

Full Length Research Paper

Adolescent suicidal behaviors, self rated health and multiple health risk behaviors: Exploring new perspectives in suicide prevention research

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We sought to evaluate the extent to which self-rating of health, gender, and the co-occurrence of other health risk behaviors were related to suicidal behaviors among adolescents. Cross-sectional survey data of Colorado middle and high school students aged 12 to 18 years were analyzed using logistic regression. Main outcome variables were suicide ideation, suicide planning, and suicide attempt. Predictors included self-rated health, self-reported health behaviors, perception of body image, expression of sadness and hopelessness, self-reported sexual abuse, self-reported access to lethal weapon, and expression of school safety concerns. Adjusted results showed respondents with poor health rating had significantly higher odds of suicidal ideation (OR: 2.22), suicidal planning (OR: 1.35), and suicide attempt (OR: 2.23). Reporting of hopelessness was the most consistent predictor of suicidal behaviors with odds ratios ranging from 5.57 (for suicidal ideation) to 17.40 (for suicidal attempt). Factors associated with different adolescents' suicidal behaviors were different for boys and girls. Findings suggest the need to consider gender differences as regards self assessment of health in order to improve the effectiveness of suicide interventions among adolescents.

Key words: Self-rated health, suicidal behaviors, suicide ideation, suicide attempt, suicide planning, adolescents.

INTRODUCTION

Suicide and suicidal behaviors among adolescents are a priority public health concern (De Leo et al., 2004; Joe et al., 2006; Mercy et al., 2001; Nock et al., 2008). This concern has spawned numerous epidemiologic studies and further interest in exploring relations linked to these destructive behaviors is growing (De Leo et al., 2004; Joe

et al., 2006). A number of studies conducted across the U.S. have revealed a pattern of rapid increases in suicide rates over the last three decades. Even though there has been a slight decline in suicide rates in recent years, a rising trend of adolescent suicidal behaviors is evident among young people ages 15 to 25 (Pfeffer, 2001; Shain and American Academy of Pediatrics [AAP] Committee on Adolescence, 2007). Currently in the U.S., suicide is the third leading cause of mortality among the 15 to 25 year age group (American Foundation for Suicide Prevention, 2009). According to the Centers for Disease

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Control and Prevention (CDC), the observed suicide rates might even be higher if underreporting or misclassification of other injuries related to suicide is considered (Hamilton et al., 2007). Completed suicide rate in Colorado is almost 36% higher than the national reported average and statewide youth suicide is the second leading cause of death (The Colorado Trust, 2007). Among adolescents, gender differences in suicidal behaviors have been documented to suggest that males are more likely to complete suicide by high lethal methods, while females have higher non-fatal suicide attempts, but it is still unclear what factors might account for higher female suicide attempts (Lewinsohn et al., 2001; Reinherz et al., 2006). In addition, an emerging trend of increasing suicidal thoughts (suicidal ideation) and preparation of specific plans to attempt suicide have gained a greater prominence among adolescents in the country, and has become a heightened concern for public policy (Hamilton et al., 2007; Horowitz et al., 2009; Valadez-Meltzer et al., 2003). Suicidal behaviors, including suicidal thoughts, suicide planning, and suicide attempts are strong predictors of completed suicide (AAP committee on adolescence, 2000; Page et al., 2006).

Despite a growing number of documented relationships among fatal and non-fatal suicidal behaviors, a number of questions remain about how specific aspects of suicidal attempts or other suicidal behaviors are related to an individual's self perception of health as being good or poor, and the extent to which these perceptions are linked to adolescent problem behaviors. Self-rated health (SRH) is an important health outcome measure in many epidemiological investigations, and its consistent relationship with mortality in both cross-sectional and longitudinal studies is an added feature for exploring how it might be related to adolescent suicidal behaviors (Vingilis et al., 2002). Although, SRH uses a simple psychometric assessment tool, responses given in epidemiological research have shown consistent predictive validity for numerous health and social outcomes (Idler et al., 2000; Vingilis et al., 2002). However, to our knowledge, investigation of the relationships among SRH and related constructs (hopelessness, perception of body image, perceived safety at school) and suicidal behaviors among adolescent populations has been limited. Whereas some studies have reported SRH as predicting future mortality from some underlying causes related to cardiovascular diseases and other malignant conditions, other investigators found no association between SRH and suicidality (Benyamini et al., 2003; Breidablik et al., 2009). However, the relationship between SRH and suicidal behaviors also suggest that some risk exposures

