Paediatrics & Child Health, 2019, e51–e56
doi: 10.1093/pch/pxy075
Original Article
Advance Access publication 07 June 2018

OXFORD

Original Article

Knowledge and practice of harm-reduction behaviours for alcohol and other illicit substance use in adolescents with type 1 diabetes

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Ethics Board Approval: Conjoint Health Research Ethics Board, University of Calgary

Abstract

Objective: To survey adolescents with type 1 diabetes mellitus (T1DM) about their knowledge and application of harm-reduction recommendations when they engage in alcohol and other illicit substance use.

Methods: Cross-sectional survey and chart review of adolescents with T1DM aged 13 to 18 years.

Results: One hundred and ninety patients were approached and 164 were included in the analysis. Mean age was 15.6 years (standard deviation [SD]=1.5). Fifty-one per cent were male. Of those who reported consuming alcohol, 95% knew that they should have a friend or parent check their blood glucose in the middle of the night after drinking but only 62% reported actually doing this in practice. Similarly, 98% reported knowing that they should wear a medic alert identification but only 79% reported actually doing this. Of those who reported consuming cannabis, 14% reported forgetting to check blood glucose and 14% reported forgetting insulin when using cannabis. From the chart review, a significantly lower proportion of adolescents reported substance use during their clinic visits (alcohol 26%, tobacco 19%, illicit substance 25%) compared to the self report in the survey (alcohol 55%, tobacco 30%, illicit substance 32%).

Conclusions: Adolescents' knowledge of harm-reduction practices for the use of alcohol and other illicit substances is not always put to practice. Motivating adolescents to use their knowledge in practice is an important area to improve in diabetes self-management. Those who reported engaging in substance use in the survey had not always reported use during interactions with health care providers. This emphasizes the need for unbiased, universal education of all adolescents in the clinic.

Keywords: *Adolescent; Alcohol; Cannabis; Harm reduction; Tobacco; Type 1 diabetes.*

Adolescence is a period of transition during which teens assert their independence and try new experiences (1). Adolescents with type 1 diabetes mellitus (T1DM) engage in risk-taking behaviours, such as illicit substance use, in similar proportions to their peers (2).

Alcohol consumption by individuals with T1DM is associated with an increased risk for hospitalization for diabetic ketoacidosis (DKA) (3–5). Alcohol can also cause severe hypoglycemia within 6 to 36 hours of consumption, even with amounts that are insufficient to cause intoxication (6,7). It may be difficult for individuals unfamiliar with T1DM to differentiate between the effects of intoxication and hypoglycemia in an individual with T1DM. Illicit substances such as ecstasy, cocaine, heroin and ketamine may also increase risk for DKA

(5,7–9). Impaired judgment under the influence of alcohol, cannabis or other illicit substances may lead to insulin omission or incorrect insulin dosing and lack of blood glucose monitoring. Regular alcohol, tobacco and cannabis use can have long-term adverse effects on glycemic control in individuals with T1DM (7).

The aim of this study was to assess the knowledge and application of harm-reduction recommendations for alcohol and other illicit substance use in adolescents with T1DM who use these substances.

METHODS

Design

This study was a cross-sectional survey of adolescents with T1DM being followed in a tertiary centre paediatric diabetes clinic combined with a chart review to assess reported substance use during clinical encounters. The survey methodology has been previously described in a study on the prevalence of substance use (2) and is outlined briefly below.

Subjects

Participants were recruited from the Alberta Children's Hospital Diabetes Clinic (Calgary, Alberta, Canada) July 2014 through November 2014. Adolescents were included if they were between the ages of 13 to 18 years, diagnosed with T1DM at least 1 year prior with follow-up in the paediatric diabetes clinic at Alberta Children's Hospital. Exclusion criteria included intellectual disability precluding the ability to understand and complete the survey and language barriers that could limit the understanding of survey questions.

