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Electronic cigarette usage amongst high school students in South Africa: A mixed methods approach

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Acknowledgements

Articles

Electronic cigarette usage amongst high school students in South Africa: a mixed methods approach

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Summary

Background The WHO has highlighted that: "promotion of e-cigarettes has led to marked increases in e-cigarette use by children and adolescents." The long-term neuropsychiatric and psychological consequences of substance abuse in adolescence is well recognised. Limited data exists on the adolescent burden of vaping-related nicotine addiction and behavioural and/or psychological dependence to guide pharmacological or behavioural interventions to stop electronic cigarette usage.

Methods A self-administered brief electronic survey was provided to a large, sample of high school students from January to October 2023 in South Africa. Questions on vaping usage, initiation, reasons for continuation and indicators of physical and psychological dependence were asked. A mixed methods approach was used to obtain and analyse quantitative and qualitative responses.

Findings 25,149 students from 52 South Africa schools completed the survey. 45.8% identify as female, 51.7% male, 0.3% transgender, 2.1% do not identify with a gender. Current vaping was reported by 16.83% (95% CI: 16.47–17.30), with 36.71% reporting ever using a vaping product (95% CI: 26.06–37.36). The odds of vaping increased by grade but not with increasing school affluence. 47% vaped within the first hour of waking suggesting high nicotine addiction. Vaping initiation reasons of: 'social influences' and 'curiosity', changed significantly to ongoing motivations of: 'enjoyment', 'managing mental distress' and 'addiction' to nicotine. Paired quantitative/qualitative responses regarding stress and dependence showed inconsistencies at the individual student level.

Interpretation Vaping in the schools surveyed was high and increased by grade but was not associated with school level affluence. Drivers for vaping initiation change significantly to persistence drivers with significant nicotine addiction. Adolescent perceptions (qualitative/quantitative) are frequently incongruent suggesting that mixed methods evaluations are required to understand individual level drivers of vaping. Urgent interventions tailored to this population are required. Nicotine addiction may require "off-label" pharmacotherapies alongside tailored behavioural interventions utilising the expressed concerns, psychological and dependence measures elicited from adolescents.

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A team effort!

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Permission to conduct the survey was provided by the South African Department of Basic Education, the Provincial Departments of Basic Education, school principals, and the school's governing body/board. Ethics approval was provided by the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (UCTHREC 248/2022).

Background

- A 2023 World Health Organisation call to action highlights that the promotion of e-cigarettes has led to a substantial rise in e-cigarette use by children and adolescents.
 - In the USA, e-cigarette use amongst students in grades 6–12 has been declared '**an epidemic**'.
 - Surveys from the UK indicate that **20.5%** of young people aged 11–17 have tried vaping, and that **7.6%** of young people aged 11–17 currently vape.



Background



- A study on electronic cigarettes use among youth in 75 countries using data from the Global Youth Tobacco Surveys (2014–2019) estimates:
 - Ever e-cigarette use among youth aged 13-15 at **20.2%**;
 - Current e-cigarette use among youth aged 13-15 at **10.9%**.
- South Africa was not included in this study – South Africa last conducted a GYTS in 2011.
 - Respondents to this survey were asked not asked about their use of e-cigarettes.

Our goal: to understand the burden of e-cigarette use among South African adolescents.

Our approach

- We developed a survey to study e-cigarette use, vape dependence, and the mental health and social stressors associated with vaping among a large sample of South African high school learners.

School Selection Overview

- Approached **90** schools in major centres like Cape Town, Johannesburg, Pretoria, Durban and smaller centres such as Bloemfontein, Pietermaritzburg and East London.
- **Selection Criteria:**
 - Schools identified via the National Department of Education website & National School Associations network to ensure **Fee Variability** – both low-fee & high-fee schools; and **School Type variability** – single-sex & co-ed schools.
- All were “fee-paying” schools. We were not able to include less well resourced schools without easy internet access, or non-fee-paying schools.



Our sample

📌 Total Schools Analysed: 52 | 📌 Total Students in Sample: 25,149

- Sampled schools categorised into 3 income brackets by annual fees:
 - **Lower-fee** schools: R20,000 - R40,000 = 17% of pupils in sample
 - **Medium-fee** schools: R40,000 - R90,000 = 64% of pupils
 - **High-fee** schools: >R90,000 = 19% of pupils
- School type breakdown:
 - 31% of learners attended **co-ed** schools
 - 41 % attended **all-boys'** schools, and
 - 29 % attended **all-girls'** schools



Our sample

We also asked all students their basic demographic information (age, grade and gender) and presented them with three 10-point Likert scales that were used to evaluate:

- (1) students' ability to concentrate while studying;
- (2) how stressed they feel about school/life; and
- (3) how harmful they believe vaping is relative to tobacco use.

