

**Tobacco and other substances use among high-school students in
Ethiopia**

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Summary

This dissertation reports and discusses the results of three publications. Two papers are based on the school survey data which was conducted in four big regions and the capital city (Addis Ababa) of Ethiopia. In the school survey, 3,355 grade 9 and 10 students participated from 36 schools. Moreover, the third paper is based on 25 in-depth interviews conducted among shisha smokers secondary school students. The objective of this dissertation is to discuss the prevalence of tobacco, alcohol and khat among secondary school students in Ethiopia. Also, determinants for use of tobacco products were identified. Moreover, the qualitative study explored the lived experiences of shisha smoking among secondary school students. A total of 2.4 % of students were regular users of cigarettes. Of the study participants, 17 % of students regularly used alcoholic products and 8.5 % used khat in lifetime. Based on this study, ever use of khat (adjusted Odds Ratio[AOR]=4.1, 95% confidence interval [CI]: 2.5-6.8), ever use of alcohol (AOR= 2.3, 95 %CI: 1.4-3.7), having a friend who smoked cigarette (AOR=2, 95 %CI: 1.2-3.5) were associated with ever use of cigarettes. This can be explained as students may use different substances concurrently or afterwards to complement the effect on each other and this is supported by studies conducted elsewhere. Khat chewing had a major role in tobacco use among adolescents, which is supported by studies conducted in African countries and the Arabian Peninsula. Moreover, the qualitative study showed that there is a strong link between khat chewing and shisha smoking. Students stated that shisha smoking complements the effect of khat, and they would not like shisha if they did not chew khat. Other evidence also showed that khat was blamed for being a gateway to the use of tobacco products. This study recommends that awareness-raising programs about the negative health effects of substance use should be designed for students. The school environment should be free from cigarettes and shisha by enforcing already existing tobacco control laws. Khat accessibility and consumption should be restricted for young. We believe that this study finding contributes to designing preventive strategies for substance use among secondary school students in Ethiopia.

Hirpa. Selamawit: Tobacco and other substances use among high-school students in Ethiopia, Halle (Saale), Univ., Med. Fak., Diss., 19 pages, 2023.

Referat

Diese Arbeit fasst die aus drei wissenschaftlichen Arbeiten bestehende Dissertation zusammen und diskutiert deren wesentliche Ergebnisse. Zwei Veröffentlichungen basieren auf Schulbefragungsdaten, die in vier Regionen Äthiopiens und der Hauptstadt (Addis Abeba) durchgeführt wurden. An der Schulbefragung nahmen 3.355 Schüler der Klassen 9 und 10 aus 36 Schulen teil. Die dritte Veröffentlichung basiert auf 25 Interviews, die mit Shisha-rauchenden Sekundarschülern durchgeführt wurden. Das Ziel dieser Dissertation ist es, die Prävalenz von Tabak, Alkohol und Khat unter Sekundarschülern in Äthiopien zu diskutieren und Determinanten für den Konsum von Tabakprodukten zu identifizieren. Darüber hinaus untersuchte die qualitative Studie die Erfahrungen des Shisha-Rauchens bei Sekundarschülern. Insgesamt 2,4 % der Studierenden konsumierten regelmäßig Zigaretten. Von den Studienteilnehmern konsumierten 17 % regelmäßig Alkohol und 8,5 % Khat. Faktoren, die mit dem Tabakkonsum in Verbindung gebracht werden sind der Konsum anderer Substanzen wie Khat (adjustiertes Odds Ratio [aOR]= 4,1; 95 %-Konfidenzintervall [KI]: 2,5-6,8) und Alkohol (aOR=2,3, 95 %-KI: 1,4-3,7) sowie rauchende Freunde (aOR=2, 95 % KI 1,2-3,5). Eine Erklärung wäre, dass Studenten verschiedene Substanzen nutzen können und so deren Wirkung aufeinanderergänzen. Sowohl weitere Studien, die in afrikanischen Ländern und auf der Arabischen Halbinsel durchgeführt wurden, als auch die qualitative Studie belegen, dass das Kauen von Khat eine wichtige Rolle beim Tabak- und Shishakonsum unter Jugendlichen spielt. Die Schüler gaben an, dass Shisha-Rauchen die Wirkung von Khat ergänzt, und dass sie Shisha nicht mögen würden, wenn sie kein Khat kauen würden. Diese Studie empfiehlt, dass für Schüler Programme zur Sensibilisierung der negativen gesundheitlichen Auswirkungen des Substanzkonsums konzipiert werden sollten. Das Schulumfeld sollte frei von Zigaretten und Shisha sein, indem bestehende Tabakkontrollgesetze durchgesetzt werden und die Zugänglichkeit von Khat sollten für junge Heranwachsende eingeschränkt werden. Damit kann diese Studie einen Beitrag für den Entwurf präventiver Strategien für den Substanzkonsum bei Sekundarschülern leisten.

Hirpa. Selamawit: Tobacco and other substances use among high-school students in Ethiopia, Halle (Saale), Univ., Med. Fak., Diss., 19 Seiten, 2023

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Abbreviations and Acronyms

AOR	Adjusted Odds Ratio
CI	Confidence Interval
FCTC	Framework Convention for Tobacco Control
GYTS	Global Youth Tobacco Survey
ICC	Intra-Cluster Correlation Coefficient
OR	Odds ratio
IRB	Institutional Review Board
JTI	Japan Tobacco International
MOE	Ministry of Education
NCD	Non-communicable disease
NTE	National Tobacco Enterprise
SDGs	Sustainable Development Goals
SPH	School of Public Health
UK	United Kingdom
UKRI	UK Research and Innovation
VIF	Variance Inflation Factor
WHO	World Health Organization
YRBS	Youth risk behavior survey

1- Introduction and objectives

1.1 Description of the problem

Substance use has a negative health consequence; though high rate of substance use is continued to be reported among adolescents (Obadeji et al., 2020). Globally, tobacco, alcohol, khat, and marijuana are among the list of substances used by many (Gebremariam et al., 2018). World Health Organization (WHO) has included tobacco and alcohol in the list of four behavioral risk factors for non-communicable diseases (NCDs) such as cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases (Gupta et al., 2021). Non-communicable diseases are responsible for over 70 % of deaths where three fourths of deaths occur in low- and middle-income countries (World Health Organization, 2020).

Smoking tobacco exposes more than 7000 toxic chemicals where at least 70 of them are known carcinogens that have a potential to affect nearly all human body organ systems (Jeffrey et al., 2018). Tobacco industry's tactics undermine the public health efforts and tobacco use prevalence is continually increasing in developing countries. Tobacco use epidemic in Africa is at the initial phase, though there is a significant increase in the prevalence especially among the youth (Logo, 2020). A study conducted in Ethiopia showed that 3 % of school going adolescents were cigarette smoking (Getachew et al., 2019). This number is low compared to the Global Youth Tobacco Survey (GYTS) surveys in other African countries (Polanska et al., 2022); though tobacco use remains a potential public health challenge for a country like Ethiopia where the country has a second largest population in Africa and the existence of the big tobacco company like Japan Tobacco International (JTI) where they thrive to expand their market (Japan Tobacco International, 2017).

Tobacco can be in the form of cigarettes, smokeless tobacco, or shisha. Shisha is smoked using a long hose where the smoke passes through water before reaching the smoker and the tobacco content includes molasses, honey, vegetable glycerol, and fruit flavors (Ethiopian Food and Drug Administration, 2019). Shisha has become a new epidemic especially among the youth (Ezekiel et al., 2018b). The prevalence of shisha use in Africa region ranges from 3% in Ghana (Logo et al., 2020) to 26 % in Rwanda (Omotehinwa et al., 2018). Similar to cigarettes, shisha smoking is a risk factor for cardiovascular diseases and cancer (World Health Organization, 2015a). Moreover, shisha smoking can result in infections such as tuberculosis, hepatitis and herpes related with sharing the mouthpiece. Despite the negative health consequences, shisha smoking is believed to be less harmful to health, less addictive and more attractive to the social activity especially among the youth (Arshad et al., 2019, Kabbash and Saied, 2020a). A study conducted

among the youth aged 12-17 years in USA reported that the health effects of shisha smoking were not well understood and perceived as less harmful for health than for cigarette smoking (Fitzpatrick, et al., 2019).

Alcohol is a psycho-active substance that can potentially cause dependence (World Health Organization, 2022). Harmful alcohol use has impact on mental health, violence, injuries and infections beyond the NCDs (World Health Organization, 2021). Reducing the harmful use of alcohol will contribute to progress the achievement of targets of the 2030 agenda for the Sustainable Development Goals (SDGs), including the goals on ending poverty (SDG 1), quality education (SDG 4), gender equality (SDG 5), economic growth (SDG 5) and reducing inequalities between and within countries (SDG 10) (WorldHealth Organization, 2021). A systematic review showed that early age initiation of alcohol drinking associated with more regular and higher consumption of alcohol (Khamis et al., 2022). A systematic review based on studies conducted in Ethiopia between 2011 and 2017 reported that the pooled prevalence of lifetime alcohol use among high school students was 41.4 % (Roba et al., 2019). Ever drinking alcohol was associated with sex, peer pressure, family background, socio economic status, accessibility to alcohol outlets (Khamis et al., 2022, Getachew et al., 2019).

Khat is a stimulant substance, which has been usually chewed for many years in Ethiopia, East Africa, and the Southern Arabian Peninsula (Adane et al., 2021, Etana, 2018). Ethiopia is the largest producer of khat in the world, which is the source of internal tax revenue and one of the largest export commodities with the annual earning of hundredmillion of dollar (Tolcha, 2020, Cochrane and O'Regan, 2016). Khat was recognized as a substance of abuse that can cause mild to moderate psychological dependence by World Health Organization, in 1980 (Abdelwahab et al., 2015). Globally the exact number of people who uses khat is unknown, it is estimated that 10 million people use khat and predominantly from Yemen, Somali, and Ethiopia (Malasevskaja et al., 2020). It was reported that khat chewing has a negative effect on cardiovascular system, mental health, oral health and causes oral, gastric, and esophageal cancer (Alshoabi et al., 2022). Also, khat is blamed for taking half of a household budget and creating crises in families (Etana, 2018). Reasons given for starting khat chewing were to study/concentrate, to get relief from stress, peer pressure, and for pleasure (Adane et al., 2021). A systematic review showed that the pooled prevalence of khat use among university and high school students was 16.7 % in Ethiopia (Alemu et al., 2020). A study conducted in Ethiopia showed that majority of khat chewers started chewing when they were at high school (Etana, 2018).

Globally, more than 4 % of the global population aged 15-64 had used Marijuana in 2020; where higher prevalence was reported in the age of 15-16 years (United Nations Office on Drugs and Crime, 2020). Marijuana use was highest in North America, Australia, New Zealand, and West Africa (United Nations Office on Drugs and Crime, 2020). In West Africa, Cannabis was a reason for over 55 % of drug treatment admission in year of 2018 and 2019. In Ethiopia, there are limited studies about Marijuana use. Based on a study conducted among university students in Ethiopia showed that 0.9 % of students had used Marijuana (Kassa et al., 2014). Based on WHO report, cannabis short-term effects are anxiety, cognition and coordination problems, acute toxicity, acute effect on cardiovascular and respiratory systems (World Health Organization, 2016).

Ethiopia is the second most populous country in Africa; with over 115 million people. The country has 11 regions and two chartered cities. Japan Tobacco International (JTI), the world's third largest tobacco company became the major shareholder in 2016/17 (after purchasing 70 % of the shares for USD 1 billion) of the National Tobacco Enterprise (NTE) in Ethiopia (Semonegna, 2017). The WHO Framework Convention for Tobacco Control (WHO FCTC) is the first global public health treaty in response to the tobacco epidemic and over 180 countries have become parties to the treaty (World Health Organization, 2003). Ethiopia has ratified the WHO FCTC in year of 2014, passed the strongest tobacco control proclamation (1112/2019) in year of 2019 (Ethiopian Food and Drug Administration, 2019). Based on the proclamation, it is forbidden to sell tobacco products within 100 meters from the school premises and to smoke and sell shisha (Ethiopian Food and Drug Administration, 2019). In Ethiopia it is not legal to sell alcohol products for any person under the age of 18 years old (Ethiopian Food and Drug Administration, 2019). Unlike tobacco and alcohol, there is no law prohibiting the sales and use of khat for under-age groups. In the country secondary education has two cycles: the first cycle covering grade 9-10 and the second cycle covering grade 11-12 (Ministry of Education, 2019). The official secondary school age is between 15-18 years (Ministry of Education, 2019).

Most studies conducted in Ethiopia were only limited to a single region and one substance. The current study aimed to include four large regions including the main cities and peri-urban areas. Moreover, a range of substances were included in the study and a qualitative study was done to complement the school survey result about shisha. This study is the first to estimate the prevalence of cigarette smoking, smokeless tobacco, shisha, khat and alcohol use among secondary school students at the national level. Moreover, risk factors for ever use of cigarettes among secondary

school students were identified. Secondary school students lived experiences of shisha smoking were explored and presented in this study.

1.2. Research objective

The research objectives were:

To determine the prevalence and risk factors of cigarette smoking among high school students in Ethiopia (Publication 1).

To measure the prevalence of alcohol, khat and marijuana use among high school students (Publication 1).

To measure the prevalence and determinants of shisha smoking among high school students (Publication 2).

To explore the lived experiences of shisha smoking for high school students (Publication 3.)

The research findings were discussed by reviewing literature in Africa and elsewhere. The recommendation for this study was given by considering the county context and this research findings. This dissertation is based on a cross-sectional quantitative and qualitative study resulting in three research publications (Hirpa et al 2021, 2022, 2023).

2- Discussion

In Ethiopia, this is the first study conducted among secondary school students which covers a wide range of substances in four large regions (Oromia, Tigray, Amhara, Sidama) and the capital city (Addis Ababa). For this study, we have included 3,355 students from 36 secondary schools. Data were collected using a pre- tested questionnaire in three local languages. Moreover, qualitative research was done to understand the lived experiences of shisha smoking among high school students. Commonly in Ethiopia, shisha smoking is perceived as it has no harm for health and there are limited studies on the topic.

In this study, ever use is defined as use of any substance at least once in a lifetime. Current/ regular use is defined as use of substance at least once in the past 30 days from the survey time. The main findings of the three publications are prevalence, risk factors for substance use and lived experiences of shisha smoking among Ethiopians secondary school students. A total of 4.7 % and 2.4 % of students were ever and regular users of cigarettes, respectively. From the study participants, 40% of study participants ever used alcohol and 17% were regular users. Of all students 8.7 % and 4.1 % ever used and were current users of khat; respectively. Three-point two percent (3.2%) of participants ever used smokeless tobacco and 2.3 % ever used marijuana (publication one). This study reported a prevalence of 2.6 % of ever use of shisha and 0.6 % current shisha smoking (publication two). Individual level factors associated with ever use of cigarette were ever use of smokeless tobacco, shisha, khat, alcohol, and friends smoked cigarette. From the four school level variables, ever seen anyone smoking in the school was significantly associated with ever use cigarette (publication one).