Ethics

Written consent was obtained from all participants 15 years of age and older. For participants 13 to 14 years of age, written consent was obtained from parents and assent from participants. This study was approved by the Conjoint Health Research Ethics Board at the University of Calgary (Calgary, Alberta, Canada).

Recruitment

During the study period, each consecutive adolescent with diabetes who presented to the clinic for their routine clinic appointment was invited by clinical staff to complete the survey. If the adolescent agreed, the research coordinator was contacted and provided more information about the study and obtained written consent. Participants were then given the survey to complete. The recruitment period was 5 months since most adolescents would have follow-up visits in the range of every 3 to 5 months in the diabetes clinic.

Data collection

The initial version of the survey was piloted on two adolescent volunteers with and without diabetes to assess for flow and reading level and time required for completion. The content of the survey was reviewed by three paediatric endocrinologists and three diabetes educators for content validity. The final version of the survey (Supplementary Appendix) was completed on a touch screen tablet computer by the adolescent in a confidential clinic room setting without the presence of their family or usual health care provider. There was survey branching so some questions were only asked of adolescents that responded 'yes' to previous use of alcohol, tobacco or illicit substance. A research assistant was present in the room to provide instructions.

Chart review

A retrospective chart review by an observer blinded to the survey responses was performed for all survey participants. The chart review included i) whether alcohol, tobacco and illicit substance use were previously documented for each participant and ii) whether risks and harm-reduction education had been discussed in a clinic visit. Health care professionals have a standard form in our clinic electronic medical record to document at each visit whether an individual acknowledged or denied use of each substance and whether education regarding use of that substance occurred. However, clinicians do not always answer all questions.

Survey responses were matched to chart reviews for each patient by a research assistant who was not involved in clinical interactions with survey participants. Separate comparisons were done for alcohol, tobacco and illicit substance use.

Statistical analysis

Data are presented as proportions. The difference in proportions was assessed using a McNemar test for paired analysis. A Bonferroni correction for multiple comparisons was applied and a significance level α=0.003 was hence used for statistical tests.

RESULTS

Participants

In our clinic, there are 494 adolescents aged 13 to 18 years followed with T1DM. A total of 190 patients were approached consecutively at diabetes clinic appointments during the study period. The total number of patients approached was limited by the availability of the research coordinator to be at all of the diabetes clinics during the study period. Of the 190 approached, 20 declined to participate, and 6 did not meet inclusion criteria, leaving a total of 164 participants that completed the survey. The demographics of participants were similar to all 13 to 18-year-old clinic patients (51% males versus 53% males; mean age 15.6 years; SD=1.5 versus mean age 15.8 years; SD=1.7 years).

Knowledge of the effects of alcohol, tobacco and other illicit substances on blood glucose

Alcohol can put people with T1DM at risk for both hyperglycemia and hypoglycemia while tobacco and cannabis can cause mild hyperglycemia. Respondents (N=164) felt that alcohol could increase (N=42; 26%), decrease (N=51; 31%) or could have either effect (N=63; 38%) on blood glucose following consumption. Five per cent of the respondents felt that alcohol had no effect on blood glucose (N=8; 5%). Respondents felt that tobacco could increase (N=35; 21%), decrease (N=11; 7%), have either effect (N=59; 36%) or have no effect (N=59; 36%) on blood glucose. Respondents felt that cannabis could increase (N=23; 14%), decrease (N=20; 12%), have either effect (N=83; 51%) or have no effect (N=38; 23%) on blood glucose.

Alcohol harm-reduction recommendations

Of the 164 survey participants, 84 had previously consumed alcohol and responded to knowledge and application questions around alcohol use. Of those who reported consuming alcohol, 95% knew that they should have a friend or parent check their blood glucose in the middle of the night after drinking but only 62% reported actually doing this in practice. Similarly, 98% reported knowing that they should wear a medic alert identification but only 79% reported actually doing this. Seventy-five per cent of the participants responded that they should worry about hypoglycemia after consuming alcohol. Forty-two per cent of the respondents reported being aware of recommendations to adjust insulin dose after consuming alcohol to minimize the risk of hypoglycemia. Table 1 summarizes a comparison of adolescents' knowledge of recommended harm-reduction practices and reported application of that knowledge in all 84 individuals who reported previously consuming alcohol and completed the survey questions.