	Frequency	Proportion of sample (%)
School grade	25 194	
Grade 8	5745	22.80
Grade 9	5525	21.93
Grade 10	5403	21.45
Grade 11	5307	21.07
Grade 12	3123	12.75
Gender	24 994	
Female	11 455	45.8
Male	12 927	51.7
Transgender	86	0.3
Don't identify	526	2.1
Level of concentration (1 = no problem concentrating; 10 = really struggle to focus)	21 453	
1 ≤ Score ≤ 5 (little-to-no problem concentrating)	9721	45.31
5 < Score ≤ 10 (below-average ability to concentrate)	11 732	54.69
Feelings of stress about school/life (1=not stressed; 10=very stressed)	21 453	
1 ≤ Score ≤ 5 (no- to- little stress)	4055	18.90
5 < Score ≤ 10 (above-average levels of stress)	17 398	80.10
Perceived harms of vaping (1 = vaping is harmless, 10= vaping is as bad as tobacco)	21 429	
Low harm	1825	8.52
Moderate harm	7608	35.50
High harm	11 996	55.98

What we investigated

- All students were asked about their use of 4 products in the 30 days preceding the survey:



e-cigarettes

tobacco cigarettes



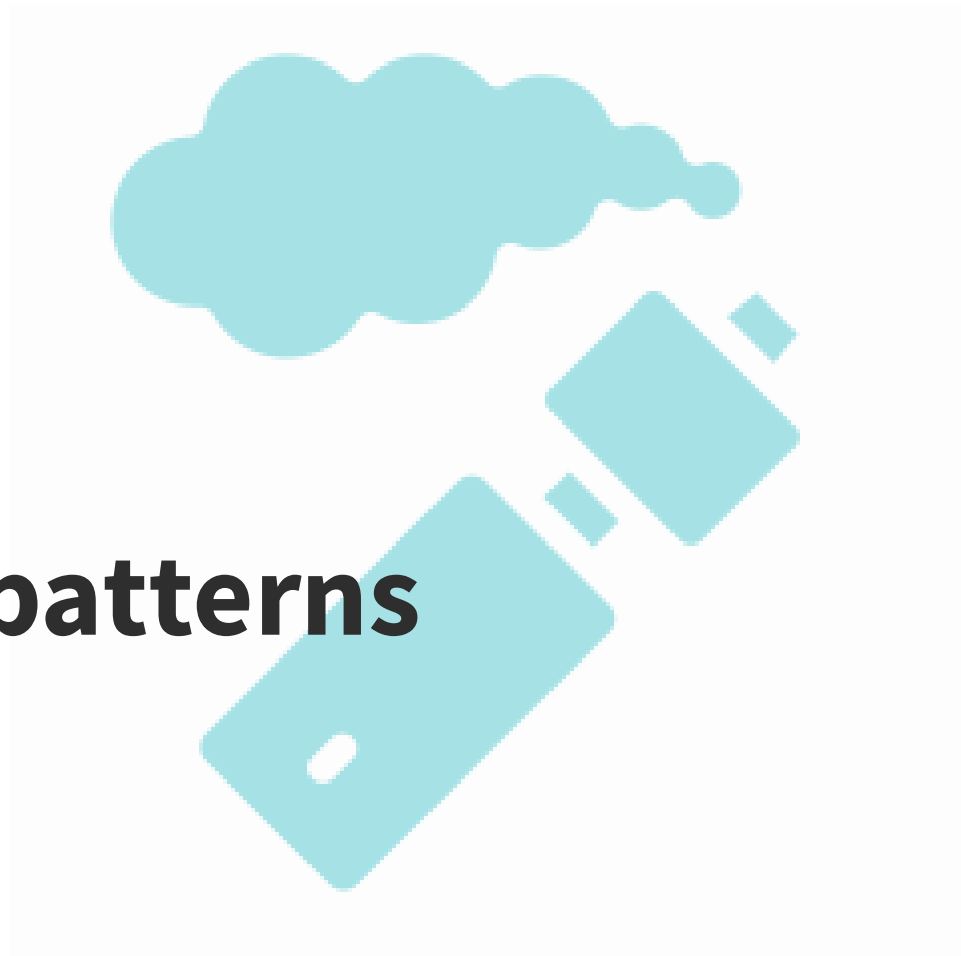
cannabis



hookah pipes

- Students who indicated that they currently vaped were asked additional questions about:
 - their vaping history and habits
 - their reasons for starting and continuing to vape
- Using this data, we studied e-cigarette use, vape dependence, and the factors associated with vaping among a large sample of South African high school learners.

