying information and included an introduction mentioning the exclusive use of the data for research purposes, and specifying the participants' right to decline participation at any time, with respect of the principle of nonmaleficence.

Statistical methods

Data were analyzed in SPSS version 21 for Windows (SPSS Inc., Chicago, IL). Continuous variables are presented as mean \pm standard deviation (SD) for normally distributed variables, and as median and interquartile range (IQR) for non-normally distributed variables, whereas categorical variables are presented as frequency and percentage.

The prevalence of ever smoking, the first primary outcome, was estimated as the percentage (95% CI) of children who reported having ever tried or experimented with cigarette smoking, even by taking only one or two puffs (item C5 of GYTS questionnaire). The prevalence (95% CI) of active smoking, the second primary outcome, was estimated as the percentage of children who self-identified as active smokers.

Factors associated with ever or active smoking were analyzed with chi square test for categorical variables and independent t-test for continuous variables. Multivariate logistic regression was used to analyze the independent factors of ever and active smoking; the results are presented as odds ratios (OR [95% CI]).

The level of significance was set at $p < 0.05$.

Results

Demographic characteristics

A total of 6717 school children were included; the mean (SD) age was 14.6 (2.36) years, and 51.4% were boys. Most (90.8%) were from public schools, and almost half (47.2%) were in the three highest grades (10th to 12th). At the time of the survey, 61.2% of the participants had father working only and 3.3% had mother working only, and 30.8% spent 50 Saudi riyals (SAR) or more per week (Table 1).

Table 1: Characteristics of the school students who participated in the youth Tobacco Survey of Jeddah, 2020 (N = 6717).

Parameter	Level	Mean	SD
Age	(years)	14.61	2.36
Parameter	Level	Frequency	Percentage
Gender	Male	3452	51.4
	Female	3252	48.4
	Not specified	13	0.2
Nationality	Saudi	4175	62.2
	Non-Saudi	2358	35.1
	Not specified	184	2.7
Grade	4 th	289	4.3
	5 th	265	3.9
	6 th	521	7.8
	7 th	825	12.3
	8 th	879	13.1
	9 th	773	11.5
	10 th	1148	17.1
	11 th	1059	15.8
School type	Public	6098	90.8
	Private	460	6.8
	Not documented	159	2.4
Father's educational level	Elementary	470	7.0
	Intermediate	792	11.8
	High school	1890	28.1
	Diploma	368	5.5
	College	2066	30.8
	Do not know	1071	15.9
Mother's educational level	Elementary	661	9.8
	Intermediate	802	11.9
	High school	1460	21.7
	Diploma	172	2.6
	College	1247	18.6
	Do not know	775	11.5
Parents' professional status	Not documented	1600	23.8
	Father works	4108	61.2
	Mother works	222	3.3
	Both parents work	939	14.0
	Both parents do not work	961	14.3
	I do not know	441	6.6
Amount of money spent per week	Not documented	46	0.7
	None	1704	25.4
	<10 SAR	842	12.5
	10–30 SAR	1257	18.7
	>30–50 SAR	843	12.6
	>50–100 SAR	893	13.3
>100 SAR	1178	17.5	

Lifetime experience of smoking

The prevalence of ever smoking was (14.1%; 95% CI = 13.2–14.9), and the mean (SD) age of smoking the first cigarette was 13.76 years (2.23). Regarding expected smoking status after 1 year, 80 (1.2%) said that they would

definitely smoke, and 178 (2.6%) said that they would probably smoke. When asked whether they would smoke if one of their best friends offered them a cigarette, 114 (1.7%) replied that they would definitely accept, and 204 (3.0%) replied that they would probably accept. The most frequently used tobacco products were cigarettes (8.8%) and hookah (6.6%); 57% reported having easy or somewhat easy access to cigarettes if they wanted to smoke (Table 2).

Assessment of current smoking

A total of 254 participants (3.8%, 95% CI = 3.3–4.3%) identified themselves as active smokers (Table 2) and reported a median of 10 days smoked in the past 30 days (IQR = 30) (Table 3). Of these, 96 (37.8%) declared not having smoked during the past 30 days, 49 (19.3%) declared smoking 1 cigarette or less daily (28, 11.0%), 44 (17.3%) smoked two to five cigarettes daily, whereas 32 (12.6%) smoked more than ten cigarettes daily. The most frequently consumed tobacco products were cigarettes (120, 47.2%) and hookah (109, 42.9%). Most smokers (128, 50.4%) bought cigarettes by themselves, whereas 38 (15.0%) took them from a family member, and 37 (14.6%) received them from a friend. The two main sources of cigarettes were grocery stores (46.1%) and convenience stores (26.0%), and the majority of students were not refused sales (120, 52.4%) (Table 3).