Based on in-depth interviews conducted with students who had a shisha experience, peer influence played a major role in the initiating and maintaining shisha use. Furthermore, khat chewing, enjoying the shisha smoking and the environment, accessibility and leisure time were reasons for continued shisha smoking (publication three). In this section, the findings from the school survey and qualitative research result are discussed in detail.

2.1. Prevalence and risk factors for tobacco, khat and alcohol consumption among high school students in Ethiopia (publication one)

Ethiopia is one of the countries with a low prevalence of tobacco use in the sub-Saharan African region (Guliani et al., 2019); in agreement with this our study reported lower prevalence of current cigarette smoking (2.4%) compared to the Global Youth Tobacco surveys conducted in other African countries (GYTS, 2018, Logo et al., 2021, Jallow et al., 2017). This study reported comparable prevalence of current cigarette smoking for Addis Ababa to a study conducted in year of 2016

(3.5% vs 3%) (Getachew et al., 2019). In contrary to this, our study reported lower prevalence of current cigarette smoking compared to studies conducted in different places of Ethiopia (Dida et al., 2014, Ermekoet al., 2021). These two studies were conducted only in part of Ethiopia where the problem of cigarette smoking and khat chewing was common, whereas our study was more representative of the Ethiopian context including the Northern region where cigarette smoking and khat chewing prevalence is low.

The results of our study show 40% of students stated that there were cigarette shops within 100 meters premises from the school compound and 11% of students saw someone smoking cigarettes in the school compound. Moreover, 26% of students ever gone to shop to buy cigarettes. In Ethiopia, it is common to send children to buy small consumable items. Smokers may send children to buy cigarette for them even though the strong tobacco control laws ban not to sell cigarette for children less than 21 years. Furthermore, it is forbidden to sell and smoke tobacco products in and within 100 meters radius of the school compound; based on (proclamation 1112/2019). This shows the gap in the enforcement of the tobacco control law in Ethiopia.

Our study reported that 17% of students were regular users of alcohol. Though the report is lower than studies conducted in Europe and other African countries; (Riva et al., 2018, Cannizzaro et al., 2022, Kamenderi et al., 2019, Hormenu et al., 2018). Other studies conducted among secondary students in Ethiopia reported that, 14% and 23% (Getachew et al., 2019, Ali and Worku, 2020) of regular alcohol use which is comparable to our study. Although the legal age for drinking alcohol in Ethiopia is 18 years; this study shows a challenge in the implementation of the law as 75% of regular drinkers use “*Tella*” which is a local beer brewed at home. The explanation for the high prevalence of alcohol use among secondary students could be related with, common practice for local beer sells and drinking, this is especially true in Northern part of Ethiopia. A large cohort study that analyzed more than 430,000 participants data reported that drinking above once per-day led to a

life loss of 7-10 years among men (Liu, YT. et., al., 2022). This evidence supports that health promotion interventions like raising community awareness about the health effects of alcohol is very important for the case of Ethiopia.

In this study, ever use of khat reported was 8.5 %. In Hawassa, placed in the Southern part of Ethiopia the lifetime prevalence of khat chewing was 14.6 % (Kassa et al., 2017) among high school students which is comparable to this study finding (13.3 %). Our study also showed regional variations for the current use of different substances. Cigarette smoking and khat chewing were highest in the southern part of Ethiopia whereas alcohol drinking was highest in the Northern part of Ethiopia. This is supported by studies conducted among the adult population in Ethiopia (Guliani et al., 2019). Evidence showed that there was a wide khat cultivation in the Sidama zone (Southern part of Ethiopia) (Kassa et al., 2017); which supports the high prevalence in the region. Intervention programs for substance use problems should be designed based on regional priorities.

As of this study, high school students who use khat were 4.1 times [95%CI: 2.5-6.8], more likely to ever use cigarettes. Studies conducted in African countries and Arabian Peninsula showed that, there is a concurrent use of cigarette smoking and khat use (Guliani et al., 2019, Adane et al., 2021, Nakajima et al., 2016, Fiidow et al., 2022). Our study reported that students who ever used smokeless tobacco, shisha and drank alcohol had a higher odd for ever use of cigarettes. Once students are exposed to a substance, they most likely would be eager to experiment with other substances. Furthermore, students may use different substances concurrently or afterward to compliment the effect on each other. Of this study, having a friend who smokes cigarettes was significantly associated with the ever use of cigarettes and this agrees with studies conducted in Ethiopia and other countries (Getachew et al., 2019, Polanska et al., 2022, Jallow et al., 2017).

2.2. An Emerging Problem of Shisha Smoking among High School Students in Ethiopia (Publication two)

Globally, shisha use accounts for a significant amount of tobacco use and it is mostly prevalent in Middle East, Asia, and Africa continents (World Health Organization, 2015a). Also, it was reported that shisha smoking prevalence was strongly increased from 2007 to 2016 among adolescents and young adults in Germany (Orth and Merkel, 2018). The prevalence of shisha use reported in this study is low compared to studies conducted among high school and university students in Egypt, Rwanda, and Saudi Arabia (Muzammil et al., 2019, Kabbash and Saied, 2020b, Omotehinwa et al., 2018, Othman et al., 2019). One possible explanation might be that these studies were conducted in the cities and our study included regions and peri-urban areas

where shisha smoking was not popular. Furthermore, our study only focused on high-school students and shisha smoking prevalence could be higher among university students. Our study report is comparable to the Global Youth Tobacco survey conducted in Ghana (3.1 %) which included participants in the age range between 11 and 17 years (Logo et al., 2020).

Of this study, Hawassa city in the Southern part of Ethiopia had a higher prevalence of shisha smoking compared to other regions. This could be explained by wider khat cultivation in the region due to its economic advantage and concurrent use of tobacco products with khat (Tolcha, 2020, Nakajima et al., 2016). From students who never used shisha, 50 % of the study participants were not sure whether shisha smoking is harmful as cigarettes and 39 % reported that shisha smoking is less harmful for health than cigarette smoking. In agreement with this study, a systematic review of 45 papers from Global North and 41 from Global South reported that shisha smoking was perceived as less harmful and less addictive than cigarettes smoking (Arshad et al., 2019). A study conducted in Finland among 12 to 18 years old adolescents showed that, 36 % of girls and 38 % boys did not know that shisha is harmful to health though more than 95 % of adolescents knew the harmful effects of cigarettes (El-Amin et al., 2022). In Ethiopia, health education about the harmful effects of shisha smoking is not common. There are myths like shisha smoking is good for skin color and harmful substances would be filtered out through water (Martins and Santos, 2019).

Ethiopia is one of the countries with a strong tobacco control law where selling and smoking flavored tobacco is forbidden (Ethiopian Food and Drug Administration, 2019). Moreover, it is forbidden to sell any kind of tobacco products within 100 meters radius from the school area. In contrast to this, our study reported that there were shisha houses within 100-meter radius for more than 7 % of schools. This shows the gap in the implementation of tobacco control law in Ethiopia.

As of this study, ever use of khat (AOR:4.2, 95% CI: 1.9-10.4), marijuana (AOR:3.9, 95% CI: 1.4-11.1), cigarettes (AOR:8.2, 95% CI: 3.4-19.8), and smokeless tobacco (AOR:3.1, 95% CI: 1.1-8.4) were significantly associated with ever use of shisha. In agreement with this, studies conducted in Africa, Europe and Asia indicated that adolescent's exposure to different substances were associated with shisha smoking (Galimov et al., 2019, Logo et al., 2020, Omotehinwa et al., 2018, Santano-Mogena et al., 2021). This could be explained by, once students are exposed to one substance, students most likely try or experiment with other accessible substances. Moreover, studies in Ethiopia and Yemen reported that, khat and tobacco products are used concurrently (Adane et al., 2021, Nakajima et al., 2016, Reda et al., 2012).

2.3. “If I don’t smoke shisha, I won’t be able to sleep” : lived experiences of high school students in Ethiopia” (publication three)

In this qualitative study, a total of 25 students participated from Addis Ababa (the capital city) and Adama (the main town of Oromia region). The study was conducted to explore the lived experiences of shisha smoking including causes of initiation, accessibility, concealment, regrets, health risks and fund among high school students. Students had previous or current shisha smoking experience. Based on the WHO FCTC measures should be taken to provide a protection for the public from exposure to tobacco smoke in workplaces, public transport, indoor public places and as appropriate, other public places (World Health Organization, 2003).

2.3.1. Initiation and continuous use of shisha smoking

Peer influence

As of this study peer influence had played a major role in initiation and continuous shishasmoking. In agreement with our study, other studies conducted elsewhere reported the role of peer influence in shisha smoking among young people (Othman et al., 2019, Ezekiel et al., 2018a). A study in the UK showed that shisha cafes are places where people get pleasure and have a chance to interact socially (Mugenyi et al., 2018).

To relive from stress

Based on this study, shisha was considered as an escape from stress. Students started shisha smoking to forget any stressful circumstances in their life. This included bad childhood experiences, disagreements with close family and a bad mood. Students considered shisha as an escape mechanism from stressful situations. Other evidence also showed that shisha was used by the young people to relax, entertain, and get a pleasure (Mugenyi et al., 2018, Arshad et al., 2019)

Khat chewing

Khat chewing was blamed as reason for continuous use of shisha. Our data described the strong link between khat chewing and shisha smoking. One of the interviewees who was a regular shisha user for the past four years stated that; when someone chews khat, he/she may want to smoke shisha. Students smoked shisha at the same time with khat chewing or afterwards. It was said that shisha smoking complements the effect of khat, and it was common for the interviewees to state that they would not like shisha if they did not chew khat. Khat was blamed for being a gateway to use tobacco products (Guliani et al., 2019, Guracho et al., 2020). Khat is a plant that causes sleep problems (Alshoabi et al., 2022) and depression after the effect from the plant ends. So, students may use different substances including shisha to avoid the effect. Moreover, students may prefer

shisha than cigarettes because of the different and attractive flavors.

Accessibility of shisha and having a free time

Accessibility for shisha and having leisure time as reasons for continuous usage. Students can buy, rent, or even can make the shisha equipment by themselves using available materials. Moreover, they rent houses in a group for the purpose of shisha smoking and buy the *Mossel*. A study conducted in the age group of 11-18 years in Lebanon showed that accessibility of shisha as a reason for continuous use (Akel et al., 2022).

Based on the tobacco control law in Ethiopia, shisha smoking is forbidden, but community awareness about the tobacco control laws is important for the prevention and control of shisha in Ethiopia. Of this study, participants mentioned that when they had a free time, there were not enough affordable places where they can socialize with friends. The only options would be khat shops and shisha houses. In agreement with this, a study conducted in 2020 in all regions of Ethiopia showed that only limited number of functional youth centers were existed (Tefera et al., 2020). As a country with a young population, affordable youth centers where students can have activities and spend time with their friends should be expanded.

2.3.2. Concealment about shisha use

Based on this study report, students didn't talk about their shisha use to their parents and teachers. They used different techniques to conceal their practice. Students would go out while their parents were sleeping, wear their school uniform and pretend for their parents as if they spent their day in the school but they may not attend the whole class instead use the time for substance use. Most of the government schools in Ethiopia have 50 plus students in one class section where it is challenging for teachers to closely follow up. The reason for hiding could be related to fear of not getting approval for their shisha use practice. This made it impossible to receive guidance from parents and teachers.

2.3.3. Students regret about their addiction life

Students who were addicted to shisha and other substances, regretted their academic performance, time, and money they spent. Our study also clearly showed that students practice shisha smoking at the same time as school time (see publication 3). This shows the consequences of shisha use in academic performance for adolescents. In most cases students went to shisha houses during the school time which could explain their poor academic performance. In agreement with this, a cross

sectional study conducted among adolescents in Sudan showed that lower academic performance was associated with shisha use (Othman, et al., 2019).

2.3.4. Health risks and effects of shisha smoking

In our study, students reported that they had experienced different symptoms like difficulty of breathing, cough, chest pain, headache, vomiting and even fainting while they smoke shisha. For shisha smoking burning charcoal is mostly used as the heat source, the smoke contains toxicants produced both from charcoal and tobacco products (World Health Organization, 2015b). Shisha smoking is forbidden in Ethiopia; students usually smoke in a small house with closed doors and windows. Due to this carbon monoxide intoxication can result in shisha smoking session, which can lead to syncope (Chenoweth et al., 2021) due to the secondary formation of carboxyhemoglobin in the blood, which compromises the transportation of sufficient oxygen to body parts including the brain. This implies the effect of shisha smoking on students' health, economy, and social life.

Based on this study, female shisha smokers had a risk for pregnancy and other reproductive health problems. An interviewee who was regularly using shisha for four years stated that: In shisha houses, it is common to use other substances like khat, cigarettes and hashish. Especially, hashish has a potential for intoxication apparent by disturbances in the level of consciousness, cognition, perception, and behavior (World Health Organization, 2016).

2.3.5. Source of funds to buy shisha

Our study showed that students' expense for shisha depends on the type of house, the number of people in the group, time spent in smoking shisha and number of other substances they use in the shisha house. Students reported that they would spend 150 Ethiopian birr (\$3) and this expense did not include expenses for khat, water, coffee, and other things. Students added that it was a common thing to share expenses for friends and they do it usually. Their main source of funding for substance was their parents. Students receive money from their parents in the name of other expenses in the school. Few students had jobs where they could fund their expenses for shisha. Our study also showed that students would steal money or participate in robbery to cover the expenses for shisha. This study revealed the social consequences of adolescent's shisha use and the need for interventions.

2.4. Strengths and Limitations

This school survey is the first-ever conducted to describe consumption of tobacco, alcohol, khat, shisha and, other substances among school going adolescents covering a wide geographical area and large sample size in Ethiopia. It included a wide range of school-going adolescents from the main capital city, urban, and peri-urban areas of the four different regions (Oromia, Amhara, Tigray and Sidama). Similar to most studies in Ethiopia, the response rate (97 %) was high for the school survey (publication one and two), which minimize the risk of selection biases. The qualitative research to explore the lived experience of shisha smoking among school going adolescents is the first study conducted in the capital city (Addis Ababa) and the main town of Oromia region (Adama). Our study has limitations. First, this is a cross-sectional study, and it does not explore causal relationships. We cannot determine which substance is a cause for using other substances. Second, social norms may mask the true prevalence of substance use which was assessed using a self-administered questionnaire. To minimize this, the data collectors were not working in the school, school directors and teachers were not present in the class at the time of data collection. Third, our study finding is limited in the generalizability to the rural population in Ethiopia and for adolescents in the same age group who do not attend school. Fourth, the time of data collection coincides with the COVID-19 pandemic which resulted in schools' closure and affected the finalization of data collection. We were able to collect data from all target regions but not from all schools. Finally, we collected data from all eligible students who were present in the class at the time of the data collection and willing to participate in the study. This study finding might underestimate the actual prevalence of substance uses in Ethiopia, if students who use substances were more likely to be absent from the class. To recruit students for the qualitative research we have used a snowball sampling technique which has a limitation in recruiting similar students. To minimize this, we have used maximum variability criteria to select and recruit students. Moreover, there could be social desirability bias where boys overestimate and girls underestimate their shisha smoking experience. To avoid this, we informed the participant about the purpose of the study, and we encouraged them to tell us their actual shisha use experiences.