Vape use patterns

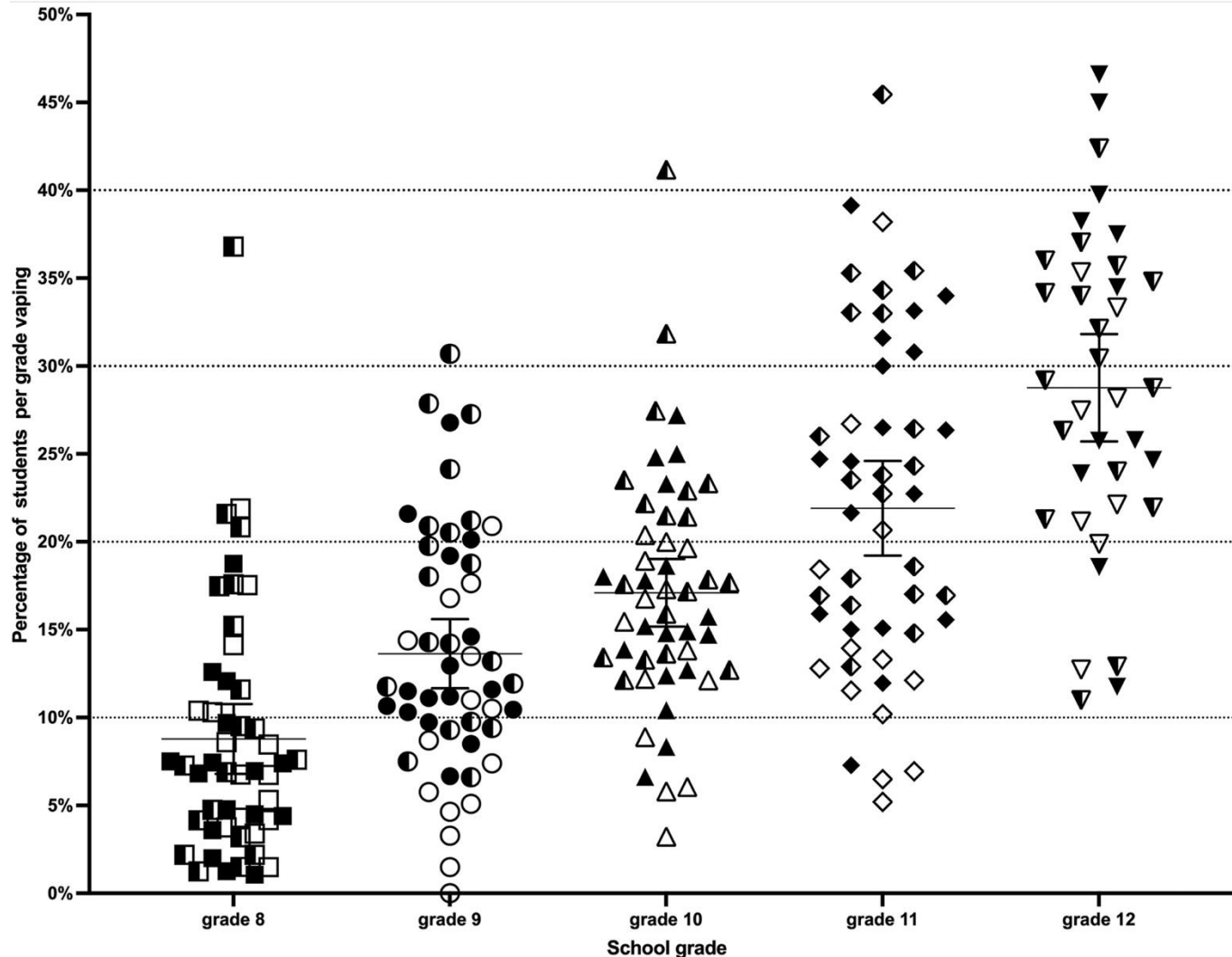


Findings



- In the 30 days preceding the survey:
 - **36.7%** of learners reported having ever tried a vaping product.
 - **16.8%** of the sampled high school students reported that they currently vape.
 - There were far lower rates of tobacco cigarette use (**2.1%**), cannabis use (**5.1%**) and hookah pipe use (**3.2%**) among the sampled learners.