Exposure to passive smoking

Figure 1 shows that the most common source of indoor and outdoor passive smoking type was a smoking father or other close relative.

Factors associated with ever smoking

Ever smokers were on average 1.5 years older than never smokers ($p < 0.001$). Lifetime smoking was further associated with male sex ($p < 0.001$), higher school grade ($p < 0.001$), private school type ($p < 0.001$), the mother or both parents working ($p < 0.001$), and higher amounts of money (>100 SAR) spent per week ($p < 0.001$). Additionally, both indoor and outdoor exposure to passive smoking increased the probability of ever smoking (Table 4).

Factors associated with current smoking

Active smokers were significantly older (mean = 16.35 [SD = 2.00] years) than non-smokers (14.54 [2.34] years) ($p < 0.001$). The prevalence of smoking was higher among boys than girls (4.8% vs. 2.5%, $p < 0.001$), and among Saudis vs. non-Saudis (4.2% vs. 2.8%, $p = 0.001$), and increased significantly with grade ($p < 0.001$). Private schools were associated with significantly higher prevalence of smoking (7.6% vs. 3.2%, $p < 0.001$) than public schools. Furthermore, the prevalence of active smoking was significantly greater among the following categories compared with

Table 2: Experiences and attitudes toward smoking among school students who participated in the youth Tobacco Survey of Jeddah, 2020 (N = 6717).

Parameter	Level	Frequency	Percentage
Ever smoking (even one or two puffs)	No	5773	85.9
	Yes	944	14.1
Age at first cigarette (years)	Mean, SD	13.76	2.23
Do you think that you will try cigarettes soon?	Not sure	452	6.7
	Already tried	933	13.9
	Yes	81	1.2
	No	5251	78.2
Do you think you will smoke a cigarette in the next year?	Definitely yes	80	1.2
	Probably yes	178	2.6
	Probably not	367	5.5
	Definitely not	5282	78.6
	No answer	810	12.1
If one of your best friends were to offer you a cigarette, would you smoke it?	Definitely yes	114	1.7
	Probably yes	204	3.0
	Probably not	330	4.9
	Definitely not	6069	90.4
How easy would it be for you to get tobacco products if you wanted some?	Very easy	1873	27.9
	Somewhat easy	1955	29.1
	Not easy at all	2860	42.6
	Do not know	29	0.4
Tobacco type used ^a	Cigarettes	588	8.8
	Hookah	442	6.6
	E-cigarette	304	4.5
	Smokeless tobacco	111	1.7
	Sniffing tobacco	37	0.6
	Pipe	17	0.3
	Cigar	70	1.0
No. cigarettes smoked in life	Never smoked or tried	5810	86.5
	1 or more puffs but never a whole cigarette	19	0.3
	1 cigarette	14	0.2
	2–5 cigarettes	36	0.5
	6–15 cigarettes	22	0.3
	16–25 cigarettes	12	0.2
	>1 pack but <5 packs	14	0.2
	100 or more (5+ packs)	100	1.5
	Not defined	690	10.3
Self-identified as current active smoker (original)	Yes	254	3.8
	No	6463	96.2

^a More than one type may be used by a single participant.

Table 3: Assessment of current smoking among school students who reported being active smokers (N = 254).

Parameter	Level	Median	IQR
Number of days smoked in the past 30 days	(days)	10	30
Parameter	Level	Frequency	Percentage
During the past 30 days, on the days you smoked, how many cigarettes did you smoke per day?	No cigarettes during the past 30 days	96	37.8
	<1 cigarette per day	28	11.0
	1 cigarette per day	21	8.3
	2–5 cigarettes per day	44	17.3
	6–10 cigarettes per day	33	13.0
	11–20 cigarettes per day	15	5.9
	>20 cigarettes per day	17	6.7

Table 3 (continued)

Parameter	Level	Median	IQR
When was the last time you smoked a cigarette, even one or two puffs?	Earlier today	93	36.6
	Not today but during the past 7 days	46	18.1
	>7–30 days ago	25	9.8
	>1–6 months ago	33	13.0
	>6–12 months ago	16	6.3
	1–4 years ago	23	9.1
Type of smoking product used in the past 30 days*	5 or more years ago	18	7.1
	Cigarettes	120	47.2
	Hookah	109	42.9
	Smokeless tobacco	24	9.4
	Sniffing tobacco	9	3.5
	Pipe	6	2.4
	Cigar	20	7.9
Way of getting cigarettes ^a	No specific type	25	9.8
	Did not smoke in past month	45	17.7
	Bought them myself	128	50.4
	Someone else bought them for me	23	9.1
	Asked someone to give me some	23	9.1
	Bought them from another person	5	2.0
	Took them from family member	38	15.0
	Took them from a friend	37	14.6
Source of cigarettes*	Offered by someone	15	5.9
	Some other way	20	7.9
	Convenience store	66	26.0
	Grocery store	117	46.1
	Gas station	21	8.3
	Smoke shop	6	2.4
	Over the Internet	10	3.9
	Through email	3	1.2
During the past 30 days, did anyone refuse to sell you cigarettes because of your age?	Through social media	7	2.8
	Some other place	33	13.0
	Did not try to buy	66	28.8
	Yes	43	18.8
	No	120	52.4
	Did not answer	25	9.8