2.5. Conclusions

In Ethiopia, tobacco use among adolescents is low compared to most countries in Africa. However, it continues to evolve as a public health threat due to the existence of a big tobacco industry in the country and young population. Cigarette and khat uses were most prevalent in the capital city and Southern part of Ethiopia whereas almost 70% of regular alcohol drinker students were from the Northern region. Preventive measures should be set based on regional priorities on substance use problems.

The existing law not to sell alcohol for under 18 years may not be effective since three-fourth of regular alcohol drinkers use homemade beer. Thus, awareness raising programs for parents about the health risks of alcohol should be in place. Khat consumption is a gateway to use tobacco products and other substances and should be banned for under 18 children in addition to other preventive measures. The school environment should be free from tobacco products, khat and alcohol. Already existing tobacco control laws in the country to limit the availability of shisha and cigarettes within the school, and 100 meters premise should be enforced fully. Awareness-raising campaigns about the negative health effects of substance use including the reproductive health risks should be designed and implemented for high-school students in Ethiopia.

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4- Thesis

1. The prevalence of substance use among high school students in Ethiopia is generally low: 2.4 % of students were regular smokers of cigarettes, 2.6 % ever used shisha and 17 % of students were regular users of alcohol.
2. Cigarette smoking and khat chewing were highest in the southern part of Ethiopia, whereas alcohol drinking was highest in the northern areas of Ethiopia.
3. Ethiopian laws restrict drinking alcohol below the age of 18 years, but it is difficult to enforce the law since 75% of students who regularly drink alcohol used a local beer brewed at home.
4. Even though the availability of tobacco shops within 100 meters of the school compound is banned, 40 % of students reported that there were cigarette shops and more than 7% of schools had shisha houses within 100 meters of the school compounds.
5. Students who ever use smokeless tobacco [AOR: 9.4, 95 % CI:4.9–17.9], shisha [AOR:8.0, 95 % CI: 3.9–16.3], khat [AOR: 4.0, 95 % CI 2.5–6.8] and alcohol [AOR: 2.3, 95 % CI: 1.4–3.7] had a higher odd to ever use cigarettes.
6. Almost 40 % of students perceived smoking shisha as less harmful to health than cigarette smoking.
7. Peer pressure played a significant role in the initiation and continuing shisha smoking.
8. Students mentioned accessibility for shisha and leisure time as a reason for continuous usage.
9. Due to shisha smoking, students experienced different symptoms like cough, difficulty of breathing, chest pain, headache, vomiting and even fainting. Female students were prone to reproductive health problems.
10. For covering expenses related to shisha smoking, students would steal money or were involved in a robbery

Publications

- 1. Publication one-** Selamawit Hirpa, Andrew Fogarty, Adamu Addissie, Linda Bauld, Thomas Frese, Susanne Unverzagt, Eva Johanna Kantelhardt, Sefonias Getachew and Wakgari Deressa (2023). Prevalence and risk factors for tobacco, khat, and alcohol consumption among high school students in Ethiopia.

I was the key person in the research proposal writing, tool development, supervising the translation of the tool to local languages, conducting the pilot study, recruiting, and training data collectors, supervising the data collection, supervising the data cleaning process before data entry, creating the data entry template, data analysis, manuscript writing, and I was the corresponding author in the paper publication process.

- 2. Publication two-** Selamawit Hirpa, Andrew Fogarty, Adamu Addissie, Linda Bauld, Thomas Frese, Susanne Unverzagt, Eva Johanna Kantelhardt, Sefonias Getachew and Wakgari Deressa (2021). An Emerging Problem of Shisha Smoking among High School Students in Ethiopia. *Int. J. Environ. Res. Public Health* 2021, 18, 7023. <https://doi.org/10.3390/ijerph18137023>

I was the key person in the research proposal writing, tool development, supervising the translation of the tool to local languages, conducting the pilot study, recruiting, and training data collectors, supervising the data collection, supervising the data cleaning process before data entry, creating the data entry template, data analysis, manuscript writing, and I was the corresponding author in the paper publication process.

- 3. Publication three-** Selamawit Hirpa, Fiona Dobbie, Andrew Fogarty, Adamu Addissie, Mirgissa Kaba, Thomas Frese, Susanne Unverzagt, Eva Johanna Kantelhardt, Kamran Siddiqi, Linda Bauld and Wakgari Deressa (2022). "If I don't smoke shisha, I won't be able to sleep": lived experiences of high school students in Ethiopia. *Journal of Global Health Reports*. I was the main person in conceiving the research question, proposal writing, developing the interview guide, conducting in depth interviews with other colleagues, supervising the data collection and coding, data analysis, manuscript writing, and I was the corresponding author in the paper publication process.



Prevalence and risk factors for tobacco, khat, and alcohol consumption among high school students in Ethiopia

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Abstract

Background Tobacco, khat, alcohol, and marijuana are the main risk factors for non-communicable diseases. There are limited studies on substance use in Ethiopia, especially among secondary school students. This study aims to determine the epidemiology of substance use among secondary school students in Ethiopia.

Methods This cross-sectional study was conducted in March 2020 in four large regions of Ethiopia and the capital Addis Ababa. We collected data from 3,355 grade 9 and grade 10 students in 36 randomly selected high schools. Data were collected on tobacco, khat, alcohol and other substances. Mixed effect logistic regression models were fitted to determine the predictors of cigarette smoking.

Results 157 (4.7%) of the participants ever smoked cigarettes and 81 (2.4%) were current smokers. 106 (3.2%) ever used smokeless tobacco, 1,342 (41.8%) had ever drunk alcohol, 290 (8.7%) ever used khat, 137 (4.8%) chewed khat regularly and 76 (2.3%) ever used marijuana. There was a significant regional variation in substance use patterns; cigarette and khat use was the highest in southern regions, whereas alcohol use was highest in the northern areas. Availability of cigarette and khat shops within a 100-meter radius of the school compound was reported by 1,229 (37.5%) and 816 (25%) students, respectively. Three hundred fifty-four (10.9%) students had ever seen someone smoking a cigarette in the school compound. Ever use of smokeless tobacco (Adjusted Odds Ratio (AOR) = 9.4, 95% CI: 4.9–17.9), ever use of shisha (AOR = 8, 95% CI: 3.9–16.3), ever use of khat (AOR = 4.1, 95% CI: 2.5–6.8), ever use of alcohol (AOR = 2.3, 95% CI: 1.4–3.7), having a friend who smoked a cigarette (AOR = 2, 95% CI: 1.2–3.5), and ever seen someone smoking a cigarette in the school compound (AOR = 1.9, 95% CI: 1.1–3.4) were associated with ever use of cigarettes.

Conclusion Substance use prevalence in Ethiopia has regional variations and prevention strategies should be tailored to the needs of the regions. Although this study reported a lower prevalence of cigarette smoking, students could access cigarettes and khat in nearby school areas. The existing tobacco control laws that prohibit selling tobacco products to children and adolescents under 21 years of age and ban establishing tobacco shops close to school compounds should be enforced.

Keywords Tobacco, Khat, Alcohol, High school, Students, Ethiopia

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Background

Tobacco, khat, alcohol, and marijuana are among the list of substances used by many globally and cause public health challenges due to their negative effects on the physical, mental, and social well-being of individuals who use them [1]. The World Health Organization (WHO) included tobacco and alcohol among the risk factors for four main non-communicable diseases (NCDs): chronic respiratory diseases, diabetes, cardiovascular diseases, and most cancers [2]. Tobacco products are substances that are completely or partly made of tobacco leaf that can be administered through a variety of routes including smoking, chewing, sucking and nasal application as a snuff [3]. Tobacco smoke contains more than 7,000 chemicals and hundreds of these chemicals are proven to be hazardous to health [4].

Globally, an estimated 24 million children between the ages of 13 and 15 years use tobacco [5]. In Ethiopia, a previous study in Addis Ababa and the surrounding towns estimated a 3% prevalence of cigarette smoking among school-going adolescents [6]. These figures are low in comparison to studies conducted in other African countries [7], [8]. However, the existing large number of young population and the tobacco industry's aspiration to create new markets in the country [9] laid the ground for a rapid future increase in consumption unless proper preventive measures are in place.

Khat is a plant containing a psycho-stimulant substance, and khat chewing is a pressing public health problem in East Africa. It is mostly chewed but it can also be infused as a tea or can be dried and smoked like a cigarette [10]. It is commonly grown in the region (Ethiopia, Kenya) and the Arabian Peninsula [11]. Studies have shown that khat consumption is associated with cardiovascular, gastrointestinal, mental, and oral hygiene problems [12], [13], and a cause for household economic instabilities [14]. In Ethiopia, khat is commonly used for social recreation, religious rituals and as a stimulant [15], [16], particularly by students aiming to improve academic performance. A study in eastern Ethiopia indicated that the mean age to start khat chewing was 15.1 years [10] and multiple substance use (khat, cigarette, and alcohol) was high [10]. Apart from the negative effects of khat on health, people who use it can also progress to cigarette smoking and alcohol use. The excessive use of alcohol is a major global contributor to morbidity, mortality, and injury. Among the health impacts of alcohol dependence, liver cirrhosis, cancers, and injuries are commonly reported [16]. Alcohol consumption is strongly associated with behavioral and mental disorders of youth. A meta-analysis that included studies conducted in Ethiopia between the 23% [17]. years 2000 to 2019 reported

that regular alcohol consumption among high school students was Marijuana use among adolescents is linked with mood disorders, poor academic performance, psychotic and addiction problems [18]. Limited studies exist about the prevalence of marijuana use in Ethiopia. A study conducted in the year of 2011 in the southern part of Ethiopia showed that 0.9% of university students used marijuana in the past 12 months [19].

Ethiopia is the second- most populous country in Africa with more than 115 million people of which 60% are under the age of 25 years [20]. Ethiopia is the largest producer of khat in the world, and it is one of the largest export commodities with annual earnings of more than one hundred million dollars [21], [22]. In Ethiopia, most previous studies on substance use were limited to mostly khat use among university students living in not more than one region [10], [14], 15], [23]. The current study included four big regions and the capital Addis Ababa. This makes it the first study to cover a wide geographic area and a range of substances among secondary school students. Accurate estimates of substance use are critical to designing prevention and control strategies. Therefore, this study aimed to estimate the prevalence and risk factors of tobacco, khat, and alcohol use among school-going adolescents in Ethiopia.

Methods

This study draws on data from a survey described in a previously published paper on shisha smoking among school-going adolescents in Ethiopia [24]. **Study setting and design** Ethiopia has 11 regions and two chartered cities. The official secondary school age is between 15 and 18 years. The national Gross Enrollment Ratio (GER) for grades 9–12 was 32% in the year 2018/2019 with Addis Ababa (the capital city) having the highest with 87.6% [25]. This study was conducted in the main cities (i.e., Adama, Bahir Dar, Hawassa, Mekelle, and Addis Ababa) and peri-urban (within a 50 km radius of the main cities) areas of the four large regions.

Study population and sample size calculation

School- aged adolescents 13–22 years who were in grades 9 and 10 participated in the study. Open Epi Version 7.02 statistical software [26] was used to calculate the minimum sample size. The sample size was calculated to estimate the prevalence of cigarette, shisha, khat use, and alcohol consumption [27] with a 95% precision, 80% power and an Intra-cluster Correlation Coefficient (ICC) of 0.1. 20% was added for possible non-response for the pupils and 10% for the schools. The minimum sample size was 4,714 clustered into 50 schools. However, due to the COVID-19 pandemic and subsequent school closures, in March 2020, we were able to collect data

only from 36 out of the 50 schools. The total number of schools included from urban and peri-urban study areas was 6 from Adama, 5 from Hawassa, 9 from Bahir Dar, 10 from Mekelle, and 6 from Addis Ababa. The respective number of study participants were 585 from Adama, 557 from Hawassa, 874 from Bahir Dar, 881 from Mekelle and 458 from Addis Ababa.

Sampling procedures

To produce a representative sample of study participants, a two-stage cluster sampling approach was employed. The total number of schools in the sampling frame was four hundred fifty-five (455). For the selected urban and peri-urban areas, of each region, two sampling frames were prepared separately, which included the list of government and private schools, and the study schools were randomly selected from these frames. The secondary sampling units were class sections for grades 9 and 10 in each school. The mean number of sections in preschools was 9.5. All students in the selected class section were invited to participate in the study and the sampling probability was 1.5%.

Survey instruments and data collection

Interview questionnaire was used to assess substance use and its risk factors among students. School directors were interviewed about the availability of cigarette and khat shops surrounding the school compound. The tools were developed by adapting the Global Youth Tobacco Survey (GYTS) [28] and the Youth Risk Behavior Survey (YRBS) instruments and by reviewing relevant literature. The tools were translated from English to 3 local languages (Amharic, Afan Oromo, and Tigrigna) and were pre-tested among 250 students. Data collection was conducted from March 9 to 17, 2020 after giving a 2-days training for data collectors.

Consent was obtained from each schoolmaster to collect data from students in the regular class session in the absence of their teachers or school directors. Students in the selected classes were asked to complete the paper-based questionnaire individually and to consult the data collectors for any ambiguity on the questions. Due to the COVID-19 pandemic, we could not collect data from all the selected 50 schools.

Data analysis

After data were checked for completeness and consistency, Epidata Version 3.1 software [29] was used to enter the data. Data were analyzed using Stata/SE14.0 software [30]. The survey weight was calculated considering the total and the selected schools in the study areas, the total number of grade 9 and 10 students in the study areas and the number of students who participated in the study. To determine our survey weight, we used STATA command, [generate weight_cluster = (FPC1 FPC2)

^-1]. After that, we set our survey data using STATA command “svyset PSU [pweight= weight_cluster], fpc (FPC1)||SSU, fpc(FPC2) single unit(centered). The primary sampling unit (PSU) for our analysis was schools and the secondary sampling unit (SSU) was class sections and all pupils in the selected sections were invited to participate in the study. The primary outcome variable of this study was ever smoking cigarettes. Independent variables in the level- 1 model were socio-economic variables and ever use of different substances. Independent variables in model-2 included all the 11 variables in model-1 and an additional 4 school- level variables.

