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The impact of the 'CATCH My Breath' vaping prevention curriculum among high school students in Ontario, Canada: Results of a pilot test

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ABSTRACT

Background: Youth vaping is a public health concern in Canada. However, there is a dearth of evaluation data for school-based vaping prevention programs in Canada. This pilot study assessed short-term changes in knowledge, subjective norms, and intentions to vape among a sample of high school students in Ontario, Canada exposed to the 'CATCH My Breath' (CMB) vaping prevention curriculum.

Methods: A convenience sample of 10 high schools across Ontario delivered CMB lessons between October 2022 and April 2023. Students completed an online survey before being exposed to CMB and 4-weeks after the lessons. McNemar's Chi-square exact tests of paired proportions assessed significant changes in knowledge, subjective norms, and intentions to vape before/after exposure to the curriculum among n = 116 students who could be linked over time.

Results: After exposure to CMB, students exhibited a significant increase in their knowledge: pre-test scores averaged 5.5 and post-test scores averaged 7.5. At post-test, significantly fewer students thought that most people in high school vape. There were no significant changes in intentions to vape and pre/post changes were similar for boys and girls.

Discussion: After exposure to CMB, high school students in Ontario demonstrated significant increases in knowledge of the risks of vaping and modest reductions in perceptions of subjective norms of vaping. CMB has been adapted for use in high schools in Canada, and implementing this program could help to reduce youth vaping.

1. Introduction

Vaping has increased dramatically among adolescents in Canada (CAMH, 2019; Cole et al., 2020; Hammond and Reid, 2023), and it continues to be highly prevalent following the early periods of the COVID-19 pandemic (Leatherdale et al., 2022). According to recent nationally representative data, 30.0 % of adolescents aged 15–19 years have ever tried vaping, 13.6 % reported vaping in the last 30 days, and 6.5 % reported vaping daily (Government of Canada and Statistics Canada, 2023). Many adolescents who have not vaped are also susceptible to vaping in the future, lacking a firm commitment to not vape (Bold et al., 2017; Carey et al., 2018; Seo et al., 2020). As a result, these adolescents may be influenced by peer vaping norms and behaviours (Kintz et al., 2020; Mantey et al., 2021) and exposure to direct (Shan and Azagba, 2022) and indirect vaping marketing and advertising (Bennett et al., 2020) and initiate vaping.

School-based vaping prevention programs have an important role in increasing student knowledge of the risks of vaping and influencing social norms of vaping that may prevent or delay youth vaping. However, there are few school-based vaping prevention programs that have been developed, and only some have been evaluated (Liu et al., 2020). Most programs target middle school students (grades 6–8) rather than high school students (grades 9–12), even though almost one-third of students in grades 9–11 will initiate vaping over a one-year period

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(Williams et al., 2021). Other evidence indicates that current prevention programs are associated with an increase in student knowledge of vaping devices (Baker et al., 2022; Gaiha et al., 2021; Herrmann et al., 2024; Hollis et al., 2022; McCauley et al., 2023; Weser et al., 2021) and may reduce intentions to vape in the future (Andrews et al., 2023; Gaiha et al., 2021; McCauley et al., 2023).

To our knowledge only one vaping prevention program has been evaluated in Canada, and only post-test surveys were collected for quality improvement purposes (Hollis et al., 2022). Therefore, the objective of this pilot study was to assess short-term changes in knowledge of the risks of vaping, subjective norms of vaping, and intentions to vape among a convenience sample of high school students in Ontario, Canada exposed to the 'CATCH My Breath' (CMB) vaping prevention curriculum.

2. Materials and methods

This was part of a larger pilot study that tested the implementation of 'CATCH My Breath' (CMB) in a sample of high schools in Ontario, Canada in order to support the adoption and scalability of CMB in high schools across Canada. In addition to the quantitative data presented here, qualitative interviews with curriculum presenters and focus groups with students provided in-depth insight into the perceptions of the appeal, appropriateness, and comprehensiveness of the curriculum (Cole et al., 2023). A convenience sample of 10 high schools across Ontario participated in this pilot study. This study was reviewed and received ethical approval from the Research Ethics Board at Ontario Tech University (#16837) as well as appropriate school board committees.

