Objective: To identify early predictors of suicidal ideation in young adults, and to determine when specific time-varying determinants become important in predicting later suicidal ideation.

Methods: Data were available for 877 participants in the Nicotine Dependence in Teens study, an ongoing prospective cohort of students aged 12 to 13 years at cohort inception in 1999. Time-invariant covariates included age, sex, mother's education, language, and self-esteem. Time-varying covariates included depression symptoms, family stress, other stress, alcohol use, cigarette use, and team sports. Independent predictors of past-year suicidal ideation at age 20 years were identified in 5 multivariable logistic regression analyses, one for each of grades 7, 8, 9, 10, and 11.

Results: Eight per cent of participants (mean age 20.4 years [SD 0.7]; 46% male) reported suicidal ideation in the past year. In grade 7, none of the potential predictor variables were statistically significantly associated with suicidal ideation. In grade 8, participation in sports teams in and (or) outside of school protected against suicidal ideation (OR 0.6; 95% CI 0.4 to 0.8; P = 0.002). Depression symptoms in grades 9, 10, and 11 were independent predictors of suicidal ideation (OR 2.2; 95% CI 1.5 to 3.2, OR 1.6; 95% CI 1.0 to 2.5, and OR 1.9; 95% CI 1.1 to 3.4, respectively). No other variables were statistically significant in the multivariate models.

Conclusion: Depression symptoms as early as in grade 9 predict suicidal ideation in early adulthood. It is possible that early detection and treatment of depression symptoms are warranted as part of suicide prevention programs.
Suicide is a leading cause of death among youth in both developed and developing countries. In Canada, suicide is the second leading cause of death among people aged 15 to 34 years, and the third leading cause of death among adolescents aged 10 to 14 years. More than 400 people aged 15 to 24 years die from suicide each year in Canada.

Suicidal ideation refers to thoughts about self-destruction, including the idea that life is not worth living, wishing to be dead, and specific plans to end one’s own life. It is generally a sign of severe emotional distress and is among the most powerful predictors of subsequent suicide attempts and completed suicide. One-third (34%) of lifetime suicide ideators make a suicide plan; 72% of those with a plan make a suicide attempt; and 26% of those without a plan make an unplanned attempt. Most planned and unplanned suicide attempts occur within the first year after the onset of suicidal ideation.

Prevalence estimates of suicidal ideation vary across studies, likely owing to differing definitions of suicidal ideation and differences in study populations. In a recent review, Nock et al. reported that the lifetime prevalence of suicidal ideation was 20% to 24% among American adolescents aged 12 to 17 years. Brezo et al. reported a lifetime prevalence of suicidal ideation of 20% and 18% among Canadian adolescents aged 15 to 18 years and young adults aged 19 to 24 years, respectively. In Canada, past-year suicidal ideation among adolescents ranged between 5% and 17%. About 6% to 11% of American college students considered attempting suicide in the past 12 months.

The risk of suicidal behaviour, which includes suicidal ideation as well as planning and attempting suicide, increases during adolescence and young adulthood. Increased understanding of the early determinants of suicidal ideation and behaviour will inform the development of effective preventive programs, and therefore has the potential to reduce the public health burden associated with suicidal behaviour in youth. However, to date, few longitudinal studies identify predictors of suicidal ideation. Studies that do exist vary considerably in design and methods; they often have few follow-up periods or short follow-up periods; suicidal ideation and attempts are sometimes combined into a single variable; and covariates investigated are generally few and differ widely across studies. Longitudinal population-based studies of long duration and frequent follow-up that investigate a wide range of potential predictor variables are needed to identify early modifiable risk factors for suicidal ideation. Our analysis aimed to identify early predictors of suicidal ideation in young adults, and to determine when specific time-varying determinants become important in predicting later suicidal ideation.

Clinical Implications

- It is possible that early detection and treatment of depression symptoms are warranted as part of suicide prevention programs.

Limitations

- Data are self-reported and therefore subject to misclassification.
- Data on suicidal ideation were drawn from a single item, and data on self-esteem were collected only once.
- Use of a convenience sample, albeit population-based, may limit external generalizability of the findings.

Methods

Data were drawn from the Nicotine Dependence in Teens (NDIT) study, a prospective cohort investigation of 1293 students recruited in 1999/2000 from all grade 7 classes in a convenience sample of 10 secondary schools in Montreal, Quebec. Self-report questionnaires were administered at school every 3 months during secondary school from grades 7 to 11, for a total of 20 survey cycles during secondary school. In 2007/2008 when participants were aged 18 to 24 years, data were collected in mailed self-report questionnaires in survey cycle 21. In addition, parents completed mailed self-report questionnaires in 2009/2010. Our study was approved by the McGill University Institutional Review Board and the Ethics Research Committee of the Centre de recherche du Centre hospitalier de l’Université de Montréal.