A two-level mixed-effects logistic regression model was fitted to adjust for confounding variables and account for school level clustering. The model fitting was a three- step process where the null model (model-0) measured the random effect and ICC in the odds of ever smoking cigarettes. The ICC represented the proportion of the within school variation on ever smoking cigarette in the total variation [31]. The first model (model-1) was fit to assess the effect of student-level predictors on the odds of ever smoking cigarettes. The final model (model-2) was fit to assess the effect of student-level characteristics and cluster level (school level) factors on ever smoking cigarettes. The *xtmelogit* STATA command was used to run the models. Crude odds ratios (OR) and adjusted OR (AOR) with their corresponding 95% confidence intervals (CIs) were calculated using univariate logistic and multivariable mixed-effects logistic regression models, respectively. The level of statistical significance was set at $\alpha=0.05$.

Results

A total of 3,457 students were invited to participate in the study from 36 schools (82% of the targeted 50 schools) and 3,355 (97%) participated in this study. Data were analyzed for 3,347 students after discarding eight questionnaires that were incomplete for most of the variables. In this study, 1,804 (54%) were females. The age of 3,001 (89.7%) students was between 15 and 18 years and the mean age (\pm SD) was 16.5 ± 1.4 years. Of study participants who ever used cigarettes, 89 (57.5%) started smoking in the age between 12 and 16 years. A total of 2,618 (78%) students were from government schools. Additional information on students' socio-demographic characteristics is described elsewhere²⁴.

Prevalence of substance use among high school students in Ethiopia.

A total of 157 (4.7%) of students ever used cigarettes and 81 (2.4%) were regular cigarette smokers. The prevalence of ever use and regular use of khat was 290 (8.7%) and 137(47.9%), respectively. We found variations in the prevalence of substance use between regions (Table 1).

Table 1 Weighted prevalence of substance use among high school students in Ethiopia (March 2020)

Variables	Categories	Frequency (%)	95% CI*
Ever use of cigarette (n= 3,347)	Overall	157 (4.7)	[3.3–6.7]
	Addis Ababa	34 (7.4)	[5.8–9.5]
	Adama	24 (4.1)	[2.2–7.6]
	Bahir Dar	22 (2.5)	[1.4–4.5]
	Hawassa	64 (11.4)	[7.7–16.5]
Current use of cigarette (n= 3,347)	Overall	81 (2.4)	[1.7–3.5]
	Addis Ababa	16 (3.5)	[2.2–5.6]
	Adama	13 (2.2)	[1.0–5.0]
	Bahir Dar	11 (1.3)	[0.5–3.0]
	Hawassa	34 (6.1)	[4.2–8.7]
Ever drink alcohol products (n= 3,347)	Overall	1342 (40.1)	[32.3–48.5]
	Addis Ababa	162 (35.4)	[30.4–40.7]
	Adama	145 (24.7)	[17.8–33.2]
	Bahir Dar	607 (69.4)	[57.5–79.2]
	Hawassa	125 (22.3)	[15.1–31.7]
Regularly drink alcohol (n= 1,347)	Overall	559 (41.5)	[34.6–48.7]
	Addis Ababa	51 (31.5.0)	[18.7–47.9]
	Adama	37 (25.2)	[16.7–36.1]
	Bahir Dar	248 (40.7)	[29.8–52.8]
	Hawassa	81 (64.8)	[50.2–77.1]
Ever use of khat (n= 3,347)	Overall	290 (8.7)	[6.6–11.3]
	Addis Ababa	60 (13.1)	[10.5–16.2]
	Adama	68 (11.6)	[9.8–13.7]
	Bahir Dar	79 (9.0)	[6.1–13.1]
	Hawassa	75 (13.4)	[7.9–21.8]
Regular use of khat (n= 286)	Overall	137 (47.9)	[42.1–53.7]
	Addis Ababa	21 (35.6)	[13.2–66.7]
	Adama	32 (47.1)	[37.2–57.1]
	Bahir Dar	30 (38.5)	[29.1–48.8]
	Hawassa	51 (68.0)	[50.3–81.7]
Ever use of smokeless tobacco (n= 3,346)	Overall	106 (3.2)	[2.0–5.0]
	Addis Ababa	17 (3.7)	[2.1–6.5]
	Adama	18 (3.1)	[1.9–4.9]
	Bahir Dar	10 (1.1)	[0.4–3.6]
	Hawassa	37 (6.6)	[4.3–10.1]
Ever use of marijuana (n= 3,244)	Overall	76 (2.3)	[1.6–3.1]
	Addis Ababa	26 (5.8)	[4.5–7.1]
	Adama	12 (2.0)	[1.5–2.8]
	Bahir Dar	18 (2.1)	[1.4–3.0]
	Hawassa	18 (3.3)	[1.7–6.1]
	Mekelle	2 (0.24)	[0.0–1.6]

*Confidence Interval

Table 2 Weighted proportion of substance use by socio-demographic characteristics of high school students in Ethiopia (March 2020)

Variables	Categories	Frequency (%)	95% CI
Sex proportion of participants who ever used cigarettes (n= 1173)	Male	114 (73.5)	[65.9–19.7–34.1]
	Female	41 (26.5)	[19.7–34.1]
Proportion by age intervals of participants who ever used cigarettes (n= 1573)	13–14	3 (1.9)	[0.5–5.1]
	15–17	107 (68.2)	[60.6–19.7–34.1]
	18–19	41 (26.1)	[19.7–34.1]
	20 and above	6 (3.8)	[1.6–7.8]
Age at initiation of cigarette smoking (n= 1723)	≤ 11 years	17 (13.8)	[8.5–20.8]
	12–14 years	41 (33.4)	[25.4–30.7–12.7–17.2]
	15–16 years	48 (39.0)	[30.7–12.7–17.2]
	17 and above	17 (13.8)	[12.7–17.2]
Ever seen anyone smoking in the school (n= 3,261)	No	2,254	[63.1–6.9–16.4]
	Yes	354 (10.9)	[6.9–16.4]
	I am not sure	653 (20)	[18.7–31.1–14.7–19.4]
Regular alcohol drinkers consume (n= 559)	Beer	196 (36)	[31.1–14.7–19.4]
	Wine	99 (18.1)	[14.7–19.4]
	Local drink (Areke)	106 (19.4)	[15.9–22.4]
	Local honey wine (Tej)	95 (17.4)	[14.1–20.3]
(More than one response was possible)	Homemade beer (Tella)	408 (74.7)	[69.2–76.6]

The highest proportion of cigarette smoking, khat chewing and ever use of smokeless tobacco was reported from Hawassa, southern Ethiopia. 1342 (40.1%) of students ever drank alcohol and the highest prevalence (69.4%) was from Bahir Dar, northwestern Ethiopia. We found that 76 (2.3%) of students used marijuana and the highest proportion was from Addis Ababa (5.8%).

Socio demographic characteristics of substance users

From students who ever used cigarettes 114 (73.5%) were males (Table 2). More than 68.2% of students who ever used cigarettes were in the age group of 15–17 years. Three hundred fifty-four (10.9%) students had ever seen someone smoking cigarettes in the school compound. Almost 74.7% of regular alcohol drinkers consumed homemade beer (*Tella*).

Cigarette smoking status of friends and parents

Three hundred sixty (11%) study participants reported that they had friends who smoked cigarettes. One hundred thirty-five (38.4%) of them acknowledged that their friends smoked every day (Table 3). More than 90% of the students' fathers and mothers did not smoke cigarettes.

Access to cigarettes and khat retail outlets

Of the students, 851 (26.0%) had ever gone to the shop to buy cigarettes and 206 (24.6%) of them reported that it was easy to buy cigarettes (Table 4).

Table 3 Weighted prevalence of cigarette smoking practice of friends and parents of the study

Variables	Categories	Frequency (%)	[95% CI]
Any of your friends' smoke cigarettes (n= 3,277)	No	2,389	[71.4–74.4]
	Yes	360	[9.9–12.1]
	I don't know/I am not sure	528 (16.1)	[14.9–17.4]
How often do your friends smoke cigarettes (n= 352)	Every day	135	[33.4–43.5]
	Weekly	25	[4.8–10.2]
	Sometimes	94	[22.3–31.5]
	I don't know/I am not sure	98 (27.8)	[23.4–32.7]
Father smokes cigarettes (n= 3,277)	No	2,969	[89.6–91.6]
	Yes	60	[1.4–2.3]
	I don't know	248	[6.7–8.5]
Mother smokes cigarettes (n= 3,277)	No	3,125	[94.6–96.0]
	Yes	5 (0.2)	[0.1–0.3]
	I don't know	147 (4.5)	[3.8–5.2]

Table 4 Access to cigarettes and khat retail outlets among high school students in Ethiopia (March 2020)

Variables	Categories	Frequency (%)	[95% CI]
Ever gone to the shop to buy cigarettes? (n= 837)	No	2,423	[72.5–75.5]
	Yes	851 (26.0)	[24.5–27.5]
Buying cigarettes from a shop? (n= 837)	Very Difficult	327 (39.1)	[35.8–42.4]
	Easy	145 (17.3)	[14.8–20.0]
	Very easy	206 (24.6)	[21.8–27.6]
	Other	159 (19.0)	[16.5–21.8]
Where do you get cigarettes from? (n= 851) (More than one answer was possible)	Supermarket	133 (12.9)	[10.9–15.0]
	Petty trader	649 (62.8)	[59.9–65.7]
	Street	171 (16.6)	[14.4–18.9]
	Friends	29 (2.8)	[1.9–4.0]
Are there any cigarette shops within 100 m radius from your school? (n= 3,274)	No	909 (27.8)	[26.3–29.3]
	Yes	1,229	[35.8–39.2]
Do students buy cigarettes from shops that are found in 100 m radius from the school	I don't know	1,136	[33.1–36.3]
	Yes	148 (12.3)	[10.5–14.2]
*Are there cigarette shops within 100 m radius from the school	No	297 (24.7)	[22.3–27.1]
	Yes	760 (63.0)	[60.3–65.8]
Are there khat shop within 100 m radius from the school	No	14 (38.9)	[24.1–55.4]
	Yes	22 (61.1)	[44.6–75.9]
Do students chew khat in shops that are found in 100 m radius from the school	No	1,186	[34.7–38.0]
	Yes	816 (25.0)	[23.6–26.5]
	I don't know	1,258	[36.9–40.3]
Do students buy khat in shops that are found in 100 m radius from the school	No	89 (11.1)	[9.1–13.5]
	Yes	188 (23.7)	[20.7–26.7]
Do students buy khat in shops that are found in 100 m radius from the school	I don't know	518 (65.2)	[61.8–68.4]

*Response by school directors

A total of 1,229 (37.5%) students acknowledged that there were shops for cigarettes within 100 m radius of the school. Of the interviewed 36 school directors, 22 (61.1%) responded that there were shops for cigarettes within a 100- meter radius from the schools. 816 (25.0%) of students mentioned that there were khat shops within a 100-meter radius of the school compound.

Individual and school-level variables associated with ever smoking cigarettes

Significantly associated variables with ever use of cigarettes, in model-1 and model-2 were similar (Table 5). Furthermore, one variable from the school level variables was significantly associated with ever use of cigarettes. Ever use of smokeless tobacco (AOR= 9.4, 95%CI: 4.9–17.9), ever smoked shisha (AOR= 8.0, 95% CI: 3.9–16.3), ever used khat (AOR= 4.1, 95%CI: 2.5–6.8), ever drank alcohol (AOR= 2.3, 95%CI:1.4–3.7), friends smoked cigarette (AOR= 2.0, 95% CI: 1.2–3.5), and ever seen anyone smoking cigarette in the school (AOR = 1.9, 95% CI:1.1–3.4) were strongly associated with ever use of cigarettes.

Model-1 includes student-level characteristics as socio- economic variables (age, sex, parent's residence, source of income) and ever use of different substances (khat, smokeless tobacco, alcohol, marijuana, shisha, any of your friends and/or father smoke a cigarette). Model-2 includes student-level and school-level-characteristics (school type, ever seen anyone smoking cigarette in the school, cigarette shops, number of students in the school).

Discussion

While cross-sectional surveys regularly provide data on substance use in adolescents in high income countries, there remain relatively few reports of this kind in low- income and middle-income countries including the countries in East Africa region. Ever and regular cigarette smoking prevalence is 4.7% and 2.4%, respectively. 40% of students had ever drunk alcoholic products and 8.7% had ever used khat. A small proportion (3.2%) of participants had ever used smokeless tobacco and 2.3% had ever used marijuana. Ever use of smokeless tobacco, shisha, khat, alcohol, and friends who smoked cigarettes were individual participant level factors that were significantly associated with ever use of cigarette. From the school- level variables, ever seeing anyone smoking in the school was significantly associated with ever use of cigarettes. In Ethiopia therefore, substance use prevalence has a wide variation across regions due to accessibility, social norms, geographic, religious, and socio-economic factors [32]. We reported differences in the prevalence of cigarettes, alcohol, khat, smokeless tobacco and

Table 5 Multi-level logistic regression model for ever use of cigarettes among high school students in Ethiopia (March 2020)

Variables	Categories	Ever smoked cigarette (%) n= 157	Model-1 OR (95% CI)	Model-2 AOR (95% CI)
Age	13–17	108	-	-
	18 and above	45	0.9 [0.6–1.5]	0.9 [0.5–1.5]
Sex	Male	112	-	-
	Female	39	0.6 [0.4–1.0]	0.6 [0.4–1.0]
Parent's residence	Rural	42	-	-
	City	111	1.4 [0.8–2.3]	1.3 [0.8–2.3]
Source of income from parents	No	29	-	-
	Yes	124	1.2 [0.6–2.3]	1.2 [0.6–2.3]
Ever use of khat	No	71	-	-
	Yes	82	4.4 [2.7–7.1]	4.1 [2.5–6.8]
Ever use smokeless tobacco	No	104	-	-
	Yes	49	8.7 [4.6–16.4]	9.4 [4.9–17.9]
Ever drink alcohol	No	43	-	-
	Yes	110	2.3 [1.4–3.7]	2.3 [1.4–3.7]
Ever used marijuana	No	118	-	-
	Yes	33	1.5 [0.7–3.5]	1.4 [0.6–3.2]
Ever smoked shisha	No	101	-	-
	Yes	51	7.8 [3.9–15.7]	8.0 [3.9–16.3]
Any of your friends smoke a cigarette	No	59	-	-
	Yes	76	2.4 [1.4–4.0]	2.0 [1.2–3.5]
	I don't know	18	1.1 [0.6–1.9]	1.0 [0.5–1.9]
Father smokes cigarette	No	129	-	-
	Yes	6	2.2 [0.8–6.4]	2.2 [0.8–6.3]
	I do not know	18	1.3 [0.7–2.5]	1.2 [0.6–2.3]
School type	Government	120	-	-
	Private	33	-	1.2 [0.7–2]
Ever seen anyone smoking a cigarette in the	No	81	-	-
	Yes	48	-	1.9 [1.1–3.4]
	I don't know	23	-	1.1 [0.6–2]
Cigarette shops within 100 m radius	No	46	-	-
	Yes	107	-	1.2 [0.7–2]
Number of students in the school				1.1 [0.9–1.3]

(-) Reference group

marijuana in different regions. Ever use of cigarette, smokeless tobacco and khat were highest in Hawassa, southern Ethiopia. This could be explained by wide khat cultivation in the region, also a common practice of concurrent use of khat chewing and cigarette smoking [33], [34]. Studies that explore the culture and perceived health risks in relation to smokeless tobacco are needed to understand the higher prevalence in Hawassa. Our study finding of ever use of khat in this region (13.4%) is comparable to the study conducted in the same region (14.6%) in the year 2015 [35].