2.1. 'CATCH My Breath' intervention

CMB is an evidence-based vaping prevention curriculum originally designed for students in the United States in grades 6–8 (Kelder et al., 2020). CMB is based on best practices from previous school tobacco prevention studies and was designed to be delivered through four 35- to 40-minute lessons by a trained presenter (Kelder et al., 2021). The curriculum design and content targets two key constructs of Social Cognitive Theory: self-efficacy and behavioral capacity (i.e., knowledge and skills) (Bandura, 1998; Luszczynska and Schwarzer, 2015; Kelder et al., 2015). The curriculum provides students with knowledge of why and how to resist vaping. Specifically, CMB lessons provide information about social norms related to vaping (e.g., most youth do not vape), outcome expectations (e.g., health and addiction risks, school rules about vaping), and media literacy (e.g., how to recognize and decipher tobacco industry marketing of vapes) (Kelder et al., 2021). To solidify the content, in-class activities allow students to practice refusal skills, which is known to be an important component of successful smoking prevention programs (Kelder et al., 2020; Thomas et al., 2015). Through the acquisition of knowledge of the risks of vaping and development of refusal skills, it is anticipated that CMB would change intentions to vape among students who never vaped and therefore reduce youth vaping rates.

The presenters were provided access to the necessary materials (e.g., detailed curriculum) and resources (e.g., classroom handouts, full click-and-play versions of the lessons) through the CATCH digital access portal. CMB lessons informed students of the components of vapes and the known and potential health consequences and addiction risk of vaping; discussed social norms and reasons for vaping; provided students with positive alternatives to vaping and strategies to resist peer influences; helped students to recognize advertising and messaging tactics by the vaping industry; and discussed school, provincial, and national policies for vaping (Kelder et al., 2021, 2020). As the original lessons were designed for students in the United States, slight adaptations were made to the curriculum for the Canadian context prior to delivery (e.g., including Canadian prevalence data, Canadian vaping policies).

CMB lessons were delivered in 28 classes between October 2022 and April 2023. The curriculum was delivered by classroom teachers in most cases; however, at two schools (7 classes), public health unit staff assigned to the participating schools delivered the lessons. CMB lessons were originally designed for elementary schools, where class periods are 30–40 min; however, classes in many Ontario high schools are 60–75 min long. As a result, lessons were frequently combined to deliver the curriculum over 2 days (n = 12 classes) or 3 days (n = 4 classes). Some presenters delivered the program over 4 days (n = 7 classes).

2.2. Sample selection

Initially, local school boards and schools were approached to participate in the pilot study; however, interest in the curriculum grew over the course of the study and other school boards were subsequently invited to participate. A total of 10 schools from 5 school boards participated (including an independent, all-girls school). Initially, it was intended for CMB lessons to be delivered during Grade 9 Health and Physical Education classes because the content aligned with the provincial curriculum and all students are required to take a physical education class at this grade level. However, during school recruitment, some schools chose to deliver the lessons in other required classes for Grade 9 students (e.g., Grade 9 Science or English classes). Because CMB was delivered during class time, all students in the classes, regardless of parental consent, were exposed to the curriculum.

Students in participating classes were invited to complete an online pre-test survey before being exposed to CMB and a post-test survey 4-weeks after exposure to the last lesson. Active consent procedures, where students had to return a consent form signed by their parent/guardian, or passive consent procedures, where parents needed to notify the research team if they did not want their student to participate, were used depending on school board requirements. Most schools (n = 8) required active consent procedures. In all cases, students also chose whether or not they completed the survey the day of the data collection.

Based on school enrollment data, n = 836 students were eligible to complete the surveys; n = 494 students had parental permission to complete the surveys (38.9 % of students in active consent schools, 98.2 % in passive consent schools). After data cleaning (i.e., removing duplicate surveys, blank surveys), n = 313 pre-test surveys remained. At post-test, n = 235 students completed surveys (47.6 % of those with permission). Lower follow-up survey participation rates were observed in some schools as a result of the curriculum being delivered close to the winter break.

2.3. Measures

An online survey was distributed to students with consent pre/post exposure to the CMB curriculum in order to assess short-term changes in knowledge of the risks of vaping and attitudes towards vaping. The pre/post surveys consisted of the same 38 questions and were administered during class time in 9/10 schools up to one week prior to the first lesson and four weeks after the final lesson (one school did not have any students who completed the pre-test or post-test surveys). Similar to previous research (Bredin and Leatherdale, 2013), the first five questions were used to develop a unique code for each respondent that allowed the research team to link pre/post student data. The survey was designed to be completed within 10–15 min to reduce participant burden.