Study Variables

Suicidal ideation was measured once in survey cycle 21 by the following question: "In the past 12 months, how often did you feel suicidal?" Response choices included never; less than once a month; 1 to 3 times per month; 1 to 6 times per week; and every day. For multivariable analysis, participants were grouped according to whether they reported feeling suicidal in the past year. To provide
evidence for the concurrent construct validity of the suicidal ideation indicator, we examined the association between suicidal ideation and 3 other indicators of mental health, including a lifetime diagnosis of a mood disorder (that is, depression or bipolar disorder), a lifetime diagnosis of an anxiety disorder (that is, phobia, fear of social situations, obsessive-compulsive disorder, panic disorder, or generalized anxiety disorder), and whether the participant had sought psychological or psychiatric care in the past year.

Potential predictor variables investigated were selected based on the strength of evidence in existing longitudinal studies on suicidal ideation in youth, as well as on the availability of data for the variable in NDIT. Sociodemographic data (that is, age, sex, language spoken most often at home [French or other], born in Canada [yes or no]) were collected at baseline. In addition, data on mother completed university (yes or no) were drawn from the parent questionnaire.

Self-esteem was measured once in grade 9 in survey cycle 12 in a 9-item modification of a validated scale. Participants reported how true each item was for them (not at all true, a bit true, or very true): I think I am someone who... The depression symptom score, obtained by dividing the sum of the scores for the 6 items by the number of items responded to, ranged from 1 to 4, with higher scores indicative of more worry or stress.

Data on time-varying potential predictor variables, including depression symptoms, worry or stress, cigarette smoking, alcohol use, participation in sports teams at school, and participation in sports teams outside school, were collected in all survey cycles (1 to 20) during secondary school.

Frequency of depression or anxiety symptoms was measured in a validated 6-item scale, which assessed how often (never, rarely, sometimes, or often) in the past 3 months by any of the following: your parents separating or divorcing; breaking up with your boyfriend or girlfriend; your relationship with your father; your relationship with your mother; your relationship with your brother(s) and (or) sister(s); your relationship with your friends; a health problem (such as acne or asthma); your weight; sex; your new family (parents remarried); financial problems in your family; or school work. Results from an exploratory factor analysis of the 12 items with an Oblimin (oblique) rotation, using data from survey cycle 4 (in grade 7), suggested a 2-factor solution, with 2 eigenvalues greater than 1, and a break in the scree plot at 2. Financial problems in your family was excluded because it loaded similarly onto more than one factor. To assess the stability of the 2-factor structure over time, we conducted a confirmatory factor analysis with data from survey cycle 20 (grade 11), which supported the 2-factor structure (« = 0.95, df = 43, P < 0.001; comparative fit index = 0.95, root mean square error of approximation = 0.05, 90% CI 0.04 to 0.06, standardized root mean square residual = 0.03). The first factor (labelled family stress) comprised 5 items (parents separating or divorcing, relationship with father, mother, siblings, and living in a new family). The second factor (labelled other stress) comprised 6 items (sex, breaking up with a boyfriend or girlfriend, relationship with friends, health problems, weight, and school work). Responses to the items within each factor were summed and then divided by the number of items responded to (grade 7 mean 1.3 [SD 0.3]; median 1.2 [IQR = 0.4]; Cronbach α = 0.71 for the family stress factor; grade 7 mean 1.5 [SD 0.4]; median 1.4 [IQR = 0.5]; and Cronbach α = 0.69 for the other stress factor), with higher scores indicative of more worry or stress.

Participants reported whether they had smoked cigarettes in each of the 3 months preceding each questionnaire. Frequency of alcohol use in the past 3 months was coded low (never, a bit to try, or once or a couple of times a month) or moderate to high (once or a couple of times a week, or usually every day). Participation on sports teams in and (or) outside school since the beginning of the school year was coded yes or no.