The lowest rate of cigarette and khat use in Mekelle, northern Ethiopia, reported in this study could be described as the region being the first in banning khat cultivation and consumption. Moreover, cigarette smoking in public places was banned in 2015 [32]. In Ethiopia, there are national laws regarding preventive

measures for the use of tobacco products and alcohol. This is encouraging; however, it takes more attention to enforce the law both in the capital and the regions.

Our study reported a lower prevalence of current use of cigarettes compared to studies conducted in Ghana, Uganda, and other parts of Ethiopia [7], [8], [10], [36]. Studies conducted in other parts of Ethiopia were specific to one city or town where the problem of cigarette smoking or other substances, such as khat chewing, was common which could explain the higher prevalence of cigarette use.

In this study, school-going adolescents who use khat were 4.1 times more likely to ever use cigarettes. Studies conducted in the adult population and adolescent age groups reported that khat chewing is a gateway to tobacco products [32], [34], [37]. This study also found that students who ever used smokeless tobacco,

shisha and drank alcohol had higher odds of ever use of cigarettes. Once students are exposed to one substance, it is likely that they would experiment with new substances leading to concurrent use of substances.

Having a friend who smokes cigarettes was significantly associated with the ever use of cigarettes and this agrees with studies conducted in other parts of Ethiopia and other countries [6], [33], [38], [39]. This could be the result of peer influence or having a higher chance that adolescents would have friends with similar experiences. To minimize peer influence, awareness programs about the health effects of substance use should be designed for schools. Moreover, students who had ever seen anyone smoking cigarettes in the school were significantly associated with ever use of cigarettes. Under normal circumstances, it is not common to see someone smoking in school compounds. However, students smoke in hiding places like at the back of toilets in schools and those who ever smoked cigarettes had a higher chance of reporting smoking in these places and seeing someone smoking.

Based on the existing tobacco control law in Ethiopia (proclamation 1112/2019) [40], selling tobacco products to adolescents and youth aged younger than 21 years is prohibited. Likewise, smoking in school compounds and selling tobacco products within 100 m premise from the school compound is also not allowed. However, more than 60% of school directors who took part in this study and almost 40% of students reported that there were cigarette shops within 100 m radius of the school compounds. 11% of students saw someone smoking in school compounds at least once and 26% ever went to a shop to buy cigarettes. This suggests a gap in the implementation of the tobacco control law in Ethiopia. Tobacco control law enforcers should give priority and design a system to make sure school environments are free from tobacco products and other substances. Also, schools should play a major role in the implementation of a smoke-free environment in schools and their surroundings.

Strengths and limitations

The study involved a range of substances and a wide geographic area. This enabled to generate a nationally representative data for multiple substances. However, the study is not without limitations, the cross-sectional study design provides a snapshot of substance use prevalence rather than exploring causal relationships. Second, social norms may mask the true prevalence of cigarette and other substance use. To minimize this, school directors and teachers were not present in the

class at the time of data collection. Finally, even though the response rate was high, we collected data from eligible students who were attending classes at the time of the survey. This could have affected our estimates, considering the possible association between substance use and poor school attendance. Since we have analyzed the data at the school and individual student levels, we have only accounted for school level correlation. This might undermine the power of the study in determining predictors of ever use of cigarettes. We haven't conducted non-response adjustment as well, however, since the response rate was considerably high, we don't expect this will have an impact on the study outcome.

Conclusion

Ever use and current smoking of cigarettes among school-going adolescents in Ethiopia were generally low and varied across regions. Cigarette, khat, smokeless tobacco and marijuana use were most prevalent in Hawassa, southern Ethiopia, and Addis Ababa. Whereas almost 70% of students from Bahir Dar, northern Ethiopia ever used alcohol. Cigarette shops were available within 100 m radius from more than half of the studied schools. Control measures should be taken to ensure that school environments are free from cigarettes, khat retailers. Like tobacco, there needs to be a law to control the pervasive khat chewing practice of adolescents. In addition, tobacco and alcohol control law enforcement should be strengthened and substance use prevention and control programs should be available in schools.

List of abbreviations

AOR	Adjusted Odds Ratio
CI	Confidence Interval
GER	Gross Enrollment Ratio
GYTS	Global Youth Tobacco Survey
ICC	Intra-Cluster Correlation Coefficient
IRB	Institutional Review Board
OR	Odds Ratio
NCDs	Non-Communicable Diseases
PSS	Primary Sampling Unit
SD	Standard Deviation
SPH	School of Public Health
SSU	Secondary Sampling Unit
WHO	World Health Organization
YRBS	Youth Risk Behavior Survey

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12889-023-15088-x>.

Supplementary Material 1

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Author contribution

WD, SH, AF, SG and LB conceived and designed the study. SH and WD designed the data collection tool. WD, AF, TF, SU, EV, AA, SG and LB reviewed the research proposal and gave comments. SH and SG coordinated the data collection. SH developed the data entry template and supervised the data cleaning and entry procedures. SH and WD analyzed and interpreted the data. SH drafted the manuscript. WD, AF, SU, TF, SG, AA, EK, and LB gave a critical review of the manuscript and feedback.

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Data availability

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Declarations

Ethics approval and consent to participate.

The research was conducted in accordance with the Helsinki Declarations. The study protocol received approval from the Institutional Review Boards (IRB) of the College of Health Sciences at Addis Ababa University (protocol number: 036/19/SPH) and the University of Nottingham, UK (Reference number: 497–1912). The need for informed consent from parents or guardians of children under 16 has been waived by the Institutional Review Boards (IRB) of the College of Health Sciences at Addis Ababa University (protocol number: 036/19/SPH) and the University of Nottingham, UK (Reference number: 497–1912). We have got written consent from each schoolmaster for the participation of children under 16. Written consent/assent was sought from each study participant.

Consent for publication

Not applicable.

Competing interests

None declared.

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An Emerging Problem of Shisha Smoking among High School Students in Ethiopia

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Abstract: Shisha smoking is also known as hookah, water pipe, goza, and nargile. Shisha use among the young is increasing globally. Shisha smoke results in a high concentration of carbon monoxide, tar, nicotine, and heavy metals which can be toxic to humans, especially with chronic exposure. This study aims to determine the prevalence and risk factors of shisha smoking among in-school adolescents in Ethiopia. Four regional states in Ethiopia (Oromia, Amhara, Southern Nations, Nationalities, and Peoples' Region, Tigray) and the capital city (Addis Ababa) were the study areas. A two-stage cluster sampling approach was employed to produce a representative sample. From the sampling frames in the study areas, 36 high schools were selected randomly. A multi-level logistic regression analysis was used to account for cluster-specific random effects, the effect of individuals', and school-level variables for ever-use of shisha. A total of 3355 secondary school grade 9 and 10 students aged between 13 and 22 years took part in this study. A total of 86 (2.6%) and 20 (0.6%) of the study participants, reported that they had ever smoked or were current smokers of shisha, respectively. Of all study participants, 38.6% perceived shisha as less harmful than cigarettes and 48.5% reported that they do not know which was more harmful to health. Students were more likely to ever use shisha if they had friend/s who smoke shisha (AOR = 16.8, 95% CI: 6.4–44.3), ever smoked cigarettes (AOR = 8.2, 95% CI: 3.4–19.8), ever used khat (AOR = 4.2, 95% CI: 1.9–10.4), ever used marijuana (AOR = 3.9, 95% CI: 1.4–11.1), ever used smokeless tobacco (AOR = 3.1 95% CI: 1.1–8.4), and students had received income from their parents (AOR = 3.1 CI: 1.1–8.8). Prevalence of ever and current use of shisha among high school students is low in Ethiopia compared to many countries in Africa. The majority of adolescents perceived shisha as less harmful to health than cigarette smoking. Health education about the harmful effects of shisha should be delivered to adolescents, along with information on other substances like khat, cigarettes, marijuana, and smokeless tobacco to prevent initiation of substance use.

Keywords: shisha smoking; high school students; Ethiopia

Background

Tobacco is manufactured and used in different forms that include cigarettes, cigars, chewable tobacco, snuff, bidis, and shisha smoking, which is also known as hookah, water

pipe, goza, and nargile [1]. Shisha is a flavored or non-flavored product that is smoked through a long hose where the smoke passes through water before reaching the smoker and the syrup tobacco content includes molasses, honey, vegetable glycerol, and fruit flavors [2].

In most parts of the world, cigarette smoking is considered the most common form of tobacco use, though shisha is becoming extensively used worldwide with high prevalence in the Middle East, Africa, and Asia [3].

Shisha smoke delivers high concentrations of carbon monoxide, nicotine, tar, and heavy metals at levels that are as high as or higher than a cigarette smoke and which can be toxic to humans, especially with chronic exposure [4,5]. Shisha smoking has been associated with different health problems like oral and lung cancer, cardiovascular, and respiratory diseases [6,7].

A study conducted in the USA on adolescents aged 12–17 years showed that the health effects of shisha smoking were not well understood by young people, and the perceived risk to health was less than for cigarette smoking [8]. Another study conducted in Saudi Arabia among secondary school students found that shisha was considered less harmful than cigarettes by 47.2% of study participants and more socially accepted than cigarettes [9]. In the same study, almost 60% of adolescents presumed that harmful substances would be filtered out through water smoking shisha [9].

Shisha use among young people is increasing globally [10]. Based on studies conducted in Africa, the prevalence of ever use of shisha among youth ranges from 3% in Ghana [3] to 26% in Rwanda [11]. A study conducted at Debre Berhan University in Ethiopia found that 4.2% of students had ever used shisha [12]. Studies reported that peer influence, regular alcohol drinking, having a friend/s who smokes shisha, being aware of shisha cafes availability, and a positive attitude towards shisha use were associated with shisha smoking [11,13].

Ethiopia is one of several countries in sub-Saharan Africa with strong tobacco control laws. Based on the Ethiopian Food and Drug Administration Control Proclamation Number 1112/2019, selling and smoking shisha is forbidden [2]. However, very limited evidence exists regarding tobacco product use among adolescents in the country. Almost all existing studies focus on cigarette smoking. The aim of this study was to determine the prevalence of shisha smoking among high school students in Ethiopia. We also examined potential factors associated with shisha smoking. The results will be used to engage with policymakers about the extent of the problem and risk factors.

Methods

1.1. Study Design and Setting

This cross-sectional study was conducted in Ethiopia, a country comprised of 10 regional states and two city administration councils. The business capital, Addis Ababa city, and the business capitals of the four big regions (i.e., Adama, Bahir Dar, Hawassa, and Mekelle) with their respective peri-urban districts were involved in the study. In Ethiopia, secondary education has two cycles; the first cycle covering grades 9 and 10 and the second cycle covering grades 11 and 12. The majority of secondary school students are aged between 15 and 18 years.

There were 301 urban and 96 peri-urban high schools in the study areas. The total number of high school students in the study regions and their respective peri-urban districts were; 130,619 in Addis Ababa, 43,575 in Adama, 39,670 in Bahir Dar, 36,816 in Hawassa, and 30,608 in Mekelle.

1.2. Study Population and Sample Size Calculation

Adolescents currently attending school aged 13–22 years who were in grades 9 and 10 participated in this study. The minimum sample size was calculated using OpenEpi Version 7.02 statistical software [14]. The sample size was powered to estimate the prevalence of cigarette, shisha, khat use, and alcohol consumption [15,16] with 95% precision, 80% power

and considering an intra-cluster correlation coefficient (ICC) of 0.1, and a non-response rate of 30% among the students and a 10% rate from the schools. The total sample size was 4714 school going adolescents clustered into 50 schools.

1.3. Sampling Procedures

A two-stage cluster sampling approach was employed to produce a representative sample of students. A sampling frame was prepared separately for each urban and peri-urban study areas. A total of 50 schools were selected randomly from the list in all study areas. Because of the occurrence of COVID-19 pandemic at the end of data collection around mid-March 2020, it was not possible to collect data from all 50 selected schools. We were able to collect data in 36 schools. Subsequent to selecting the schools, one classroom from both grade 9 and 10 in the study school was selected. Then all the students in the selected classrooms were invited to participate in the study. Students who were absent from their class at the time of the survey, unable to fill the questionnaire with any health-related issues, and those who were not willing to participate in the survey were excluded.

1.4. Survey Instruments and Data Collection

The questionnaire was developed in English and later translated to three different local languages, Amharic, Afan Oromo, and Tigrigna and was translated back into English to check for consistency of the ideas across all the versions. The questionnaire was developed by considering shisha use related questions from the Global Youth Tobacco Survey (GYTS) instrument [17]. The tool was pre-tested among 250 students (100 students from Addis Ababa for Amharic, 100 students from Sebeta for Afan Oromo, and 50 students from Adigrat for the Tigrigna version of the questionnaire). The questions were modified by the first author based on this study objective and school environment questions were developed by the last author. All research team members reviewed the tool. Two-day data collection training was given to ten experienced data collectors. Research team members supervised the data collection. Data were collected from 9 to 17 March 2020. The questionnaires were distributed to grade 9 and 10 students in the selected schools and classes. Students were asked to complete the questionnaire individually and to consult the data collectors for any ambiguity on the questions. Also, data were collected from all school directors in regard to the availability and feasibility of shisha smoking in school environment areas.

1.5. Data Processing and Analysis

Data were checked for completeness and consistency before and during data entry that was conducted using Epidata Version 3.1 software [18]. Data were analyzed using Stata/SE 14.0 software [19]. Frequency and percentages of study participants and school-level characteristics were calculated. The prevalence of current and ever use of shisha was estimated. In the bivariable analysis, the chi-square test was used to test the significance of the association between shisha use and the individual level characteristics. Mean and standard deviation were used to summarize continuous variables. The primary outcome variable of this study is ever use of shisha. Independent variables in the level-1 model are age, sex, parent's residence, source of income, ever smoked cigarette, ever used smokeless tobacco, ever drank alcohol, ever used khat, ever used marijuana, friends use shisha, and shisha smoking more harmful to health compared to cigarette. Independent variables in model-2 included all the 11 variables in model-1 and an additional 4 school level variables (school type, shisha houses within 100 m radius from the school compound, teacher in the school who smokes shisha, and the number of students in the school).

In this study, ever use of shisha was defined as shisha smoking at least once in a lifetime, current shisha smoker as shisha smoking at least once in the past 30 days from the study period and a peri-urban area as a town within 50 km radius from the main city in the specific region.