Frequency of reported vaping across individual schools by grade



- Vaping rates varied by grade and schools.
- The proportion of learners reporting e-cigarette use increased by grade:
 - Around **9%** of Gr8 students reported using vapes, but this rose sharply to an average of **29.5%** among Gr12 pupils.
 - Some schools had usage rates as high as **46%** among Gr12 pupils.

The model



- We estimated a model to determine the factors that determine the likelihood that a learner currently uses vapes.

- The model controlled for:



Demographics (age, grade and gender)



Physiological factors (stress and concentration)



Perception of e-cigarette harm relative to cigarettes



School-fee brackets

- The odds of vape use significantly increase with age, and by grade.
- Gender identity does not show a significant association with vaping odds.
- Students reporting above-average concentration abilities have lower odds of vaping.
- Perceptions of the harm associated with vaping are significantly associated with current vape use.
- At the school-level, fee bracket is not significantly associated with the odds of vape use.

	Odds-Ratio	p-value
Age (in years)	1.25 [1.16-1.35]	<0.0001
Grade (base=grade 8)		
Grade 9	1.23 [1.07-1.43]	0.0049
Grade 10	1.37 [1.13-1.66]	0.0012
Grade 11	1.48 [1.16-1.90]	0.0019
Grade 12	1.84 [1.34-2.52]	0.00017
Gender (base= male)		
Female	0.92 [0.82-1.03]	0.16
Transgender	0.90 [0.48-1.66]	0.75
Does not identify with a gender	1.12 [0.88-1.43]	0.35
Cognitive factors		
Above-average ability to concentrate (base= below-average ability to concentrate)	0.72 [0.65-0.81]	<0.0001
Above-average levels of stress (base=below-average levels of stress)	0.99 [0.90-1.09]	0.84
Perceived harms of vape use relative to tobacco (base=relative to tobacco, vaping is harmless)		
Moderate perceived harm of vaping	0.61 [0.57-0.70]	<0.0001
High perceived harm of vaping	0.18 [0.16-0.21]	<0.0001
School fees (base= high-fee schools)		
Mid-range fee schools	0.96 [0.72-1.29]	0.79
Low-range fee schools	1.27 [0.88-1.82]	0.20

Indicators of addiction amongst students who vape

This analysis only used the responses of learners who identified themselves as current vape users



Methods

- Our survey collected information on 5 indicators that can inform our understanding of students' addiction to vaping/vaping dependence based on their self-reported vaping behaviour. These include:
 1. Average vaping intensity
 2. The time they wait between waking up and vaping (Less than 5 minutes, 5 minutes to 1 hour, after an hour)
 3. Whether the student can get through the entire school day without vaping (Y/N)
 4. Whether the student reports that they feel anxious/angry if they are required to wait a long time before they can vape (Y/N)
 5. Whether the student uses nicotine or non-nicotine vapes (Y/N)



Among the learners who indicated that they vape:

- **38.3%** reported that they vape every day, and more than half of the learners in our sample reported that they vaped four or more days per week



- **88.1%** of pupils reported using vapes that contain nicotine



- **47%** reported that they vaped within the first hour of waking up



- **11.8%** of students indicated that they cannot get through the school day without vaping



- **24.9%** indicated that waiting a long time before they can vape makes them feel anxious or angry



Based on these responses, we constructed 2 novel vape dependence scores that reflect students' addiction levels (higher scores indicate greater addiction).

Dependence Score 1 (range 2-10), based on:	Scoring framework
Average number of vaping days each week	1 (one day per week) – 7 (all days of the week)
Time from waking to first vape use	1 (more than an hour) - 3 (less than five minutes)

- We used the midpoint score of 6 to classify students as having either “high vape dependence”, or “low vape dependence”.
- On this measure, **58.4%** student vape users in are sample **are highly vape dependent**.