Knowledge of the risks of vaping: Consistent with previous evaluations of CMB (Kelder et al., 2020), students indicated whether nine statements about the risks of vaping were true or false. These nine statements were relevant to content from the lessons.

Subjective norms of vaping: Consistent with previous evaluations of CMB (Kelder et al., 2020), students indicated whether they agreed or disagreed with two statements about subjective norms of vaping: "Most people my age vape" and "Most people in high school vape".

Intentions to vape in the future: Two questions assessed intentions to

vape in the future among students who had never vaped: "If one of your best friends were to offer you a vape, would you use it?" and "At any time during the next year do you think you will use a vape?", with responses 'definitely not', 'probably not', 'probably yes', and 'definitely yes'. For both questions, any response other than 'definitely not' was considered an intention to vape in the future. Similar to a previous study (McCauley et al., 2023), we examined the results separately for each question.

Demographic and behavioural characteristics: Students also answered demographic questions (grade, age, gender, race/ethnicity), and validated vaping measures (ever and current use) (Doran et al., 2020; Vogel et al., 2019).

2.4. Analysis

Data from pre/post surveys were linked based on the unique codes created by participating students. McNemar's Chi-square exact tests of paired proportions assessed significant differences in the proportion of students who correctly answered knowledge questions about vapes relevant to the curriculum, who agreed with statements about subjective norms of vaping, and who indicated intentions to vape if offered by a friend and intentions to vape in the future before/after exposure to the curriculum. A sensitivity analysis repeated the analysis in the full, unlinked sample of students, with similar results (not shown). Given a lack of evidence in this area, we also stratified the analyses by gender to explore whether there were differences in changes in knowledge, subjective norms, and intentions to vape by gender that could be addressed in future programs. The data analysis for this pilot study was generated using SAS software, Version 9.4 of the SAS System for Windows.

3. Results

Of the n = 313 students who completed the pre-test survey, 37.1 % (n = 116) were linked to their post-test survey. The average age of students in the linked sample was 14.1 years (standard deviation = 0.5), 60.3 % identified as girls and 32.8 % identified as boys, 66.1 % identified as white, 19.1 % had ever tried vaping and 11.3 % reported vaping in the past 30-days (Supplementary Table 1). The linked sample included a significantly higher percentage of girls and a lower prevalence of both ever and current vaping compared to the sample of students who could not be linked (n = 197).

3.1. Knowledge of the risks of vaping

As shown in Table 1, after being exposed to the CMB curriculum, students showed positive changes in knowledge about the risks associated with vaping. Pre/post changes in knowledge were similar across gender subgroups. Across the nine statements, students exhibited a significant increase in their knowledge levels after exposure to CMB ($p < 0.001$), with pre-test scores averaging 5.5 and post-test scores reaching 7.5. A significant increase in knowledge scores was observed among both boys (pre-test: 5.3, post-test: 7.0, $p < 0.001$) and girls (pre-test: 5.7, post-test: 7.7, $p < 0.001$). As shown in Supplementary Table 2, there were few significant differences in the proportion of correct answers by gender at pre-test and post-test.

3.2. Vaping subjective norms and intentions

As shown in Table 2, significantly fewer students agreed with the statement "Most people in high school vape". While fewer students also agreed with the statement "Most people my age vape" at post-test, it was not significantly different. Analyses of subjective norms stratified by gender were not significant. Intentions to vape were relatively stable between pre-test and post-test. While not significant, fewer boys thought they would use a vape if a friend offered or thought they would vape in the future at post-test compared to pre-test. In contrast, more girls thought they would use a vape if a friend offered or thought they would vape in the future at post-test compared to pre-test (not significant).

4. Discussion

These are the first pre-post data of changes in knowledge, subjective norms, and intentions to vape following exposure to a vaping prevention program among high school students in Canada. Grade 9 students demonstrated significant increases in knowledge about the risks of vaping four weeks after exposure to the 'CATCH My Breath' (CMB) vaping prevention program. While there were modest changes to subjective norms of vaping, there were no significant changes in intentions

Table 1
Changes in percentage of high school students responding correctly to statements about vaping pre and post exposure to CATCH My Breath, overall and by gender, 2022–23 CATCH My Breath Pilot Study, Ontario, Canada.