A two-level mixed-effects logistic regression model was fitted to adjust for confounding variables. The model accounted for the effects of student-level characteristics (level-1)

and school (level-2) factors on ever use of shisha. The model fitting was a three-step process where the null-model (model-0) measured the random effect and intra cluster correlation (ICC) in the odds of ever use of shisha. The ICC represented the proportion of the between-schools variation on ever use of shisha in the total variation [20]. The total variation is, between schools plus the within school variation of the chances of ever use of shisha. The first model (model-1) was built to assess the effect of student level predictors on the odds of ever use of shisha. The final model (model-2) was built to assess the effect of student-level characteristics and cluster level (school level) factors on ever use of shisha. We used the xtmelogit command in Stata to perform the multi-level mixed effect logistic regression analyses. Multicollinearity was checked for independent variables before the model was fitted and none were dropped from the model as all the variables had a variance inflation factor (VIF) value of <10 [21]. Crude odds ratios (ORs) and adjusted ORs with the corresponding 95% confidence intervals (CIs) were estimated using univariate logistic and multivariate mixed-effects logistic regression models, respectively, to quantify the associations between potential predictors and outcome variable. The level of statistical significance was set at a *p*-value <0.05.

Results

1.6. Socio Demographic Characteristics

Data were collected from 36 schools (11 private and 25 governmental schools), 82% of the targeted 50 schools. The total number of grade 9 and 10 students per school ranged from 108 to 4191. Due to the COVID-19 pandemic, schools were closed suddenly in March, 2020. For this reason, it was not possible to finalize the data collection and collect an equal amount of data from all regions. From a total of 3457 students who were invited to this study, 3355 (97%) participated. After discarding eight questionnaires that were incomplete for the majority of important questions, data from 3347 participants remained in the analysis. The age of 2499 (74.7%) of the secondary school students ranged from 15–17 years (Table 1). The mean age (SD) was 16.5 1.4 years and almost 54% of them were females. In this study, 2618 (78%) of study participants were from government schools. More than 3000 (90%) students got their income from their parents.

Table 1. Study participants and school level characteristics in Ethiopia (March 2020).

Variable	Category	Frequency	Percentage (%)
Sex (<i>n</i> = 3319)	Female	1804	53.9
	Male	1515	45.3
Age (<i>n</i> = 3321)	13–14	99	3.0
	15	689	20.6
	16	1055	31.5
	17	755	22.6
	18	502	15.0
	19–20	190	5.7
Religion (<i>n</i> = 3313)	>20	31	0.9
	Orthodox Christian	2203	65.8
	Muslim	367	11.0
	Protestant	654	19.6
	Catholic	51	1.5
Living area (<i>n</i> = 3347)	Other	38	1.1
	Addis Ababa	458	13.7
	Adama	586	17.5
	Bahir Dar	875	26.2
	Hawassa	561	16.8
	Mekelle	867	25.9

Table 1. Cont.

Variable	Category	Frequency	Percentage
School type (n = 3347)	Private	729	21.8
	Government	2618	78.2
Total number of grade 9 and 10 students in the school (n = 36)	108–350	9	25.0
	408–980	7	19.4
	1058–1600	9	25.0
	1604–2273	6	16.7
	≥2677	5	13.9
Student grade level (n = 3347)	Grade 9	1685	50.3
	Grade 10	1662	49.7
Parents living area (n = 3310)	Rural	1185	35.4
	City	2125	63.5
Source of income (n = 3328)	Parents	3004	90.4
	Work for myself	257	7.7
	Other	67	2.0

1.7. Shisha Use Practice and Perception about Shisha Smoking

Of a total of 3347 students, 86 (2.6%) and 20 (0.6%) of the study participants reported that they had ever smoked or were current smokers of shisha, respectively (Table 2). The peri-urban areas of Hawassa had the highest proportion of ever use of shisha (7.1%), followed by Addis Ababa (4.8%), and Adama (2.6%) cities. The region has a significant association with ever use of shisha (p-value < 0.001). Sixty-seven (4.4%) male and 19 (1.1%) female participants ever smoked shisha. Of all study participants, 1285 (38.4%) perceived shisha as less harmful for health than tobacco while 1616 (48.3%) reported that they did not know about this. The perception about harmful effects of shisha has significant association with ever use of shisha (p-value < 0.001).

Table 2. Prevalence and perception about shisha smoking among high school students in Ethiopia (March 2020).

Variable		Frequency (%)		p-Value
		Never Shisha Users	Ever/Current Shisha Users	
Ever used shisha by regions	Total	3245	86 (2.6)	<0.001
	Addis Ababa	432 (95.2)	22 (4.8)	
	Adama	568 (97.4)	15 (2.6)	
	Bahir Dar	870 (99.8)	2 (0.23)	
	Hawassa	520 (92.9)	40 (7.1)	
	Mekelle	855 (99.2)	7 (0.8)	
Ever used shisha	Male	1441 (95.6)	67 (4.4)	<0.001
	Female	1776 (98.9)	19 (1.1)	
Current use of shisha by regions	Total	3311	20 (0.6)	<0.001
	Addis Ababa	445 (98)	9 (2.0)	
	Adama	580 (99.5)	3 (0.5)	
	Hawassa	554 (98.9)	6 (1.1)	
	Bahir Dar	872 (100)	0 (0)	
	Mekelle	860 (99.8)	2 (0.2)	
Is shisha smoking harmful to health?	No	60 (84.5)	10 (14.1)	<0.001
	Yes	2677 (97.6)	55 (2)	
	I do not know	486 (96)	19 (3.7)	
Is shisha smoking less harmful than tobacco smoking?	No	357 (94)	23 (6)	<0.001
	Yes	1250	35 (2.7)	
	I do not know	1590	26 (1.6)	

1.8. High School Students’ Parents and Friends’ Shisha Smoking Practice

Two hundred and five (6.1%) students reported that their friends smoke shisha while 526 (15.7%) were not sure or did not know their status (Table 3). In more than 90% of the study participants, neither their mothers nor fathers smoke shisha, but 205 (6.1%) participants reported that at least one of their friends smokes shisha.

Table 3. High school students’ parents and friends’ shisha-smoking experience in Ethiopia (March 2020).

Variable	Categories	Frequency (%)
Any of your friend’s smoke shisha (n = 3347)	No	2588 (77.3)
	I am Yes sure	205 (6.1)
	I do not	168 (5)
	not know	358 (10.7)
	Missing	28 (0.84)
How often do your friends smoke shisha (n = 205)	Every day	32 (15.6)
	Weekly	47 (22.9)
	Sometimes	71 (34.6)
	I am not sure	21 (10.2)
	I do not know	21 (10.2)
	Missing	13 (6.3)
Do any of your friends smoke shisha by region (n = 205)	Addis Ababa	90 (43.9)
	Adama	44 (21.5)
	Hawassa	29 (14.2)
	Bahir Dar	33 (16.1)
	Mekelle	9 (4.4)
Father smokes shisha (n = 3347)	Yes	11 (0.3)
	No	3041 (90.9)
	Not do not know	126 (3.8)
	elevant for me	135 (4)
	Missing	34 (1)
Mother smokes shisha (n = 3347)	Yes	15 (0.45)
	No	3119 (93.2)
	Not do not know	101 (3)
	elevant for me	67 (2)
	Missing	45 (1.3)

1.9. School Environments and Shisha Smoking

A total of 251 (7.5%) school-going adolescents mentioned that there were houses for shisha smoking within 100 m from the school (Table 4). Of them, 113 (45%) reported that students smoke shisha in these houses. Sixteen (44.4%) of 36 school directors (who were school directors for 3347 students), responded that there were shisha houses within 100 m from the school compound. Moreover, it was reported that from 2 (5.6%) of these schools there were 2–3 teachers who smoke shisha.

Table 4. Shisha smoking practice in the school environment in Ethiopia (March 2020).

Variable	Category	Frequency
Any shop for shisha smoking within 100 m radius from the school compound (students’ responses) (n = 3347)	Yes	251 (7.5)
	No	1311 (39.2)
	I do not know	1754 (52.4)
	Missing	31 (0.93)
Students in the school smoke in these shisha shops (students’ responses) (n = 251)	Yes	113 (45.2)
	No	25 (10)
	I do not know	106 (42)
	Missing	7 (2.8)

Table 4. *Cont.*

Variable	Category	Frequency
Any shop house for shisha smoking within 100 m radius from the school (school director response) (n = 36)	Yes	16 (44.4)
	No	20 (55.6)
Grade 9 and 10 teachers from this school who smoke Shisha (school director response) (n = 36)	Yes	2 (5.6)
	No	34 (94.4)

1.10. School and Individual Level Factors for Ever Use of Shisha

There was 36% variability between clusters (schools) with regards to the outcome variable ever use of shisha (ICC = 0.36, 95% CI: 0.2–0.6). Significantly associated variables with ever use shisha in model-1 and model-2 were similar (Table 5). Students were more likely to ever use shisha if they had friend/s who smoke shisha (AOR = 16.8, 95% CI: 6.4–44.3), ever smoked cigarettes (AOR = 8.2, 95% CI: 3.4–19.8), ever used khat (AOR = 4.2, 95% CI: 1.9–10.4), ever used marijuana (AOR = 3.9, 95% CI: 1.4–11.1), had ever used smokeless tobacco (AOR = 3.1 95% CI: 1.1–8.4), and students who had received income from their parents (AOR = 3.1 CI: 1.1–8.8). No significant association was shown for other characteristics of the students (age, sex, parent’s residence, perception about the health effects of shisha, and ever drink of alcohol) and school-level variables (school type, shisha houses near school, having shisha smoker teacher, and the number of students).

Table 5. Multi-level logistic regression model for ever use of shisha among high school students in Ethiopia.

Variables		Ever Used Shisha (%) n = 86 (2.6%)	Model-1 OR (95% CI)	Model-2 AOR (95% CI)
Age	13–16	27 (31.4)	Reference	Reference
	17 and above	59 (68.6)	0.7 (0.3–1.6)	0.8 (0.32–1.8)
Sex	Male	67 (77.9)	Reference	Reference
	Female	19 (22.1)	0.5 (0.19–1.1)	0.5 (0.19–1.2)
Parent’s residence	Rural	25 (29.1)	Reference	Reference
	City	59 (68.6)	0.9 (0.3–2.4)	0.9 (0.31–2.5)
Source of income from parents	No	25 (29.1)	Reference	Reference
	Yes	61 (70.9)	3.3 (1.2–9.2) *	3.1 (1.1–8.8) *
Ever use of khat	No	29 (33.7)	Reference	Reference
	Yes	57 (66.3)	4.4 (1.9–10.4) *	4.2 (1.9–10.4) *
Ever use of smokeless tobacco	No	50 (58.1)	Reference	Reference
	Yes	35 (40.7)	3 (1.1–8.0)	3.1 (1.1–8.4)
Ever drink of alcohol	No	24 (27.9)	Reference	Reference 1
	Yes	62 (72.1)	1.4 (0.6–3.2) *	1.4 (0.61–3.4) *
Ever use of marijuana	No	54 (62.8)	Reference	Reference
	Yes	29 (33.7)	3.8 (1.4–11.0) *	3.9 (1.4–11.1) *
Ever smoked cigar rete	No	34 (39.5)	Reference	Reference
	Yes	52 (60.5)	9.2 (3.8–22.1) *	8.2 (3.4–19.8) *
Any of your friend smoke shisha	No	19 (22.1)	Reference	Reference
	Yes	49 (57)	16.7 (6.5–42.8) *	16.8 (6.4–44.3)
Is shisha smoking less harmful than cigarette smoking	No	23 (26.7)	Reference	Reference
	Yes	35 (40.7)	1.3 (0.43–4)	1.5 (0.5–4.5)
	I do not know	26 (30.2)	1.1 (0.31–3.4)	1.1 (0.34–3.8)

Table 5. Cont.

Variables	Ever Used Shisha (%) n = 86 (2.6%)	Model-1 OR (95% CI)	Model-2 AOR (95% CI)
School type	Government	64 (74.4)	1
	Private	22 (25.6)	3.9 (0.71–
Teachers in the school who smoke shisha			1
			4.7 (0.5–43.4)
Shisha houses within 100 m radius			1
			0.3 (0.07–1.3)
Number of students in the school			1 (0.99–1)

*

Model-1—All relevant student level variables in relation to ever use of shisha use were included. * Model-2—The same student level variables and additional school level variables in relation to ever use of shisha were included.

Discussion

We found a prevalence 2.6% of ever use of shisha and 0.6% current shisha smoking among adolescents attending high schools in Ethiopia. While these rates are low, they remain a concern, given the health harms associated with shisha smoking in a country that has a very low prevalence of tobacco use. Independent risk factors for ever-shisha smoking were having friends who smoke shisha, ever use of cigarettes, khat, marijuana, smokeless tobacco, and students who receive pocket money from their parents. Students' age, sex, and perception about the health effects of shisha were not significantly associated with the outcome variable. School type (government or private), and shisha shops within 100 m from the school compound were not significantly associated with ever use of shisha. This study is the first-ever conducted to describe shisha consumption among school-going adolescents covering a wide geographical area and large sample size in Ethiopia. It included a wide range of school-going adolescents from the main capital city, urban, and peri-urban areas of the four different regions. The response rate was very high, at 97%, which decreases the risk of bias due to differential responses.

Our study has limitations. First, the cross-sectional study design cannot identify a cause-effect relationship. Secondly, our study finding is limited in the generalizability to the rural population in Ethiopia and for adolescents in the same age group who do not attend school. Third, the period of data collection coincides with the COVID-19 pandemic when schools' closures prohibited the finalization of data collection and limited the final sample size. Finally, social desirability bias might be a potential limitation of this study. However, school directors and teachers were not present in the classroom at the time of the data collection. The selected class section was divided into two for increasing the privacy of the students when completing the self-administered questionnaire.

The prevalence of ever and current use of shisha in our study was low compared to studies conducted in African countries including Ethiopia. Our study findings are comparable to the Global Youth Tobacco Survey (GYTS) conducted in Ghana that reported 3.1% of ever use of shisha in the age group of 11–17 years [3]. A higher prevalence of shisha use was reported in African countries like Rwanda (26.1%) where private university students participated and a study in Sudan among high school students reported 13.4% [11,22]. This could be explained by the fact that these studies were conducted in capital cities where shisha smoking practice might be higher.

A study in Bale (Southeast, Ethiopia) conducted among high school students showed that 5.6% were current users of shisha [23]; the study included only one specific area and khat chewing in this area was a common practice which might explain the higher prevalence of shisha use. A study among high school students in Addis Ababa and surrounding rural areas reported that 7.1% were ever use and 0.8% were current users of shisha [15]. This could be explained by more schools included in this study being mainly from Addis Ababa and within a short distance (up to 165 km) from the capital city, Addis Ababa. Our study included only 6 schools from Addis Ababa and a representative number

of schools were also included from the northern part of Ethiopia where shisha smoking practice was not common.