^a More than one option may apply for a single participant.

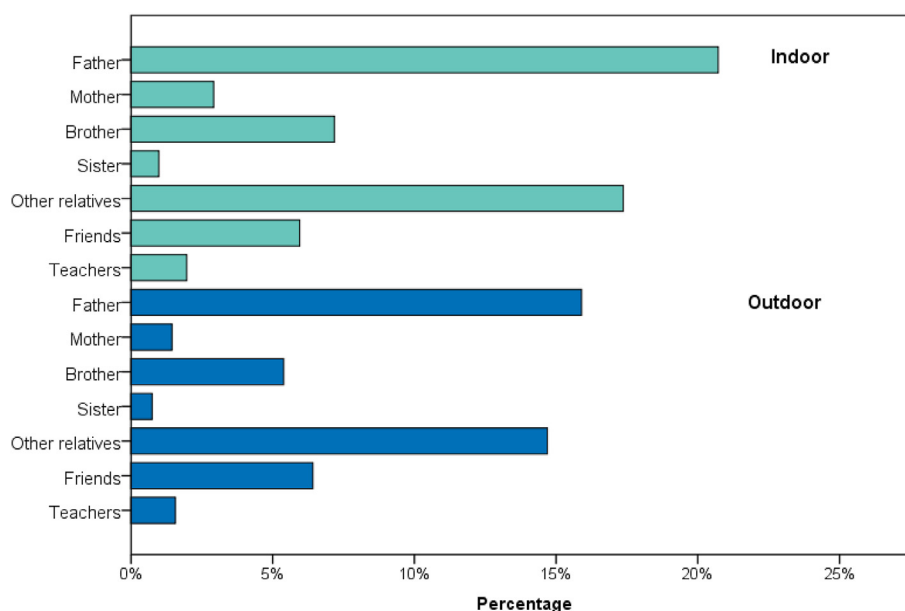


Figure 1: Exposure to indoor and outdoor passive smoking among school students who participated in the youth Tobacco Survey of Jeddah, 2020 (N = 6717). Bars represent the percentages of participants who reported being exposed to the indicated source of secondhand smoking indoors (green bars) and outdoors (blue bars).

Table 4: Factors associated with ever smoking among school students who participated in the youth Tobacco Survey of Jeddah, 2020 (N = 6717).

Factor	Level	Ever smoked		Never smoked		p-value
		Mean	SD	Mean	SD	
Age (years)	Mean, SD	15.95	1.92	14.39	2.35	<0.001*
Factor	Level	n	%	n	%	p-value
Gender	Male	564	16.3	2888	83.7	<0.001*
	Female	372	11.4	2880	88.6	
Nationality	Saudi	600	14.4	3575	85.6	0.420
	Non-Saudi	315	13.4	2043	86.6	
	Not specified	29	15.8	155	84.2	
Grade	4 th	11	3.8	278	96.2	<0.001*
	5 th	10	3.8	255	96.2	
	6 th	15	2.9	506	97.1	
	7 th	38	4.6	787	95.4	
	8 th	72	8.2	807	91.8	
	9 th	112	14.5	661	85.5	
	10 th	212	18.5	936	81.5	
	11 th	209	19.7	850	80.3	
	12 th	265	27.7	693	72.3	
School type	Public	802	13.2	5296	86.8	<0.001*
	Private	98	21.3	362	78.7	
Father's educational level	Elementary	58	12.3	412	87.7	0.059
	Intermediate	131	16.5	661	83.5	
	High school	237	12.5	1653	87.5	
	Diploma	55	14.9	313	85.1	
	College	291	14.1	1775	85.9	
	Do not know	165	15.4	906	84.6	
Mother's educational level	Elementary	77	11.6	584	88.4	0.437
	Intermediate	98	12.2	704	87.8	
	High school	198	13.6	1262	86.4	
	Diploma	28	16.3	144	83.7	
	College	152	12.2	1095	87.8	
	Do not know	106	13.7	669	86.3	
Parents' professional status	Father works	508	12.4	3600	87.6	<0.001*
	Mother works	44	19.8	178	80.2	
	Both parents work	160	17.0	779	83.0	
	Both parents do not work	155	16.1	806	83.9	
	I do not know	75	17.0	366	83.0	
Amount of money spent per week	None	223	13.1	1481	86.9	<0.001*
	Less than 10 SAR	96	11.4	746	88.6	
	>10–30 SAR	151	12.0	1106	88.0	
	>30–50 SAR	119	14.1	724	85.9	
	50–100 SAR	129	14.4	764	85.6	
	More than 100 SAR	226	19.2	952	80.8	
Exposure to passive smoking indoors	None	298	7.6	3628	92.4	<0.001*
	One person	355	16.9	1749	83.1	
	Two or more people	291	42.4	396	57.6	
Exposure to passive smoking outdoors	None	375	8.6	4009	91.4	<0.001*
	One person	343	18.8	1484	81.2	
	Two or more people	226	44.7	280	55.3	