Data Analysis
We retained the subset of participants (n = 723) who had completed (or nearly completed) data across grades 7 to 11 for multivariate analysis. We created 5 analytic datasets, each of which included suicidal ideation (yes or no) as the outcome, the sociodemographic variables, and self-esteem. Time-varying potential predictor variables averaged across survey cycles in each of grades 7, 8, 9, 10, and 11 were included in the first, second, third, fourth, and fifth datasets, respectively. In a correlation matrix of all potential predictor variables, depression and stress were moderately highly correlated (Spearman r = 0.5 to 0.8) and therefore family stress and other stress were excluded from multivariate modelling to minimize the potential for
Table 1 Comparison of selected characteristics of study participants retained for analysis (n = 877) with those of participants not retained (n = 416), NDIT study, 1999

<table>
<thead>
<tr>
<th>Variable</th>
<th>Retained n = 877</th>
<th>Not retained n = 416</th>
<th>Difference, P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at baseline, years, mean (SD)</td>
<td>12.7 (0.5)</td>
<td>12.9 (0.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male, %</td>
<td>46</td>
<td>53</td>
<td>0.01</td>
</tr>
<tr>
<td>French speaking, %</td>
<td>31</td>
<td>28</td>
<td>0.35</td>
</tr>
<tr>
<td>Mother university-educated, %</td>
<td>45</td>
<td>42</td>
<td>0.36</td>
</tr>
<tr>
<td>Canadian born, %</td>
<td>93</td>
<td>89</td>
<td>0.01</td>
</tr>
</tbody>
</table>

There were few important differences between participants retained for analysis and those not retained (Table 1).

Sixty-seven participants (8%) reported past-year suicidal ideation, including 10% of females and 5% of males (P value for difference by sex = 0.01). Participants with a mood and/or anxiety disorder were markedly more likely to report suicide ideation than participants without these disorders (31% to 36%, compared with 6% to 7%) (data not shown). Similarly, 21% of participants who had sought psychiatric help in the past year reported suicidal ideation, compared with 6% of participants who had not sought psychiatric help.

Among the sociodemographic variables, only sex was associated with suicidal ideation univariately and was therefore retained for multivariate analysis (Table 2). Self-esteem was also statistically significantly associated with suicidal ideation univariately (Table 2). Among time-varying potential predictor variables, depression symptoms were retained for multivariate analysis in all 5 models. Sports teams were retained in the grades 7 and 8 models, alcohol use was retained in the grade 11 model, and cigarette use was retained in the grades 7, 8, 9, and 11 models (Table 3).

Multivariately, the only variables that were statistically significantly related to suicidal ideation in any of the 5 models were team sports participation and depression symptoms (Table 4). Team sports participation in and/or outside of school was statistically significant in the grade 8 model only. While depression symptoms were not related to suicidal ideation in the grades 7 or 8 models, they were strongly and statistically significantly associated with suicidal ideation in the grades 9, 10, and 11 models.

Discussion

Consistent with a nationally representative Canadian sample, wherein 7.7% of young adults reported suicidal ideation in the past 12 months,14 8% of young adults in the NDIT sample reported feeling suicidal in the previous year. Our prevalence estimate was also similar to the 6% to 13% reported for young adults in the United States.19,20,29 Among the wide range of potential predictors investigated in this analysis, only depression symptoms and team sports were statistically significantly associated with suicidal ideation in multivariate analyses. While not statistically significantly

Results

Eighty-five of the original 1293 NDIT participants were either lost to follow-up or refused to continue to participate in the NDIT study after secondary school. Among 1208 participants available for follow-up after secondary school, 880 (68% of 1293) completed self-report mailed questionnaires in survey cycle 21. The mean age of participants in survey cycle 21 was 20.4 years (SD 0.7).
related in grades 7 or 8, depression symptoms were strongly and statistically significantly related to suicidal ideation in grades 9, 10, and 11.

Our finding that depressive symptoms as early as in grade 9 predict suicidal ideation concords with those of other longitudinal studies in adolescent and young adult study populations. Depressive symptoms can affect up to 15% to 20% of adolescents. While detection, follow-up, and treatment of depressive symptoms may be critical for suicide prevention, most people with long-term suicidal ideation do not seek professional help, despite the fact that most people who commit suicide meet the criteria for depressive disorder and have visited a health professional within the past month for unrelated reasons. These findings support the need for regular inquiry about depression symptoms by health professionals as early as grade 9, as this could represent optimal timing for beginning suicide prevention interventions.

Several cross-sectional studies have reported a protective relation between sports and suicidal behaviour. Our results on team sports concord with these cross-sectional reports as well as those reported in a recent 5-year longitudinal population-based study. Taliaferro et al reported that adolescents who participated in team sports during middle and high school had lower odds of suicidal ideation than those who did not participate or those who discontinued team sports after middle school. They concluded that remaining involved in sport teams throughout adolescence can offer mental health benefits, but that more studies are needed to identify mechanisms that might account for this protective relation.