Dependence Score₂ (range 2-13) adds students' ability to complete the school-day without vaping, feelings of anxiety/anger when delayed in vaping, and usage of nicotine/non-nicotine vapes to DS₁.

Dependence Score 2	Scoring framework
Number of vaping days each week	1 = vapes one day per week – 7 = vapes all days of the week)
Time from waking to first vape use	1 = more than an hour – 3 = less than five minutes
Ability to complete the school-day without vaping	1 = if they can't; 0 = if they can
Feelings of anxiety/anger when delayed in vaping	1 = does feel anxious/angry when delayed in vaping; 0 = doesn't feel anxious/angry when delayed in vaping
Usage of nicotine vs non-nicotine vapes	1 = uses nicotine vapes; 0 = uses non-nicotine vape

- We used the midpoint score of 7.5 to classify students as having either "high vape dependence", or "low vape dependence".
- On this measure, **60.70%** of vape users **exhibit high vape dependence.**



Why adolescents start and continue vaping

This analysis only used the responses of learners who identified themselves as current vape users

We asked learners reasons for:

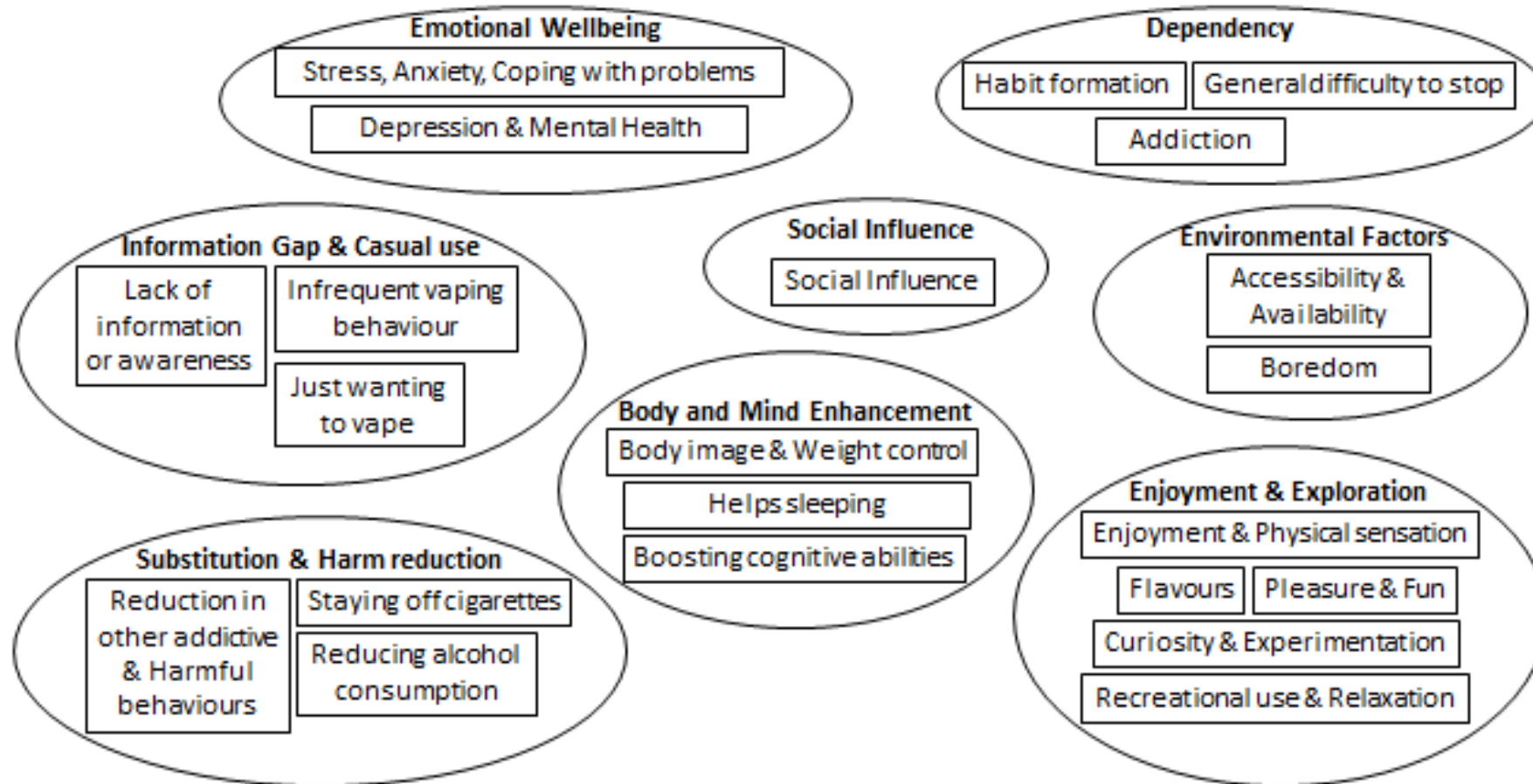


- Starting to vape:
 - Responses for reasons for initiating vaping were adapted from the US National Youth Tobacco Survey (NYTS) questionnaire, with an option for open-ended responses provided.
- Continuing to vape:
 - Open-ended responses to the question "Why do you continue to vape?".

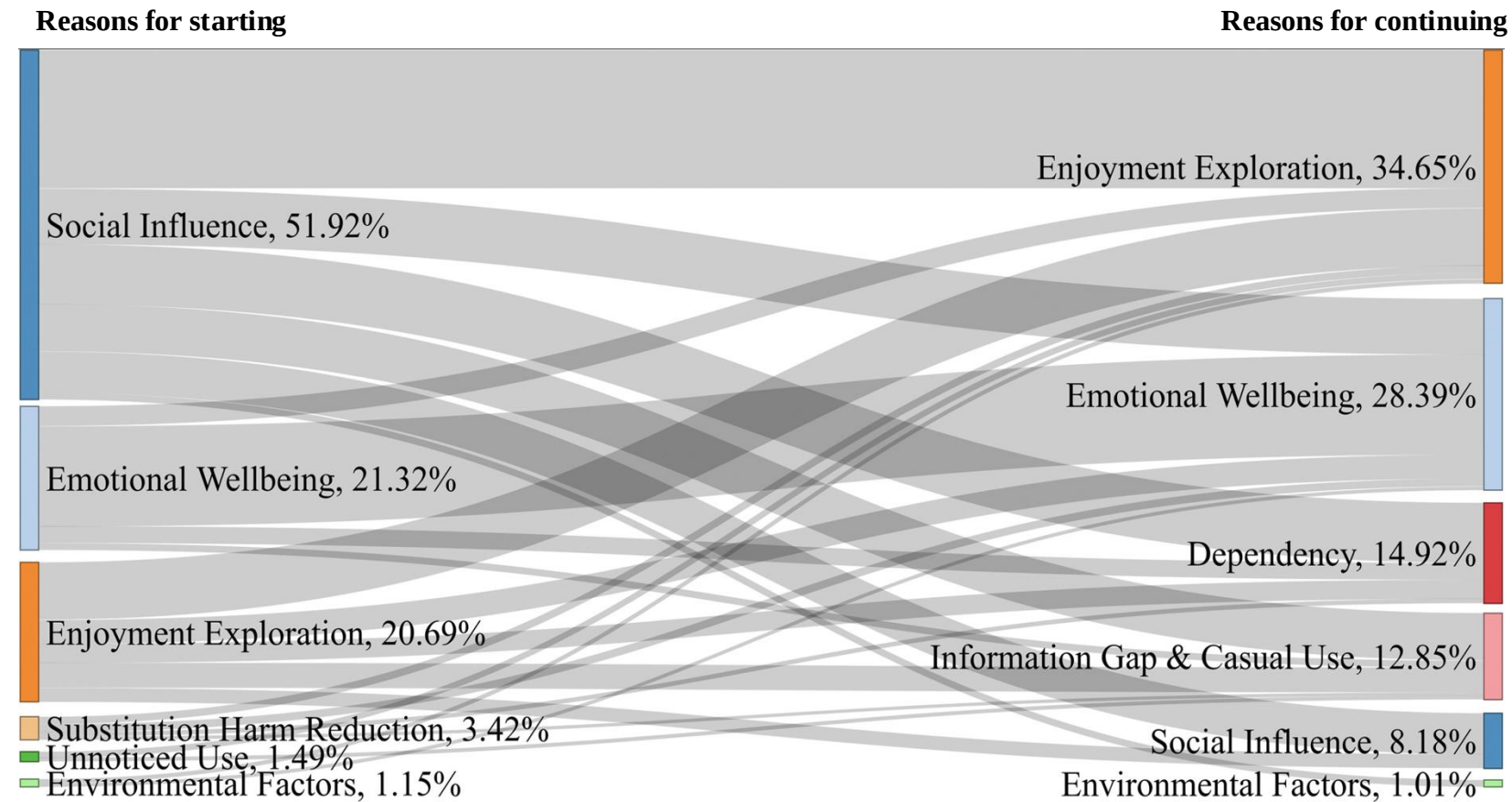
Methods

Qualitative free-text answers for reasons to continue vaping were coded into specific themes to allow comparison between initiation and continuation factors.