Cannabis harm-reduction recommendations

Of the 164 survey participants, 37 had previously consumed cannabis and responded to knowledge and application questions around cannabis use. Seventy per cent (N=26) of the respondents were aware that they should adjust their insulin when consuming cannabis. Ninety-seven per cent (N=36) responded that they know they should monitor their blood glucose while consuming cannabis. One hundred per cent (N=37) of the participants responded that they know they should monitor their blood glucose while consuming cannabis. However, 86% (N=32) of the individuals responded that they actually monitor their blood glucose while under the influence of cannabis. Fourteen per cent (N=5) of the respondents reported that they forget to take insulin while under the influence of cannabis.

Reported use of alcohol, tobacco, cannabis and other illicit substances to health care providers

Based upon the survey (N=164), 79% (N=129) of the adolescents reported discussing alcohol, tobacco, cannabis and illicit substance use with at least one health care provider during clinic visits: physicians (N=82; 50%), nurses (N=79; 48%) and dieticians (N=77; 47%). Many respondents reported substance use discussions with more than one health care professional during clinic visits and 21% (N=34) of the respondents reported that no health care professionals had discussed substance use with them in clinic.

Comparison of survey reporting and chart documentation

The charts contained yes/no documentation on use of alcohol in 118 of the 164 charts, tobacco in 87 charts and illicit substances in 76 charts. Of those adolescents that also had documentation in the charts, the substance use rates were 55% (65 of 118) for alcohol, 30% (26 of 87) for tobacco and 32% (24 of 76) for illicit substances based on the survey responses.

Table 2 shows the proportions of adolescents who reported alcohol, tobacco, cannabis and illicit substance use in the anonymous survey compared to the proportions documented by health care providers in diabetes clinic visits. Only about a quarter of those who reported substance use on the survey also had documentation of substance use on the chart review. Adolescents were more likely to report substance use in the anonymous survey compared to clinic visits. There were no participants that reported 'no' for substance use on the survey but had 'yes' documented on the chart review.

DISCUSSION

This is an important study comparing knowledge and application of recommended harm-reduction practices for adolescents with T1DM who may use alcohol and other illicit substances. Many adolescents were not aware of how these substances may acutely impact their blood glucose, which is important for insulin dose adjustment and blood glucose monitoring in adolescents who choose to experiment or regularly use one or more of these illicit substances.

Adolescents with chronic disease struggle with being different than their peers. Risk-taking behaviours, however, can have serious health implications. Few reports have addressed alcohol literacy in adolescents with T1DM. In a UK study, Barnard et al. reported that young adults with T1DM had poor knowledge of alcohol and carbohydrate content of alcoholic beverages (8). In a study of adolescents in the USA with chronic disease, including T1DM, 53% of respondents were aware that alcohol could interfere with the effects of their medications. Adolescents who were not aware that alcohol could affect their medications were fivefold more likely to consume alcohol and ninefold more likely to binge drink (9). Although 25% of the participants had T1DM, the study did not analyze the knowledge and behaviour associations specifically in this group.