Based on this study, the Hawassa peri-urban area had the highest prevalence of ever smoking shisha which could be associated with the widespread practice of khat chewing in the area. A previous study in one of our study areas in the Hawassa peri-urban area showed that the high expansion of khat due to its economic advantage is superior to all other crops grown in the area [24]. Addis Ababa and Adama followed in a higher proportion of ever use of shisha where almost all schools were taken from the main cities. Based on this study, students who received pocket money from parents were more likely to ever use shisha. Obtaining a regular allowance from parents may provide an opportunity to students to have extra money, with implications for students to be exposed to using different substances.

This study found that 2732 (81.6%) students perceived shisha as harmful to health. Over 39% of the study participants mentioned that it was less harmful than a cigarette, and almost 50% stated that they do not know whether it is as harmful as cigarettes or not. This indicates that there was low awareness about the health effects of shisha smoking among school going adolescents. In Ethiopia, it is not common to hear discussion of the health effects of shisha smoking. There are myths about shisha smoking that it is good for skin color and harmful substances would be filtered out through the water. Similar to our study finding, a systematic review of global-north and south studies reported that the majority of university students could identify the health hazards of shisha smoking and most students identified shisha as less harmful than cigarettes [25].

Our study indicated that there were shisha shops within a 100 m radius for 7.5% of the schools and some students reported smoking shisha in these houses. Based on Ethiopian Food and Drug Administration Control Proclamation 1112/2019, it is forbidden to smoke and sell flavored tobacco products [2]. Moreover, it is forbidden to sell any kind of tobacco products within 100 m of a school. Our study indicated that there are gaps in the enforcement of this tobacco control law in Ethiopia. Similarly, a recent report identified an expansion of shisha cafes in Addis Ababa [2].

Having a friend who smokes shisha was significantly associated with ever use of shisha in our study. This finding is supported by the fact that adolescents are influenced by their peer groups. In agreement with our finding, studies conducted among young adolescents in Saudi Arabia, Gambia, and Sudan showed that having friends who smoke shisha is a risk factor for the ever/current use of shisha smoking [9,22,26]. Another study conducted in different areas of Ethiopia (Debre Berhan, Shashemene, and Bale) among youth, reported that those with friends who use any kind of substance were more likely to be users of the same substances [12,23,27].

Student level factors such as ever use khat, marijuana, cigarettes, and smokeless tobacco were significantly associated with ever use of shisha. A systematic review discussed that khat chewing is associated with using tobacco products among high school students [28]. Moreover, a study conducted in the eastern part of Ethiopia showed that khat chewing is associated with any kind of tobacco products including shisha [29]. This association might be explained by the enhanced effect of tobacco products and khat chewing [30]. Khat users might interchangeably use cigarettes or shisha to complement the effect of khat. Furthermore, once students are exposed to using one substance there is a probability that they may be exposed to multiple substances.

2. Conclusions

Shisha smoking practice among high school students in Ethiopia is low compared to many countries in Africa. However, shisha use is becoming a global challenge and is linked with the use of other addictive substances including cigarette smoking. Preventive programs should be in place to increase awareness among students of the negative health effects of shisha smoking. In addition, where tobacco control measures are already in place to limit the availability of the product, for example bans on shisha houses near schools,

these should be properly enforced. Law that bans the selling of khat and marijuana to the young age group should be in place and enforced.

Author Contributions: W.D., S.H., A.F. and L.B. conceived and designed the study; S.H. and W.D. designed the data collection tool; W.D., A.F., T.F., S.U., E.J.K., A.A., S.G. and L.B. reviewed the research proposal and gave comments; S.H. and S.G. coordinated the data collection; W.D., A.F., S.U., T.F., A.A., E.J.K. and L.B. followed up the data collection progress; S.H. developed the data entry template and supervised the data cleaning and data entry procedures; S.H. and W.D. analyzed and interpreted the data; S.H. drafted the manuscript. Critical review of the manuscript and feedback was given by W.D., A.F., S.U., T.F., S.G., A.A., E.J.K. and L.B. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board (IRB) of Addis Ababa University, College of Health sciences, Ethiopia (protocol code- 036/19/SPH and approved date 22 July 2019) and the University of Nottingham, UK (protocol code- 497–1912 and approved date 13 March 2020).

Informed Consent Statement: Informed consent was obtained from students who were 18 years or above. Schoolmasters gave consent for the students in the age group of 13–17 years as approved by the IRB. Moreover, students younger than 18 years gave written assent. Clear and adequate information was given to the students regarding voluntary participation, confidentiality, the right not to respond to specific questions in the information sheet.

Data Availability Statement: The datasets used and analyzed for the current study will be available from the corresponding author on reasonable request.

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Abbreviations

AOR	Adjusted odds ratio
APC	Article Processing Charge
	Confidence interval
GYTS	Global Youth Tobacco Survey
ICC	Intra-cluster correlation coefficient
IRB	Institutional review board
SNNPR	Southern Nations, Nationalities, and Peoples' Region
	School of Public Health
OR	Odds ratio
UKRI	UK Research and Innovations
VIF	Variance inflation factor

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Research Article

“If I don’t smoke shisha, I won’t be able to sleep”: lived experiences of high school students in Ethiopia

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Background

Shisha smoking predisposes the users to cardiovascular diseases, cancer, and infections, such as tuberculosis, hepatitis, and herpes. In Ethiopia, there is little data on the adolescents’ shisha smoking experience. This study aimed to explore the lived experience of high school students and inform ongoing and future prevention and control interventions.

Methods

This study was conducted in Addis Ababa and Adama cities in Ethiopia. Twenty-five secondary school students aged 15-22 years who had shisha smoking experience participated in this study. A topic guide was used to facilitate the in-depth interviews (IDIs) and a digital audio recorder recorded the interviews. Interviews varied between

40-90 minutes and were conducted in private open-air spaces where only the interviewee and researcher were present. Each transcript was coded using Atlas.ti version 8 software. The analytical approach was iterative, with interview transcripts analyzed at the time of coding and re-analyzed after a preliminary result was drafted to search for additional themes.

Results

Students described two key factors that influenced their decision to initiate shisha smoking: peer influence and perceiving it as a means to release stress. After initiating shisha use students maintained the behaviour because of: peer influence, khat chewing, enjoyment of shisha smoking, having prolonged leisure time, and accessibility to shisha. Students regretted the impact shisha use had on their lives, such as conflict with their families, poor academic performance, and spending money on shisha smoking. Female students were also concerned about reproductive health risks related to shisha use.

Conclusions

Peer influence played a major role both in initiating and maintaining shisha use. However, students admitted concern over the impact of shisha smoking on academic performance and their relationship with their families. Since shisha use is associated with khat chewing; shisha smoking control programs cannot be successful without controlling khat. Especially young girls had worries about their reproductive health risks associated with shisha use. This suggests that targeted awareness raising programs highlighting the dangers of shisha use for both health and safety; especially for young women is required.

BACKGROUND

A water pipe that is used to smoke tobacco is known by different names in different countries including

hookah, narghile, argileh, shisha, and goza.¹⁻³ Shisha is a device for smoking flavoured or non-flavoured tobacco invented in

the 16th century by a physician named Hakim Abul-Fatha Gilani.⁴ The purpose of the device is to pass the smoke through water in an attempt to 'purify' the smoke before inhaling¹. Shisha use in Ethiopia is a fairly recent development thought to have been first introduced by Middle Eastern restaurants in 2003.⁵ However, due to popular urban trends and lifestyle changes, most restaurants in the main cities of Ethiopia started serving shisha in the past few years.^{5,6}

While the belief that shisha smoking is less harmful than tobacco smoking is prevalent,⁴ studies have found that shisha smoking contributes to cardiovascular diseases, cancer, and infections, such as tuberculosis, hepatitis, and herpes as a result of sharing the mouthpiece.^{4,7,8} Similar to other tobacco products, shisha smoking delivers the addictive drug nicotine, which can lead to dependence and users seeking regular access to nicotine products. Studies have shown that shisha smoking is perceived by users to be less harmful than cigarettes because the smoke passes through water and is filtered.^{9,10} However, the shisha smoker may inhale as much smoke in one session as a cigarette smoker would inhale by smoking 100 or more cigarettes.⁷ Available evidence reveals that reasons given for shisha smoking include, social acceptance, availability, affordability, curiosity, fashion, peer influence, attractive flavors, social stress, and poor academic performance.^{9,11,12} In Ethiopia, in addition to the above-mentioned factors chewing khat has been noted as an entry point for shisha smoking and use of other substances.¹³⁻¹⁵

Based on the Food and Medicine Drug Administration Proclamation 11/12 of 2019, selling, and smoking shisha is forbidden in Ethiopia.¹⁵ Despite this, it is common to see shisha houses nearby school compounds and shisha services in the hotels or restaurants in Addis Ababa and many cities and towns across the country.^{5,6} A review of the literature found few published studies on adolescent shisha smoking in Ethiopia. A qualitative study conducted in 2013 among shisha users in Bahir Dar city reported that accessibility, peer pressure, shisha flavor, lack of knowledge and absence of effective policy were the main reasons for shisha smoking.¹² In March 2020, we conducted a quantitative study among high school adolescents in Addis Ababa and four regions in Ethiopia and the findings showed that, having friends who smoke shisha and ever use of substances (khat, cigarette, smokeless tobacco, and marijuana) were associated with ever use of shisha.¹⁶ The purpose of the qualitative study reported in this paper was to explore the lived experiences of shisha smoking among high school students in two cities in Ethiopia. This study will contribute to our understanding of the experiences of shisha smokers and the results may help to inform policymakers to develop strategies to prevent shisha smoking among school children.

METHODS

PARTICIPANTS AND STUDY APPROACH

The study was conducted in Addis Ababa (the largest and capital city) and Adama (one of the major cities) in Ethiopia. The inclusion criteria for this qualitative study were students who attended selected high schools which were part of the afore-mentioned quantitative school survey for shisha smoking,¹⁶ who

had a previous or current experience of shisha smoking and were willing to participate in the study. A phenomenological approach was employed to explore lived experiences of shisha smokers.

SELECTION OF PARTICIPANTS

In the linked school survey¹⁶; 54 students reported previous or current history of shisha smoking and consented to a follow-up interview. These students were contacted by telephone and 10 students agreed to participate of which six participated in the actual interviews, three from Addis Ababa and three from Adama. Additional students were recruited using a snowball sampling technique by ensuring that we had the necessary range and diversity of participants that qualitative research seeks to achieve. This included a mix of students by age, sex, school grade, type of school, religion, and duration of shisha use experience. The combination of these recruitment methods resulted in a final purposive sample of 25 secondary school students.

DATA COLLECTION PROCEDURES

Interviews were conducted by the first author (SH) and two academic staff from Addis Ababa University, who have substantive experience in qualitative research. A one-day training session was provided to the team with a focus on the topic guide along with a refresher session on conducting qualitative interviews. Based on the study participants' preferences interviews were conducted in the open air and quiet spaces of different hotels.

Data collection was undertaken from October 12-22, 2020. A topic guide was used to facilitate the in-depth interview which was developed by reviewing literature and translated to the local language (Amharic). Interviews varied between 40-90 minutes and a digital audio recorder was used to record the discussion. All interviews were conducted in Amharic, transcribed and anonymized, before being translated into English.

DATA ANALYSES

An inductive thematic approach, which facilitated reporting of participant experience, meaning, and reality¹⁷ was used. The research team read and re-read each transcript to familiarize themselves with the content of the interviews. A coding frame was prepared by SH and frequent discussion and refinements were made by the research team members FD and MK. Each transcript was coded using Atlas.ti version 8 software¹⁸ by two staff members from Addis Ababa University. Regular discussion between the coders and lead researcher (SH) took place to discuss any differences and to reach a consensus. The analytical approach was iterative, with interview transcripts analyzed at the time of coding and re-analyzed after a draft result section was written to search different themes in regard to the students' lived experience of shisha smoking.

Table 1. Respondent's characteristics.

Characteristics	Addis Ababa	Adama	Total
Gender			
Male	8	9	17
Female	4	4	8
Age group			
15-16	2	0	2
17-19	9	12	21
20-22	1	1	2
Grade			
9	2	4	6
10	8	7	15
11	1	2	3
School dropout from grade 10	1	0	1
School type			
Government	10	9	19
Private	2	4	6
Shisha smoking experience (Duration of use)			
Previous user (< 1 months)	1	2	3
Previous user (3 years)	0	1	1
Regular user (<=1 year)	1	2	3
Regular user (2 years)	5	4	9
Regular user (3+ years)	5	4	9
Total	12	13	25

ETHICS CONSIDERATION

As this research is a continuation of the previous school survey, we sought consent from each schoolmaster for students less than the age of 18 years. All interviews were performed per the relevant guidelines and regulations set out in the Declaration of Helsinki.

RESULTS

A total of 25 students participated in both cities (13 from Adama and 12 from Addis Ababa). Seventeen students were men and 8 were women. The age of the students ranged from 15-22 years. All participants were students, except for one who dropped out in grade 10. Further respondent detail is presented in [Table 1](#).

Results from our thematic analysis are presented under the following six themes; initiating shisha smoking, continued shisha smoking, source of funds to buy shisha, negative side effects of shisha smoking, concealment, and concerns about shisha use.

INITIATING SHISHA SMOKING

Students discussed two key factors that influenced their decision to start shisha smoking; peer influence and seeing it as a means to release stress.

PEER INFLUENCE

Peer influence was a dominant factor and had a key role in shisha initiation. For example, students described hearing what their friends said about shisha use and accompanied them to shisha houses to try shisha for themselves. The comment was also made that students did not want to disappoint their friends or be different from their peer group.

A regular shisha user said:

"I started smoking suddenly. I went to my friend's house; (...) when I get there, they were smoking shisha and I wanted to try it. And when they asked me to do it (...) I wanted to say no but at the same time, it is something my friends were doing. They said that nothing would happen to you and has no problem and passed to me the shisha, so I had tried it like everybody".

[An 18-year-old male student, Addis Ababa]

ESCAPISM

Another facilitating factor for shisha was an escape from stress. Students reported that they started using shisha to forget their life frustrations, which included negative childhood experiences and bad moods. Moreover, having a dispute with a close family member or a friend was a trigger for initiating shisha smoking. Previously, they heard about the nice feeling created by shisha use and when there was an incident that affected their mood; they would smoke shisha.

(...) my friend used to ask me to smoke, but I used to tell her no. (...) start smoking because I was mad, that is how I started smoking".

[A 19-year-old female student, Addis Ababa]

CONTINUED SHISHA SMOKING

Once students were exposed to shisha smoking there were several reasons for continued use. These included: khat chewing; peer influence; enjoying the shisha itself and the environment; having a lot of leisure time; and having access to shisha.

KHAT CHEWING

Khat chewing was mentioned by the students as a reason for continuing shisha smoking.