SAR: Saudi riyal; *statistically significant result ($p < 0.05$).

their counterparts: children of working mothers (with or without working fathers) or jobless parents; those spending >100 SAR per week; those perceiving great ease in obtaining tobacco products; and those exposed to passive smoking ($p < 0.001$ for all) (Table 5).

Predictors of ever smoking

Ever smoking was independently associated with older age (OR = 1.21; 95% CI: 1.11–1.33), male gender (OR = 1.76; 95% CI: 1.50–2.06), private school (OR = 1.60;

Table 5: Factors associated with current smoking among school students who participated in the youth Tobacco Survey of Jeddah, 2020 (N = 6717).

Factor	Level	Smoker		Non-smoker		p-value
		Mean	SD	Mean	SD	
Age	(years)	16.35	2.00	14.54	2.34	<0.001*
Age at first smoking experience, if any	(years)	13.42	2.59	13.04	2.81	0.095
Factor	Level	N	%	N	%	
Gender	Male	167	4.8	3285	95.2	<0.001*
	Female	80	2.5	3172	97.5	
Nationality	Saudi	175	4.2	4000	95.8	0.001*
	Non-Saudi	66	2.8	2292	97.2	
	Not specified	13	7.1	171	92.9	
Grade	4 th	4	1.4	285	98.6	<0.001*
	5 th	3	1.1	262	98.9	
	6 th	3	0.6	518	99.4	
	7 th	11	1.3	814	98.7	
	8 th	9	1.0	870	99.0	
	9 th	18	2.3	755	97.7	
	10 th	51	4.4	1097	95.6	
	11 th	64	6.0	995	94.0	
	12 th	91	9.5	867	90.5	
School type	Public	198	3.2	5900	96.8	<0.001*
	Private	35	7.6	425	92.4	
Father's educational level	Elementary	15	3.2	455	96.8	0.328
	Intermediate	34	4.3	758	95.7	
	High school	60	3.2	1830	96.8	
	Diploma	18	4.9	350	95.1	
	College	75	3.6	1991	96.4	
	Do not know	48	4.5	1023	95.5	
Mother's educational level	Elementary	30	4.5	631	95.5	0.233
	Intermediate	22	2.7	780	97.3	
	High school	43	2.9	1417	97.1	
	Diploma	8	4.7	164	95.3	
	College	36	2.9	1211	97.1	
	Do not know	30	3.9	745	96.1	
Parents' professional status	Father works	121	2.9	3987	97.1	<0.001*
	Mother works	12	5.4	210	94.6	
	Both parents work	52	5.5	887	94.5	
	Both parents do not work	50	5.2	911	94.8	
	I do not know	19	4.3	422	95.7	
Amount of money spent per week*	None	53	3.1	1651	96.9	<0.001*
	<10 SAR	20	2.4	822	97.6	
	10–30 SAR	26	2.1	1231	97.9	
	>30–50 SAR	31	3.7	812	96.3	
	>50–100 SAR	41	4.6	852	95.4	
	>100 SAR	83	7.0	1095	93.0	
Perceived ease of obtaining tobacco products*	Very easy	155	8.3	1718	91.7	<0.001*
	Somewhat easy	56	2.9	1899	97.1	
	Not easy at all	41	1.4	2819	98.6	
Exposure to passive smoking indoors	None	56	1.4	3870	98.6	<0.001*
	One person	90	4.3	2014	95.7	
	Two or more people	108	15.7	579	84.3	
Exposure to passive smoking outdoors	None	375	8.6	4009	91.4	<0.001*
	One person	343	18.8	1484	81.2	
	Two or more people	226	44.7	280	55.3	

SAR: Saudi riyal; *statistically significant result (p < 0.05).