Table 1. Knowledge and application of alcohol harm-reduction recommendations in adolescents with type 1 diabetes who report previously consuming alcohol

	Knowledge Proportion responding that they know they should do these things (n=84)	**Application of knowledge** Of those who responded 'yes' to knowing what they should do, the proportion that reported actually doing this in practice	
Question (Correct response = Yes)			P-value
Hypoglycemia and DKA Prevention			
Should you tell friends and family to call 911/ seek medical attention if you are sick and vomiting the next day and have no access to insulin?	79/84 (94.0%)	54/79 (68.4%)	<0.001*
Should you make a plan in case your pump site is lost or you sleep at a friend's house without insulin?	83/84 (98.8%)	65/83 (78.3%)	<0.001*
Should you tell your friends and family what the symptoms of low blood glucose can look like when drinking too much alcohol?	82/84 (97.6%)	73/82 (89.0%)	0.004
Monitoring and Protective Strategies			
Should you have a friend or parent check you in the middle of the night after you have been drinking?	80/84 (95.2%)	50/80 (62.5%)	<0.001*
Should you set an alarm to check your blood glucose in the middle of the night after you have been drinking?	76/84 (90.5%)	50/76 (65.8%)	<0.001*
Should you worry about low blood glucose after you have been drinking?	63/84 (75.0%)	53/63 (84.1%)	1.0
Should you check your blood glucose when you are drinking?	77/84 (91.7%)	65/77 (84.4%)	0.013
Should you take your diabetes supplies with you when you are drinking?	82/84 (97.6%)	78/82 (95.1%)	0.125
Should you have a friend or adult with you who is not drinking?	79/84 (94.0%)	62/79 (78.5%)	<0.001*
Should you wear a medic alert identification?	82/84 (97.6%)	65/82 (79.3%)	<0.001*
Should you make sure you consume food?	82/84 (97.6%)	76/82 (92.7%)	0.031
Insulin Adjustment			
Should you adjust your insulin dose for the amount you have been drinking?	35/84 (41.7%)	29/35 (82.9%)	0.227

McNemar test was used with a Bonferroni correction for multiple comparisons. P-value was considered significant if it was less than 0.003. Significance is shown by *.

DKA Diabetic ketoacidosis

Alcohol consumption causes a risk of delayed hypoglycemia in those with T1DM. Harm-reduction recommendations include making others aware of symptoms of hypoglycemia, wearing diabetes medical identification, carrying treatment for hypoglycemia and consuming carbohydrate rich foods while drinking (10). Individuals with T1DM should check their blood glucose before going to bed, in the middle of the night, and in the early morning after alcohol consumption to monitor for hypoglycemia. Omission of insulin under these circumstances, however, would be dangerous and may result in hyperglycemia or DKA. As identified in this study and others (11), insulin adjustment while consuming alcohol is an important topic for clinicians to discuss with their patients.

Table 2. Adolescents with type 1 diabetes who reported illicit substance use in the anonymous survey and also had this documented in the chart review

Substance	'YES' substance use reported in survey	'YES' substance use reported in survey *and* 'YES' substance use documented in chart review
Alcohol (N=118)	65/118 (55.1%)	17/65 (26.2%)
Tobacco (N=87)	26/87 (29.9%)	5/26 (19.2%)
Marijuana and/or other illicit substance use (N=76)	24/76 (31.6%)	6/24 (25.0%)

Adolescents in our current study generally had excellent knowledge of harm-reduction recommendations for alcohol consumption in people with T1DM. Despite appropriate knowledge, adolescents may choose to not apply these measures when consuming alcohol. Our results emphasize that adjustment in insulin dose while consuming alcohol is an important focus for future education. The Diabetes Canada Clinical Practice Guidelines 2018 recommends that people using insulin should be informed of the risk of hypoglycemia with alcohol consumption and should be advised on prevention including: food intake with alcohol, insulin dose adjustments, and increased blood glucose monitoring (http://guidelines.diabetes.ca/).

Tobacco and cannabis use may cause mild hyperglycemia. Tobacco may increase blood glucose by promoting abnormal secretion of growth hormone and cortisol (7). Cannabis can increase hyperglycemia indirectly by appetite stimulation. It has been directly linked to DKA (12). Cannabis use is also associated with impaired judgment (7), which could lead to forgetting to monitor blood glucose, insulin omission or inappropriate dosing. No general harm-reduction recommendations are available for tobacco or cannabis use in adolescents with T1DM. Our clinic practice is to recommend monitoring blood glucose frequently (minimum of before breakfast, lunch, supper and bedtime with middle of the night monitoring if needed) and to use reminders to take insulin doses on time. Fourteen per cent of the adolescents who consume cannabis reported forgetting to take insulin while under the influence, putting themselves at risk for DKA. There remains a disconnect between educating these adolescents to have appropriate knowledge and motivating these adolescents to apply that knowledge.