Why Adolescents continue to vape



Sankey plot showing transitions between reasons for starting to vape, and reasons for continuing to vape:



Primary reason for starting vaping differed from the main reasons for continuing to vape:

- **<10%** of students identified social influences as the reason why they continue to vape – a stark contrast to the reasons for starting.
- From the students who started due to social influences, **17.2%** reported that they continue due to dependency.
- **12%** of those who started vaping for emotional wellbeing reasons, reported developing dependency.

Findings



- Around **46%** of students did not list addiction as a reason for continuing to vape, although their reported vaping habits aligned with patterns typically seen in individuals who are highly addicted (high Dependence Scores).
 - This suggests that many learners in our sample may lack awareness of what constitutes addiction (“cognitive dissonance”).

What needs to be done?

Translating evidence to action



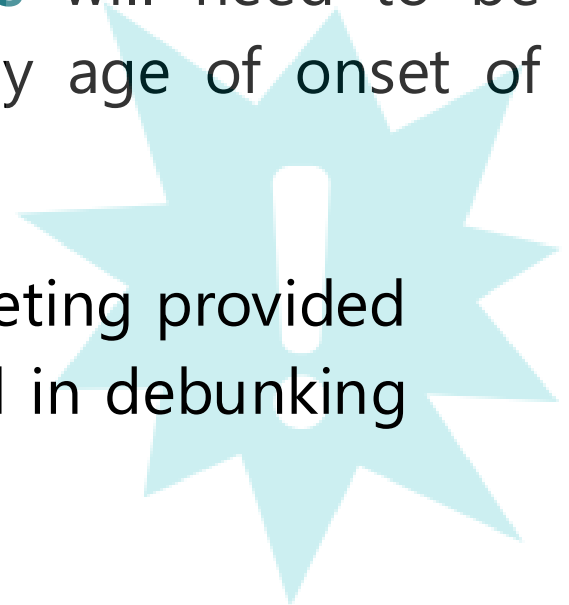


- The South African government must pass the **Tobacco Products and Electronic Delivery Systems Control Bill** which will:
 - Restrict young people's access to vapes.
 - Restrict advertising of vaping products: aids in the deglamorization of vaping among young people – reducing the general curiosity that leads many young people to begin in the first place.

- The dangerous myth that “vaping is safe” also needs to be debunked.
 - Basic education around the **harms of vaping** will be important, and the model results suggests that lack of belief in the harms of vaping is associated with active vape use.
 - It is likely that these **preventative interventions** will need to be implemented in younger grades given the early age of onset of usage (*East London anecdote*).



- Restrictions on vape marketing provided for by the Bill can also aid in debunking the myth that vaping is safe.





Finally, we need to help addicted teenagers to stop vaping.

Key Challenge: Limited Research on Effective Strategies

- Cochrane review: No robust RCT data. Unclear if adult tobacco cessation strategies apply to adolescent vaping.
 - Recent US RCT: **37% abstinence** at 7 months using a **text messaging intervention** amongst adolescent vapers.
- No validated tool for adolescent nicotine dependence. Nicotine often not classified as a “substance use disorder”.
- No approved pharmacological therapies for under-18s.
- Existing behavioural & cognitive interventions borrowed from adult smoking/substance use.

High vaping burden among high school learners required immediate action.

- Extrapolating from adult/adolescent tobacco addiction principles may guide intervention design; but effective interventions must be tailored for adolescent vaping addiction (i.e., balance addiction, mental health & social influences).
- Punishing students for vaping is unlikely to be an effective strategy. Rather identification, engagement, and adherence to treatment are critical for success:
 - Parents must be more **aware** of the signs of vaping and the underlying issues driving it.
 - **Healthcare professionals** should ask young people about their vape use during routine checkups and can also facilitate adherence to any required intervention such as patches or oral withdrawal medications.
 - And school counsellors should **teach coping strategies** to help teens navigate life's challenges in a less harmful way.



Thank you!