Vaping statement	Overall (n = 109)				Boys (n = 37)				Girls (n = 64)			
	Pre-test % (n)	Post-test % (n)	% change	p-value	Pre-test % (n)	Post-test % (n)	% change	p-value	Pre-test % (n)	Post-test % (n)	% change	p-value
Nicotine is addictive	95.4 (104)	98.2 (107)	+2.8	0.375	91.9 (34)	97.3 (36)	+5.4	0.500	96.9 (62)	98.4 (63)	+1.5	1.000
When you are addicted to something you lose control	78.0 (85)	89.9 (99)	+11.9	**0.004**	86.5 (32)	89.2 (33)	+2.7	1.000	71.9 (46)	90.6 (58)	+18.7	**0.002**
E-cigarette vapour contains mostly water	38.5 (42)	82.6 (90)	+44.1	**<0.001**	35.1 (13)	75.7 (28)	+40.6	**<0.001**	43.8 (28)	87.5 (56)	+43.7	**<0.001**
Most vapes, including JUUL, contain nicotine	78.9 (86)	97.3 (106)	+18.4	**<0.001**	73.0 (27)	97.3 (36)	+24.3	**0.004**	79.7 (51)	96.9 (62)	+17.2	**0.007**
Most sweet flavoured vapes contain nicotine	78.0 (85)	96.3 (105)	+18.3	**<0.001**	73.0 (27)	94.6 (35)	+21.6	**0.022**	81.3 (52)	96.9 (62)	+15.6	**0.006**
It is illegal for teens under the age of 19 to buy vapes	73.4 (80)	89.9 (98)	+16.5	**<0.001**	59.5 (22)	81.1 (30)	+21.6	**0.039**	81.3 (52)	93.8 (60)	+12.5	**0.039**
Direct pressure is advertising that everyone knows is paid for by the tobacco or e-cigarette industry on billboards, magazines, television, and on the internet	32.1 (35)	66.1 (72)	+34.0	**<0.001**	40.5 (15)	59.5 (22)	+19.0	0.119	29.7 (19)	67.2 (43)	+37.5	**<0.001**
Indirect pressure is advertising that hides who paid for the advertising and often doesn't even look like advertising	34.9 (38)	65.1 (71)	+30.2	**<0.001**	27.0 (10)	48.7 (18)	+21.7	**0.022**	40.6 (26)	71.9 (46)	+31.3	**<0.001**
Putting someone down for vaping is not a smart refusal strategy	45.0 (49)	62.4 (68)	+17.4	**0.003**	40.5 (15)	54.1 (20)	+13.6	0.267	45.3 (29)	65.6 (42)	+20.3	**0.019**

Table 2
Changes in percentage of high school students agreeing with statements about subjective norms of vaping and with intentions to vape in the future pre and post exposure to CATCH My Breath, 2022–23 CATCH My Breath Pilot Study, Ontario, Canada.

Vaping subjective norms statement	Overall (n = 105)				Boys (n = 36)				Girls (n = 62)			
	Pre-test % (n)	Post-test % (n)	% change	p-value	Pre-test % (n)	Post-test % (n)	% change	p-value	Pre-test % (n)	Post-test % (n)	% change	p-value
Most people my age vape.	75.2 (79)	66.7 (70)	−8.5	0.064	61.1 (22)	47.2 (17)	−13.9	0.180	82.3 (51)	75.8 (47)	−6.5	0.344
Most people in high school vape.	83.8 (88)	75.2 (79)	−8.6	**0.049**	72.2 (26)	58.3 (21)	−13.9	0.180	88.7 (55)	83.9 (52)	−4.8	0.453
Vaping intentions statement [a]	**Overall (n = 83)**				**Boys (n = 26)**				**Girls (n = 50)**			
Would use a vape if their friend offered	35.5 (33)	37.1 (33)	+1.6	0.791	37.9 (11)	28.6 (8)	−9.3	0.625	32.1 (18)	39.6 (21)	+7.5	0.344
Think they will use a vape in the next year	33.3 (31)	32.6 (29)	−0.7	1.000	31.0 (9)	25.0 (7)	−6.0	1.000	32.1 (18)	37.7 (20)	+5.6	0.508

[a] Only students who never vaped were asked these questions.

to vape in the future.