95% CI: 1.22–2.10), having a working mother (OR = 1.59; 95% CI: 1.08–2.36), and exposure to passive smoking—both indoors (OR = 1.68 and 4.11 for exposure to one or two or more smokers, respectively) and outdoors (OR = 1.68 and 2.56 exposure to one or two or more smokers, respectively; Table 6).

Predictors of active smoking

Self-determined active smoking status was independently associated with older age (OR = 1.51; 95% CI: 1.28–1.77), male gender (OR = 2.25; 95% CI: 1.65–3.06), private school

(OR = 1.91; 95% CI: 1.24–2.94), >100 SAR weekly spending (OR = 1.58; 95% CI: 1.04–2.39), and perceived ease of obtaining tobacco products (OR = 2.42; 95% CI: 1.64–3.56). Unexpectedly, active smoking was negatively associated with grade level in the adjusted analysis. That is, the ORs of active smoking for grades 6–12, with respect to grade 4, ranged from 0.07 to 0.17 ($p < 0.05$). Furthermore, exposure to passive smoking, both indoors (two or more people: OR = 3.95; 95% CI: 2.41–6.46) and outdoors (one person and two or more people smoking: OR = 1.88 [95% CI: 1.24–2.85] and 3.10 [1.89–5.28], respectively), was associated with greater risk of active smoking (Table 6).

Table 6: Predictors of ever and current smoking among school students who participated in the youth Tobacco Survey of Jeddah, 2020 (N = 6717) (multivariate logistic regression).

Factor	Level	Ever smoking				Active smoking			
		OR	95% CI	p-value	OR	95% CI	p-value		
Age	(years)	1.21	1.11	1.33	<0.001*	1.51	1.28	1.77	<0.001*
Gender	Male	1.76	1.50	2.06	<0.001*	2.25	1.65	3.06	<0.001*
	Female	(ref)	—	—	—	(ref)	—	—	—
Nationality	Saudi	—	—	—	—	(ref)	—	—	0.577
	Non-Saudi	—	—	—	—	0.85	0.61	1.19	0.351
	Not specified	—	—	—	—	1.24	0.43	3.57	0.694
Grade	4 th	(ref)	—	—	<0.001*	(ref)	—	—	0.014*
	5 th	0.63	0.25	1.57	0.317	0.45	0.10	2.09	0.308
	6 th	0.40	0.17	0.93	0.034*	0.10	0.02	0.57	0.010*
	7 th	0.53	0.25	1.12	0.097	0.17	0.05	0.64	0.008*
	8 th	0.73	0.34	1.58	0.424	0.07	0.02	0.29	<0.001*
	9 th	1.18	0.53	2.63	0.677	0.10	0.03	0.42	0.001*
	10 th	1.34	0.58	3.10	0.497	0.14	0.03	0.58	0.007*
	11 th	1.29	0.52	3.18	0.580	0.14	0.03	0.64	0.011*
School type	Public	(ref)	—	—	—	(ref)	—	—	—
	Private	1.60	1.22	2.10	<0.001*	1.91	1.24	2.94	<0.001*
Parents' professional status	Father works	(ref)	—	—	0.029*	(ref)	—	—	0.295
	Mother works	1.59	1.08	2.36	0.019*	1.51	0.75	3.04	0.246
	Both parents work	1.21	0.97	1.52	0.094	1.32	0.89	1.96	0.172
	None of parents works	1.13	0.91	1.41	0.273	1.44	0.98	2.13	0.066
	I do not know	1.40	1.04	1.89	0.029*	1.28	0.72	2.29	0.396
Amount of money spent per week	None	(ref)	—	—	0.270	(ref)	—	—	0.008*
	<10 SAR	0.85	0.64	1.13	0.261	0.66	0.37	1.18	0.163
	10–30 SAR	0.90	0.70	1.15	0.384	0.68	0.40	1.13	0.136
	>30–50 SAR	1.01	0.78	1.33	0.917	1.12	0.68	1.85	0.656
	>50–100 SAR	0.92	0.71	1.20	0.559	1.19	0.74	1.91	0.468
	>100 SAR	1.16	0.92	1.47	0.209	1.58	1.04	2.39	0.032*
Perceived ease of obtaining tobacco products	Very easy	—	—	—	—	2.42	1.64	3.56	<0.001*
	Somewhat easy	—	—	—	—	1.12	0.72	1.74	0.625
	Not easy at all	—	—	—	—	(ref)	—	—	<0.001*
Exposure to passive smoking indoors	None	(ref)	—	—	<0.001*	(ref)	—	—	<0.001*
	One person	1.68	1.35	2.09	<0.001*	1.54	0.99	2.40	0.054
	Two or more people	4.11	3.11	5.43	<0.001*	3.95	2.41	6.46	<0.001*
Exposure to passive smoking outdoors	None	(ref)	—	—	<0.001*	(ref)	—	—	<0.001*
	One person	1.68	1.36	2.08	<0.001*	1.88	1.24	2.85	0.003*
	Two or more people	2.65	1.96	3.57	<0.001*	3.10	1.89	5.08	<0.001*

OR: odds ratio; 95% CI: 95% confidence interval; (ref): reference category used for OR calculation; *Statistically significant result ($p < 0.05$).