Only 2 longitudinal studies to date have reported an association between self-esteem and suicidal ideation in youth. Kim and Kim reported that adolescent girls with low self-esteem at age 15 years were more likely to report suicidal ideation at age 17 years (OR 1.04; 95% CI 1.0 to 1.08, P < 0.05). McGee et al conducted sex-specific path analyses to study the relation between early childhood family characteristics, self-esteem, hopelessness, and thoughts of self-harm in childhood and suicidal ideation in young adulthood. They reported that low self-esteem in boys aged 11 to 13 years was associated with thoughts of self-harm in childhood, and with suicidal ideation in young adulthood.

However, this path was different in girls where a weaker direct pathway was reported between low self-esteem and suicidal ideation in young adulthood. While the stress factors were generally important univariately, neither family nor other stress were included in the multivariate models to reduce the possibility of multicollinearity. Stress may be an antecedent to depression, or it may be on the causal pathway between depression and suicidal ideation. It is possible that stress inadequately managed in early adolescence evolves into depression symptoms if stressful events do not diminish with time, and if negative rather than positive coping styles are used to deal with the stress.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Grade 9 model</th>
<th>Grade 10 model</th>
<th>Grade 11 model</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td>(95% CI)</td>
<td>OR</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>Depression symptoms</td>
<td>1.8 (1.1–2.8)</td>
<td>2.0 (1.4–3.1)</td>
<td>2.2 (1.3–3.8)</td>
</tr>
<tr>
<td>Family stress</td>
<td>0.9 (0.5–1.6)</td>
<td>0.9 (0.5–1.6)</td>
<td>1.0 (0.6–1.6)</td>
</tr>
<tr>
<td>Other stress</td>
<td>0.3 (0.1–1.1)</td>
<td>0.9 (0.6–1.3)</td>
<td>2.2 (1.2–4.1)</td>
</tr>
<tr>
<td>Sports team(s)</td>
<td>0.2 (0.1–0.4)</td>
<td>0.6 (0.3–1.0)</td>
<td>2.2 (1.2–4.1)</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>0.0 (0.0–1.0)</td>
<td>1.0 (0.6–1.6)</td>
<td>0.0 (0.0–1.0)</td>
</tr>
<tr>
<td>Cigarette use</td>
<td>0.0 (0.0–1.0)</td>
<td>1.0 (0.6–1.6)</td>
<td>0.0 (0.0–1.0)</td>
</tr>
</tbody>
</table>

* Potential predictor was included in the model as a continuous variable.
Studies on the natural course of suicidal ideation and its distal risk factors are needed to establish the temporal sequence, timing, and relations between self-esteem, stress, coping, and depression symptoms during adolescence.

Although previous longitudinal and cross-sectional studies suggest that substance use may be associated with suicidal ideation, none of the studies of tobacco use or alcohol use were independently associated with suicidal ideation in this analysis. A single longitudinal study reported an association between smoking, nicotine dependence, and suicidal ideation. Bronisch et al found that lifetime occasional users, lifetime nondependent regular smokers, and lifetime dependent regular smokers at baseline were more likely to have suicidal ideation during the 4-year follow-up period. In contrast, McGee et al did not find an association between daily smoking and suicidal ideation.

Similarly, our study did not detect an association between alcohol use and suicidal ideation, although cross-sectional studies have reported an association between suicidal ideation and alcohol use disorder and heavy drinking. The lack of association between substance use and suicidal ideation in our analysis could relate to these behaviours being very common in this study population and that we did not assess the reasons why participants used tobacco or alcohol. An indicator that measures behaviour undertaken specifically because of stress or depression symptoms (as suggested by the self-medication model of substance use) may have been more likely to detect an association with suicidal ideation. Further, proximal or concurrent substance use may have a stronger association with suicidal ideation than past substance use in adolescence. In an adult population study for example, Kessler et al found that current smoking was associated with suicidal ideation but not past smoking. Similarly, Breslau et al reported that current daily smoking in young adults, but not past smoking, predicted suicidality. Finally, substance use may be associated with an increase in the risk of suicidal ideation through the effect of nonobserved factors and (or) psychosocial variables such as depression symptoms.

Limitations of this analysis include that self-report data may be subject to misclassification. Data on suicidal ideation were drawn from a single item, although the prevalence in our study was similar to that reported in nationally representative samples, and the item used showed evidence of convergent construct validity against diagnosed mental health problems and seeking help from mental health professionals. Data on self-esteem were collected only once in grade 9; the association between self-esteem and suicidal ideation may be obscured if self-esteem is time-varying in...
secondary school. The NDIT study sample had low power to conduct sex-specific analyses. Finally, use of a convenience sample may limit generalizability of the findings.

Conclusion
In this analysis, depression symptoms in adolescents as early as grade 9 predicted suicidal ideation in young adulthood. It is possible that early detection and treatment of depression symptoms are warranted as part of suicide prevention programs.

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References