Previous studies of vaping prevention programs in the United States have also demonstrated improvements in knowledge of the risks of vaping following exposure to education programs. Consistent with other evaluations of vaping prevention programs (Baker et al., 2022; Gaiha et al., 2021; Herrmann et al., 2024; Hollis et al., 2022; McCauley et al., 2023; Weser et al., 2021), both boys and girls in our sample displayed significant improvements in knowledge of the risks of vaping. Notably, this study adds to the limited literature of the impact of vaping prevention programs on Canadian high school students. There are few vaping prevention programs available to Canadian schools, and the current study provides evidence that there are critical misperceptions about the harms of vaping among high school students which may contribute to the high prevalence of use. For example, only about one-third of students correctly identified that e-cigarette vapour does not contain mostly water at baseline. A belief that the aerosol from vapes contains water or just flavours has been reported previously (de Andrade et al., 2016), and may contribute to perceptions that vapes are harmless.

Relatively few studies have reported changes in subjective norms or intentions to vape in the future after exposure to vaping education programs (Andrews et al., 2023; Baker et al., 2022; Bteddini et al., 2023; McCauley et al., 2023). Students frequently overestimate how many of their peers use substances, which can inflate perceptions of how normative the behaviour is and increase the risk of tobacco use (Agaku et al., 2019; Tyas and Pederson, 1998). Students in our sample demonstrated a modest reduction in perceptions of subjective norms of vaping among their peers, with larger reductions among boys. While this finding deserves additional investigation, the data presented in CMB may not have reflected the personal experiences of students if a lot of their peer group vaped. Vaping prevention education programs should ensure that vaping statistics that are presented are current and relevant to students, while also acknowledging that the data may not reflect all peer groups, in order to ensure the data's perceived validity. It is also possible that the small sample size did not provide sufficient statistical power for our analyses. Future studies with larger samples should investigate whether there are gender differences in changes in perceptions of subjective norms of vaping after exposure to vaping prevention programs.

We did not identify a significant change in intentions to vape in the future among students who never vaped after exposure to CMB. Interestingly, there were divergent trends by gender: fewer boys reported intentions to vape in the future post exposure to CMB, representing a change in the desired direction. In contrast, more girls reported intentions to vape in the future, representing an undesirable change. Given that the small sample of boys and girls may have limited our ability to detect a significant effect, additional studies are needed to confirm this finding and explore why such a difference exists. While some studies have demonstrated immediate reductions in intentions to vape in the future (Andrews et al., 2023) or if offered by a friend (McCauley et al., 2023), others have found no impact over longer follow-up times (Baker et al., 2022; Bteddini et al., 2023). Additional studies are needed to identify the components of vaping prevention education programs that help to change students' intentions to vape in the future, and whether sociodemographic (e.g., gender) differences exist in the effectiveness of these components.

Limitations of the current study include a small, convenience sample of schools and students which may not be generalizable across Ontario or Canada. Loss to follow-up was higher than expected due to delays in school board application approval and school recruitment during the fall. This resulted in the post-test surveys at some schools being conducted close to the winter break, which reduced student participation rates because some students were absent from school, which negatively impacted our ability to link student pre/post data. In addition, the requirement for active consent procedures at many schools limited student participation and may bias the sample.

5. Conclusion

These are the first pre/post evaluation data for a vaping education program delivered to high school students in Canada. After exposure to CMB, students demonstrated significant increases in knowledge of the risks of vaping and modest reductions in perceptions of subjective norms of vaping. The content of CMB has been adapted for use in Canadian schools, and implementing this program could help to reduce youth vaping.

6. Disclosure statement

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CRediT authorship contribution statement

Adam G. Cole: Writing – original draft, Supervision, Resources, Methodology, Funding acquisition, Formal analysis, Conceptualization.

Lucas Fairs: Writing – original draft, Project administration, Investigation, Data curation. **Dale Mantey:** Writing – review & editing. **Anne Philipneri:** Writing – review & editing. **Celina Degano:** Writing – review & editing. **Marcella Bianco:** Writing – review & editing, Resources. **Steven H. Kelder:** Writing – review & editing.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Adam Cole reports financial support was provided by Canadian Cancer Society Research Institute. Adam Cole reports financial support was provided by Canadian Institutes of Health Research. S.H.K. and D.M. are paid consultants in litigation against the vaping industry. S.H.K created the CATCH Global Foundation in 2014, but has relinquished his intellectual property rights to UTHealth and receives no remuneration from the CATCH Global Foundation. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2024.102919.

Data availability

The authors do not have permission to share data.

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