Clinically, it is important to address how to improve the gap between adolescent knowledge and application of that knowledge when using illicit substances. Adolescents' application of knowledge may be improved through discussion with health care professionals about the barriers to following through with harm-reduction recommendations during education sessions. Motivational interviewing use in the office has variable evidence of success (13–19). In the literature, parent modeling of appropriate behaviours (20,21) and good communication with parents (22,23) were important protective factors in dissuading risky drug and alcohol use. Parent-based intervention and education may also be beneficial rather than focusing on the adolescent alone (24–29). Although variable success has been seen with these interventions, implementation of motivational interviewing, parent education and encouragement of parents to reinforce the importance of harm-reduction strategies are options to integrate into educational practices in both a primary care setting and in a multidisciplinary diabetes clinic.

Another important finding was the discrepancy between the documentation of reported alcohol, tobacco or other illicit substance use during a clinic visit as compared to that reported by adolescents in the anonymous survey. Although this was a chart review, it does seem plausible that adolescents may have been more reluctant to report illicit substance use to their health care providers during in person clinic visits due to being uncomfortable, fearful, ashamed or embarrassed. Health care providers should consider under-reporting of illicit substance use by adolescents and provide unbiased, universal education of all adolescents in the clinic regardless of who reports substance use or perceived risk factors. Education about risks of use of these substances as well as harm-reduction recommendations should start in early adolescence and should be reiterated routinely. Provision of separate educational sessions to parents and encouragement of parent–child discussions around the consequences of risky behaviours is also encouraged (7).

This study had limitations due to the fact that the data were obtained by survey and a retrospective chart review. In the survey, participants were asked questions about their past experiences, so their responses may have been subject to recall bias. In the retrospective chart review, the data were limited to what was recorded in the chart. For example, some charts had only documentation of reported use for one or two of the three categories of alcohol, tobacco and illicit substance use. It is also possible that a discussion with the adolescent about illicit substance use occurred during a visit with a health care provider but it was not documented. Another limitation was that the survey was not validated and repeated measures were not done to confirm that responses would be consistent over time. Given that this was a retrospective chart review, it is also possible that the documented discussion of substance use in the chart was not repeated at the most current clinic visit.

Conclusions

In this study, we identified a gap between adolescents' knowledge and application of harm-reduction practices for the use

of alcohol and other illicit substances in the context of having T1DM. This work is important to diabetes educators and clinicians who work with adolescents with T1DM to improve educational practices around harm reduction.

Adolescent patients reported engaging in illicit substance use in a higher proportion in our survey than that identified in the chart review, and this emphasizes the need for unbiased, universal education of all adolescents in the clinic regardless of if they report illicit substance use. Approaches to universal education that can avoid being judgmental or creating distrust could include: standardized handouts that are given to all adolescents, standardized group classes for adolescent education, or standardized counselling in clinic.

Acknowledgements

We are grateful for the participation of our adolescents with T1DM and the support of the diabetes clinic at the Alberta Children's Hospital.

Supplementary Material

Supplementary data are available at *Paediatrics & Child Health* Online.

Author Disclosures

None of the authors has any conflicts of interest to disclose.

Author Contributions

KP, HV, PL, DP, ANA, LK and JH all contributed substantially to the conception of this study. HV, ANA and JH completed the data analysis and interpretation of the data for this paper. KP and JH drafted the article. KP, HV, PL, DP, ANA, LK and JH critically appraised this paper for important intellectual content. All authors approved the final version of the article to be published.

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