Discussion

Summary of findings

This school-based study showed that 14.1% of school-aged children experienced smoking at a mean age of 13.76 years (SD = 2.23). The prevalence of self-determined active smoking was 3.8%, and most smokers consumed fewer than one to five cigarettes per day. The most commonly used tobacco products were cigarettes (47.2%) and hookah (42.9%). Half the active smokers bought cigarettes by themselves, and the remaining smokers obtained cigarettes from people to whom they were close. The two main sources of cigarettes were grocery stores (46.1%) and convenience stores (26.0%). Several socioeconomic factors were independently associated with ever smoking and smoking, and are discussed in this section.

Prevalence of ever smoking

The observed prevalence of ever smoking (14.1%) in the school setting was alarming, despite being significantly lower than that reported in other local studies and international data. For instance, in Riyadh City, the prevalence of ever smoking and smoking among adolescent male students was 34.5%.¹¹ Internationally, the US National Youth Tobacco Survey has reported an estimated prevalence of ever smoking of 24.3% (2.9 million) in middle-school students (grades 6–8) and 53.3% (8.0 million) in high-school students (grades 9–12).²⁰ According to the most recent Center for Diseases Control data, 11.3% of middle-school students and 34% of high-school students declared having used a tobacco product at least once in their lifetime.²¹ In northern Taiwan, the incidence of trying smoking among school students increased from 3.1% to 6.0% from 2002 to 2008.²² In another survey from Botswana, 29% of the participating school-age students indicated that they had experienced smoking cigarettes or any tobacco product.²³

Prevalence of active smoking

According to the self-determined smoking status, the prevalence of active smoking was 3.8% (95% CI: 3.3–4.24%), a value lower than those in both national and international data. In the USA, 12.5% (1.5 million) of middle-school and 31.2% (4.7 million) of high-school students have reported being active smokers.²⁰ In another study, 10% (261/2554) of students from 68 primary and secondary schools have declared being current tobacco smokers.²³ The prevalence observed in the present study were in a low range with respect to national data. A recent systematic review has demonstrated that the prevalence of smoking among secondary-school students in KSA ranges from 9.72% to 37.0%, whereas it ranges from 13.0% to 30.9% and 2.7% to 8.5% among male and female college students, respectively.²⁴ One of the highest levels (37.0%) of smoking has been found in a study from Jeddah; however, the study included boys only and therefore probably overestimated the overall prevalence.¹⁴ The low rates of ever and active smoking found in the present study, with respect to local data, may be explained by the COVID-19 pandemic and

the restrictive measures that were still in effect during the study period. Being confined at home, in presence of parents, would have restricted opportunities for youth to consume tobacco products. Most recently, the significant increase in tobacco prices since the start of tobacco excise taxation in KSA might have limited tobacco purchasing accessibility by youth.²⁵ Moreover, the ongoing smoking cessation program led by the ministry of health across the country might have increased the awareness of families and youth regarding smoking.²⁶

Qualitative and quantitative patterns of smoking

The authors noted a low frequency of smoking among most participants who were self-declared active smokers. This included a median of 10 days smoked in the past month (i.e., two smoking-free days in every three days in 50% of the participants); 57.1% of the smokers smoked one cigarette or fewer per day, and 63.4% had not smoked on the day of the interview. These findings suggested that occasional smoking is common in school-aged children in Jeddah, thus highlighting the relevance of implementing school-based smoking cessation interventions and awareness campaigns to maximize benefits. Willingness to abstain from smoking is more common in occasional smokers, thus increasing the chances of success for cessation programs.²⁷ A multicenter randomized experimental study has tested the efficiency of two motivational interventions (brief and intensive) in achieving smoking cessation among adolescent smokers. The two interventions consisted of four sessions with progressive cessation (intensive approach) or a single session with immediate cessation of smoking (brief approach). The endpoint results indicated abstinence rates of 64.0% at 1 month, 42.0% at 6 months, and 27.0% at 12 months, and showed greater efficacy for the brief strategy.²⁸ In another randomized open-label trial, a 10-week school-based, cognitive–behavioral group counseling combined with a 9-week nicotine replacement therapy followed by nine group sessions over a 14-week period showed a smoking abstinence rate of 21.0% among high-school adolescent smokers.²⁹ Pbert et al. have conducted a study among 1068 active smokers from 35 high schools, and demonstrated the feasibility and benefit of school nurse-delivered smoking-cessation intervention. The intervention almost doubled the rate of short-term abstinence (odds ratio: 1.90) among adolescent boys and decreased the smoking frequency at short-term in both genders.³⁰ However, a large meta-analysis by Hartmann-Boyce et al., including 41 cluster-randomized controlled trials, has concluded that evidence is limited regarding the effectiveness among youth of smoking cessation interventions, mainly consisting of behavioral therapies (counseling sessions, and computer-based or messaging interventions as delivery methods) and pharmacotherapies (nicotine replacement therapy and bupropion).³¹