The data showed that shisha smoking was strongly linked with khat chewing practice. It was said that shisha smoking complements the effect of khat and it was very common to smoke shisha after or in parallel with chewing khat. It was common for interviewees to state that they would not like shisha if they did not chew khat.

A regular shisha user for the past two years noted that:

"Just like cigarettes, you want to smoke shisha when you chew khat.... You do not normally think about smoking shisha unless you are chewing khat".

[A 19-year-old male student, Addis Ababa]

A regular shisha user added that:

"When you chew khat your eyes become wide open, then if you smoke cigarettes, shisha or if you drink "Areke" [local alcohol drink] then it will break the effect.

[A 15-year-old male student, Addis Ababa]

In contrast to this, a student stated:

"We sometimes smoke shisha only when we don't want to chew khat. There is no association with khat".

[A 17-year-old male student, Addis Ababa]

PEER INFLUENCE

Similar to starting shisha use, peer influence was also found to be an important factor in continued use. Students smoked shisha in a group and would have a high tendency to invite and encourage their friends to smoke. Students reported that it was difficult to say no to the invitation from their friends. A previous shisha user explained that the reason he smoked shisha for two years was to maintain his place in his peer group,

"Not because I like the shisha but I didn't want to be different from my friends. (...) I didn't want to be separated from my friends so I would go with them to smoke. I would just say that I like it so that they won't be mad. Even though I know the risk I would say it's nice for the sake of them."

[An 18-year-old male, Adama]

ENJOYING SHISHA SMOKING AND THE ENVIRONMENT

Students also stated that enjoying shisha smoking itself and the environment were reasons for smoking shisha. Shisha smoking made them relax and forget stressful situations at least for a little while. They liked the shisha smoke flavors available such as apple, mint, and chocolate. Students also liked the shisha smoking environment where they can have a chance to meet, talk and laugh with different people.

A regular shisha smoker for two years stated that:

"When you inhale the shisha, you will feel the flavor like incense, and it feels nice when you feel that in your mouth, so you just want to keep smoking. You don't want to pass it to the next person".

[A 15-year-old male student, Addis Ababa]

LEISURE TIME

Having free time was reported as a reason for smoking shisha by the students. Many students complained that they didn't have access to sports games and other recreational activities, and community youth centers were perceived as unorganized and unattractive to young people. This resulted in boredom and a preference to go to shisha houses.

Students from government schools who regularly smoked shisha noted that:

"I smoke and chew only once a week during school time, but now we don't have class so I can't spend all day at home it is stressful."

[A 20-year-old female student, Addis Ababa]

ACCESSIBILITY OF SHISHA

Accessibility for shisha equipment was mentioned as a reason for continued shisha use. Students could rent or buy the equipment for shisha smoking. Once they bought the shisha equipment in a group, they are only expected to buy the *Moassel* (which is named locally *Bureau*) regularly. This makes it less expensive to smoke shisha. They can buy some amount of *Moassel* with 25 Ethiopian Birr (ETB) which is equivalent to US\$0.5. This can be smoked for one session which lasts 20 minutes with a group of four smokers.

A student from grade 10 who had dropped out of formal education and who was using shisha regularly for four years stated that:

"I don't have any expense because she [a friend] has it [the shisha equipment] at her house. For sure, I would not pay to smoke daily but since I have it at her house for free, I smoke it daily. If you have to pay for it, then you have to get money to meet your need so I would not have become addicted for sure if I had to pay for it".

[19-year-old female drop-out student, Addis Ababa]

SOURCES OF FUNDS TO BUY SHISHA

The expense for shisha smoking depends on the type of the shisha house, the number of shisha smoking sessions, and

the number of shisha smokers in a group. Students usually smoke shisha in a small house with a group of three to five people, spending around three to four hours together each day. Students may spend 150 ETB (US\$3) on shisha per day and they would have additional expenses for khat, water, coffee, and other substances. It was highlighted that 'in the addiction world' people share their money with their friends. In a group, if one person has money, they would cover expenses for others. Students stated that they would ask their parents for money in the name of different daily expenses and used that money to buy shisha. Some students had small jobs and others would sell different valuables, stealing from home to cover their shisha expenses in a time when the money they would get from family was not enough.

A student from a government school stated that.

"I would just pressure my mom to give me the money, then I will come to shisha's house, whether I got 50 or 100 ETB (US\$1 or 2) from her. If she doesn't give me, I will just come to shisha house and ask someone to offer me khat and shisha".

[A 20-year-old female student, Addis Ababa]

Students described several ways that they funded their shisha use. For example, they would steal money from their mother's purse or get involved in a robbery to cover their expenses for substances. A previous shisha user for two years acknowledged that.

"Yes, I started stealing to survive. We used to be bold, so we were not scared of anybody, so we used to take money from strangers. We used to make around 10,000 ETB (US\$200) in a day, and we will spend it in a day. We will give some to our friends. We spend maybe 1,000 ETB (US\$20) for food and the remaining we use for our addiction. We will go from one club to another all night".

[An 18-year-old male student, Adama]

NEGATIVE SIDE EFFECTS OF SHISHA SMOKING

Students reported that they had experienced headaches, light headiness, coughing, vomiting, difficulty of breathing, and even fainting during shisha smoking. Usually, these symptoms happened when someone takes a deep breath for a few minutes for initiating the shisha smoke or when someone smokes shisha for the first time. A regular shisha user explained:

"(.....) you will feel lightheaded. (....) the difficulty of breathing happens if you don't say enough. For instance, if you smoke alone and if there is no one with you to share then you will have difficulty of breathing"

[A 19-year-old male student, Addis Ababa]

Those students who regularly chewed khat explained that they could not sleep if they did not smoke shisha. This is because khat chewing causes sleeping problems and makes them hyperactive. Students who chew khat uses different substances such as cigarette, shisha, and alcohol to break the effect of khat in a short time. Mostly, students chewed khat first and then smoke shisha after that or they

may use it simultaneously. A regular shisha user for eight years stated that:

"I won't be able to sleep if I didn't smoke shisha. I chew khat daily and if I don't smoke shisha, I won't be able to sleep".

[A 19-year-old female student in Adama]

CONCEALMENT OF SHISHA USE

Students reported that they did not tell their parents about their shisha use. They explained that they use different tactics to cover up their shisha smoking. Students spent school time in shisha houses and return home wearing their uniforms as if they were coming from their school. When there was no school, they gave different reasons to go out from their home to a shisha house.

A regular shisha user for four years stated that:

"We would go out while they[parents] were sleeping or we would say that we are going to church. Sometimes they suspect, but I would wear my dress and scarf and pretend like I am going to church".

[A 19-year-old female student, Addis Ababa]

CONCERNS ABOUT SHISHA USE

Expressing feelings of regret about using shisha was common among students. This was spoken in the context of regretting fights they had with their families, poor academic performance, stealing money from parents, and wasting a lot of money. However, there was also concern about their future life prospects especially female students were concerned about getting pregnant.

Female students explained that after exposure to second-hand smoke of hashish in the small and unventilated room; their judgement and memory could be impaired. For this reason, they would be vulnerable to sexual assaults. Lack of parental care and gaps in law enforcement were reported as reasons for engaging in shisha use, which for some students appeared to justify their lack of accountability for using substances instead of attending school.

A grade 9 government school student said that:

"I should be able to read English by now, but I can't. I know how to read Amharic, but I don't know how to read English, and I get jealous when I see people younger than me read English. (.....). And if the police took action while they caught me instead of letting me go for 200 ETB (US\$4), I may not have repeated the action, but now I will make sure that I have 200 ETB (US\$4) at hand to give them in case I get caught."

[An 18-year-old male student, Adama]

A regular shisha user for four years stated that:

"(.....) I think about what if this kind of thing[pregnancy] happens to me without my knowledge. My mother has lots of kids and I imagine bringing another child to her and I feel bad. And sometimes you even hate your life when you think about it. You think if you could just die and if you didn't exist. You use death as an escape and most girls committed suicide."

[A 19-year-old female student, Adama]

DISCUSSION

This study was conducted to explore the lived experience of shisha smokers among high school students. Findings demonstrated that peer influence played an important role in the initiation and regular use of shisha; other studies conducted in Sudan and Ethiopia support this finding.^{3,10} Unlike cigarette smoking, shisha is mostly smoked in groups and provides opportunities to socialize. This helps to explain why peer-influence was found to be such an important factor. Unfortunately, in Ethiopia, there is no education given at schools about the prevention of dependence on shisha or indeed other substances. This means that young people generally acquire information about shisha smoking from their peers which means they may not be aware of the negative health effects. Furthermore, experiencing stress, which could be the result of an argument with family members or close friends was mentioned as a reason for shisha use. Smoking shisha was perceived to be a coping mechanism that would enable them to forget stressful situations and enjoy the moment. These findings are similar to those from the systematic review of 56 studies which showed the main motives for school and University students to use shisha were entertainment, pleasure, relaxation, and socialization.¹⁹

Students in this qualitative study were smoking shisha to enhance the effect of khat. Khat is a stimulant plant that is easily accessible in urban areas where it is sold in a small shop near schools and higher education institutions. In Ethiopia, there is no law prohibiting the sales and use of khat for under-age groups. It is very common to see adolescents chewing khat to stay awake and for recreational reasons. This plant is attributed as being a gateway to tobacco products used in studies conducted in the UK, Middle East, and African countries.^{19,20} In addition, a qualitative study conducted in the northern part of Ethiopia, reported that shisha smokers were khat chewers.¹⁰ After chewing khat, people smoke shisha, drink alcohol, or smoke cigarette to enhance the effect. It is further reported that to break the effect of depression after the effect of khat decreased, cigarette or alcohol are being used.²¹ After chewing khat, instead of smoking cigarettes, students may prefer to smoke shisha. This is due to shisha smoke having a nice flavor and little odor which makes it easy to hide from their families.

Students stated that having leisure time was a reason for smoking shisha. When they had free time, there were very limited affordable places to visit where they could socialize and had fun. Shisha houses or khat shops were left as the only places to spend time with friends. Supporting this, another study in Ethiopia conducted in 2020 found that there were over 3,000 youth centers where only half of them were functional.²² Moreover, their contribution in terms of promoting positive youth development is minimal and even some were centers where youths acquire negative health behaviors.²² Youth-friendly centers where students can develop knowledge, skills and spend time with their peers should be expanded, accessible and affordable.

In this study, accessibility was mentioned as one reason for smoking shisha. Based on strong tobacco control laws in Ethiopia [Proclamation 1112/2019] it is forbidden to smoke and sell any kind of flavored tobacco.¹⁵ However, it is evident to see shisha houses are everywhere. Also, students rent houses and shisha smoking equipment which made it easy for them to smoke regularly. This makes the police and other stakeholders' job difficult to control the shisha smoking practice. Awareness should be created for the community that renting out houses for shisha smoking is forbidden in the law and implementation of the tobacco control law should be strengthened.

Based on this study, shisha smokers experienced headaches, cough, light-headedness, shortness of breath and even fainting while smoking. This mostly happened when they were trying to inhale the first smoke of shisha after putting it in burning charcoal. Most students mentioned that taking a deep breath to take the first smoke of shisha is difficult and needs a lot of energy. The charcoal that is used for shisha smoking is small and less flammable compared to the one used for the Ethiopian coffee ceremony. The symptoms could result due to inhaling the carbon monoxide while taking the first breath of the shisha smoke. Normally the shops for shisha smoking where students smoke shisha are small, suffocated, and with no or minimal ventilation spaces. If students were smoking in rented houses or even in the shisha shops, they would close any door or windows; so that no one would notice the smoke. In the session of shisha smoking, carbon monoxide intoxication can result in syncope due to secondary to the formation of carboxy-hemoglobin in the blood, which compromises the transportation of sufficient oxygen to body parts including the brain.²³

We found that students hide their shisha smoking practice from their parents and schoolteachers. Students used different techniques to hide their smoking practice and mostly they were successful. The reason for hiding could be fear of not getting approval from their families or teachers. Hiding their practice narrows the possibility to get guidance and support from adults. Therefore, shisha smokers were doing what makes them happy and feels right for them and their peers. After becoming dependent and time passed, students regretted their lack of engagement with learning and academic performance, their communication with family, and other parts of their lives. Moreover, female students were vulnerable to reproductive health problems. Interventions are needed that raise the awareness of female students about reproductive health risks related to shisha use. A systematic review showed that school, family, and community-based interventions had a positive impact on the prevention of smoking /tobacco use among adolescents.²⁴

STRENGTHS AND LIMITATIONS OF THE STUDY

This study is the first qualitative study to explore the lived experience of shisha smokers among high school students in the two main urban settings (Addis Ababa and Adama) of Ethiopia. We used the snowball sampling technique that has limitations in terms of recruiting similar students to those we initially identified via a wider survey in schools.

To minimize this, maximum variability criteria were used in the identification and recruitment of the students. There could be social desirability bias where boys would overestimate, and females underestimate their exposure and experience of shisha smoking. To keep down this, we encouraged students to tell us about their actual experiences with shisha smoking.

CONCLUSIONS

Our study found that peer influence plays a major role in high school students' shisha smoking uptake and ongoing use. Furthermore, khat chewing, accessibility, and having free time were mentioned as reasons for regular shisha use. It is encouraging that Ethiopia has a strong tobacco control law, but without controlling khat use, it is difficult to control the use of shisha. Students regretted their shisha use experience which could contribute to poor academic performance and conflict within families. Students reported some experience of health problems that may be related to the carbon monoxide intake while shisha smoking. Furthermore, female students reported reproductive health risks that may be related to their shisha use. Awareness-raising campaigns and programs about the negative health effects of shisha use for secondary school students should be designed and implemented in Ethiopia, alongside further efforts to fully implement tobacco control laws that prohibit the availability of shisha.

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AUTHORSHIP CONTRIBUTIONS

WD, SH, AF, and LB conceived and designed the study. WD, FD, AF, MK, TF, SU, EV, AA, KS, and LB reviewed the re- search proposal and gave comments. SH designed the interview guide. FD, MK, and WD gave comments. SH inter- viewed and coordinated the data collection. SH developed the codebook together with FD and MK. SH analyzed and interpreted the data. SH drafted the manuscript. A critical review of the manuscript and feedback was given by WD, FD, MK, KS, AF, SU, TF, AA, EK, and LB.

COMPETING INTERESTS

The authors completed the Unified Competing Interest form at <http://www.icmje.org/disclosure-of-interest/> (available upon request from the corresponding author), and declare no conflicts of interest.

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**Explanation of Previous dissertation attempt (Erklärung
über frühere Dissertationsversuche und
Selbstständigkeitserklärung):**

I hereby declare that this work is the first attempt of writing a dissertation. I also declare that this work is exclusively submitted as a dissertation for the General Practice and Family Medicine of Martin Luther University Halle Wittenberg.

Addis Ababa, 07.02.2023

Place and date

Signature

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