School-aged children may have a natural inclination to quit smoking, regardless of the effects of interventions. In the US National Youth Tobacco Survey report, 57.8% of smoking students were seriously thinking of quitting, and 57.5% had already tried to quit by ceasing use of all tobacco products for at least 1 day.²⁰ Nevertheless, the US Preventive Services Task Force (USPSTF) Recommendation Statement

in 2020 emphasized the necessity of implementing primary interventions including education or brief counseling to prevent smoking initiation among school-aged children and adolescents.³² Furthermore, the International Childhood Cardiovascular Cohort (i3C) Consortium has demonstrated that the prevalence of daily smoking in people in their twenties is directly influenced by the level of smoking during adolescence, and is largely determined by the age at the first smoking experience.³³ The study also showed that, among participants who identified as daily smokers in adolescence and were able to quit before adulthood, quitting occurred most commonly at the ages of 18–19 and a small fraction of the quitters (31.5%) relapsed in their twenties. Overall, the earlier the smoking experience occurs, the higher the risk of adulthood smoking; this risk is observed not only with regular smoking at childhood/adolescence but also with occasional smoking and isolated smoking trials.³³

Cigarettes, hookah (hubbly bubbly, shisha), and e-cigarettes were the most common tobacco products experienced by school-aged children. Data from Western countries have shown that e-cigarettes are the most frequently smoked tobacco in the school environment, followed by cigars, cigarettes, smokeless tobacco, hookahs, and pipe tobacco.²⁰ In the USA, use of tobacco products including e-cigarettes, traditional cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, and bidis has been reported in 12.5% (1.5 million) and 31.2% (4.7 million) middle and high school students, respectively.²⁰ These differences may be explained by cultural and environmental factors, because regular cigarettes and shisha remain the most commonly used tobacco products in KSA. These aspects have implications in the long-term health burden of childhood smoking and indicate a need for discussion of the eventual relevance of harm reduction approaches.

Effects of passive smoking in promoting smoking among children

This study highlights the key role of the child's environment in promoting smoking uptake and maintenance during childhood. Consistently, Leonardi-Bee et al. have demonstrated a significant increase in the relative odds of smoking uptake among children having one or both parents who smoked (particularly if the smoking parent is the mother rather than the father), a sibling, or any household member who regularly smokes. Smoking by siblings and other household members increased the odds of smoking uptake among children by up to 2.30- and 1.92-fold, respectively.³⁴ In England and Wales, approximately 23 000 adolescents have been estimated to have become current smokers at the age of 15 as a result of exposure to household smoking.³⁴ These findings demonstrate the need to increase awareness among adults regarding the risks of smoking in presence of children.

Other social influences and tobacco accessibility

Of the total students, 4.7% declared being potentially influenced to smoke by their best friends. Furthermore, most participants reported having very easy access to cigarettes if they wanted to smoke—an aspect independently associated with a 3.54-fold likelihood of active smoking. Therefore, the

issue of easy access to tobacco products by children through multiple pathways has been emphasized, and decision-makers have been urged to reinforce monitoring of such violations of the restrictive regulations in effect.¹⁷ Furthermore, efforts should be increased to protect children from the promotion of smoking in various media and the Internet. In 2015, England introduced a total ban on tobacco sale in shops, thus decreasing the rates of cigarettes purchased in shops by smoking children from 57.0% in 2010 to 39.8% in 2016.³⁵

Another independent factor influencing active smoking was a high amount of pocket money, which increased the risk of active smoking by 58%. This relationship may be bidirectional, because childhood smoking can induce greater money spending by children, and simultaneously, the availability of too much money among children may lead to their purchasing cigarettes and experiencing smoking. One possible solution may be to limit children's daily/weekly budgets as much as possible to prevent them from developing addictive behaviors, mainly smoking. Another approach used by several countries is raising cigarette prices, a measure that has been found to be highly effective in reducing smoking among youth.³⁶

Furthermore, children of working mothers had an independently elevated risk of ever smoking. This finding may be associated with multiple factors, including higher household income, increased children's allowance, and greater youth autonomy with less parental control.

Datar et al. have observed that the likelihood of youth developing unhealthy behaviors is higher among children whose mothers have long working hours in the United States. Having a working mother is associated with greater body mass index and obesity, particularly in children of families with higher socioeconomic status, owing to a combination of an unhealthy diet and other unhealthy behaviors such as sedentary lifestyle, and extensive time spent watching television and using the Internet.³⁷

Spending more time watching television and Internet without adequate supervision may also increase the susceptibility to smoking among children, particularly because of exposure to content promoting and facilitating smoking.³⁸ Nevertheless, the eventual effects of maternal work must be contextualized with the cultural features of Saudi society, and might be a confounding factor for other socioeconomic factors not investigated in the present study, such as household income, number of occupants and siblings, or family conflicts. Additionally, more broadly, changes in the lifestyles and family patterns in Saudi society may lead to the emergence of modern societal phenomena such as children smoking. These observations indicate a need for in-depth investigation of the societal and environmental mechanisms influencing children smoking in KSA, to inform development of the best preventive and corrective measures to combat this epidemic, and the alleviation of the resulting health and economic burden.

In contrast, parents' educational level was not associated with ever or current active smoking among children in the present study. Similar findings have been reported in a survey of 5053 children 12–17 years of age, which has indicated a strong association between smoking behavior in adolescents and their education level, but not that of their parents.³⁹ Other data have revealed that, although the parental level

of education significantly influences exposure to passive smoking in children, it has no influence on children's experimentation with smoking or their willingness to smoke in the future.⁴⁰ One possible explanation may be that smoking in children is influenced mainly by the level of parental supervision and the values conveyed by the family, regardless of parental educational levels. Higher parental educational levels may even increase the risk of smoking, because they are associated with higher socioeconomic status.⁴¹ Likewise, lower parental education levels do not necessarily indicate a lower risk of children obtaining cigarettes, and may be a factor influencing smoking in cases of child labor, for example.⁴²

The specific case of private schools

Children attending private schools had a risk of ever and active smoking 1.6- and 1.9-fold that in children in public schools, respectively. Likewise, a study from China involving 2725 students has demonstrated that students in private schools have a risk of smoking cigarettes 3.4–3.8 fold that of students in public schools.⁴³ In another study, the prevalence of lifetime smoking among students in private schools (35.4%) has been found to be twice that in public schools (17.4%).⁴⁴ Children attending private schools may benefit from greater autonomy and less restrictive institutional regulation than in public schools, thus potentially resulting in a smoking-permissive environment.⁴⁴ This aspect should attract attention toward the optimization of smoking prevention plans in private schools. Further research is needed to evaluate the private school environment and determine specific measures that should be undertaken to enhance anti-smoking awareness and meet national expectations.

Limitations

The present study did not investigate additional psychosocial and environmental factors affecting smoking among children and eventual co-addictions such as drugs, alcohol, video games, etc., which would have provided further insights into the mechanisms underlying smoking among children in Saudi society. Furthermore, data for some key variables, such as parental educational status, were missing, thus limiting the reliability of the findings regarding those factors. Another limitation inherent to the study period is the effects of COVID-19 restrictive measures on smoking behavior among children, which may explain the relatively low rates of smoking. Finally, the online self-administration of the questionnaire might have compromised the reliability of the answers.

Conclusion

Children smoking in Jeddah city is a serious public health problem with a substantial prevalence, and traditional tobacco products are frequently used. Yet, the current levels of smoking among school children corresponded to occasional smoking. This finding indicates a chance for increasing the efficiency of anti-smoking awareness and smoking cessation

programs for youth, which should urgently be implemented to prevent smoking and decrease the related short- and long-term health consequences. The contribution of family-associated factors is significant in determining youth access to both trying smoking and actively smoking. Specific regulations and awareness campaigns should be implemented to address these factors, notably decreasing passive smoking among children and blocking their access to tobacco products, and tobacco-promoting campaigns in households, schools, retail locations, and the Internet. The role of schools is highlighted in the case of private schools, where regulations should be aligned with the national vision.

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Conflict of interest

The author has no conflicts of interest to declare.

Ethical approval

Ethical approval was obtained from the institutional review board of King Abdulaziz University (Ref # 95-19), and specific authorizations were obtained from the EOs in Feb, 2019.

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