are more able to predict suicidality among adolescents than others (Larsson et al., 2002). For example, adolescents' report of specific depressive disorders such as sadness and hopelessness, and poor body image are more predictive of elevated health risks, poor self rated health and suicidal behaviors than smoking, alcohol use behaviors and body pains (Waters et al., 2003). Likewise, it is possible that co-occurring health risks could be more predictive of suicidal behaviors than single risk exposure. That is, complex combinations of different risk exposures as co-occurring risks are more likely to predict and account for the differences in suicidal behaviors among boys than a single exposure reporting. However, there are limited research findings from extant studies on these relationships. Given the importance of SRH as a determinant of numerous health outcomes in epidemiologic studies, a thorough understanding of these relationships would provide a stronger basis for targeted interventions aimed at reducing adolescent suicidal behaviors. In addition, the relationship between SRH and suicidal behaviors might also be affected by other confounders. In particular, demographic, psychosocial and behavioral characteristics that are associated with differences in suicidal behaviors among boys and girls could also be an important determinant of how adolescents assess their health status as excellent, good or poor. That is, age, fear of violence from the school environment or neighborhoods, gender-based violence (sexual abuse), mental health functioning, psychosocial factors (self esteem, hopelessness), body image perception and co-occurring risks is each independently associated with adolescent SRH and possibly suicidal behaviors (Page et al., 2006). For example, adolescents who report higher levels of sadness, history of physical or sexual abuse and school difficulties may characterize their health as poor and are likely to be suicidal compared to their counterparts reporting none or much lower levels of these exposures (AAP committee on adolescence, 2000). These are the most commonly reported reasons for adolescent suicide attempters. Similarly, health risk behaviors may also confound the relationship between SRH and suicidal behaviors among adolescents. Co-occurring health risk behaviors and reporting of other poor health behaviors such as smoking, alcohol use may constitute pathways for adolescents to negatively assess their health as poor, and each is known to increase risk of completed suicides (Page et al., 2006). Thus, inability to control some of these confounders in any analysis may lead to biased estimates of the relationship between adolescent SRH and suicidal behaviors.

The purpose of this study was to explore the extent to

which adolescent self perception of health is related to suicidal behaviors (suicidal ideation, suicidal planning, and suicidal attempt) and to determine whether those suicidal behaviors are linked with other co-occurring health risk behaviors among a cohort of students participating in the 2005 Colorado youth risk behavioral survey (YRBS, 2005). In addition, we sought to determine the role of gender in adolescent suicidal behaviors. The conduct of this study was approved by the Institutional review board for the conduct of human subjects in research of the University of Northern Colorado, Greeley.

MATERIALS AND METHODS

Study population

The study population was drawn from a cross-sectional survey, the 2005 YRBS. Further details of survey design and psychometric validity of questionnaire items are found elsewhere (Brener et al., 2004; Rosenbaum, 2009). Briefly, the YRBS is a self-reported, paper-based and clustered sampling survey of high school students conducted every two years by the CDC in collaboration with Colorado local and state implementing partners in the U.S. The survey elicits risk behaviors and other characteristics associated with mortality and morbidity among students in grades 9 to 12. In 2005, the survey was administered to a representative sample of 1,498 students from 29 public high schools throughout the state, and the overall response rate was 60%. Minority student populations (African-American, Hispanic, Asians and others) were purposively oversampled and the final sample included weighting factors to reflect total adolescent population in the state. Parental and student's permission were sought before administration of the survey. Letters asking parents to allow their children to participate in the surveys are sent at least two weeks before the scheduled survey, and parents with objection are allowed to return objection slip accompanying the letter.

Outcome measures

Measures of non-fatal suicidal behaviors used for the study were suicidal ideation, suicidal planning and suicidal attempts. Suicidal ideation was defined based on thoughts of death, wishing to be dead or thinking about killing oneself and was measured with the question "During the past 12 months, did you ever seriously consider attempting suicide?" Responses were dichotomized as suicide ideation present or absent. Similarly, variables on suicidal planning and suicide attempts were created based on specific responses to the survey questions. We used these variables because a number of studies have shown suicidal behaviors as forming a continuum from suicidal ideation, suicidal planning and attempt to completed suicide (Mościcki, 2001; Sourander et al., 2001).

Predictor variable

Self-rated health, was a single-item measure of health status, dichotomized into good health (excellent, very good, good) and

poor health (fair and poor). The predictive validity of this item measure for health outcomes has been reported by many investigators in numerous epidemiologic studies (Idler et al., 2000; Vingilis et al., 2002).

Covariates

Problem behaviors

Constructed from a series of items measuring risks behaviors including smoking, alcohol use, early sexual debut without condoms, fighting in school, carrying a lethal weapon to school, marijuana and cocaine use. For each student, these were summed to create a problem behavior index ranging from 0 (unexposed) to ≥ 4 (all exposure categories) according to an earlier study (Ary, Duncan, Bighan, Metzler, Noell and Smolkowski, 1999).

Self-reported health behaviors

Included smoking (current smoker, quitters, and non-smokers), alcohol use (regular, moderate, and heavy drinkers), and level of physical activity (regular, moderate, and vigorous).

Self-reported perception of body image

Was constructed based on adolescent description of body weight and categorized as normal weight, underweight, and overweight, consistent with earlier studies (Eaton et al., 2005; Neumark-Sztainer et al., 2002).

Symptoms of sadness and hopelessness

Depressive-related symptoms were considered to be present if adolescents responded 'yes' and absent if they responded 'no' to a question on ever feeling sad or hopeless continuously for 2 weeks.

Sexual abuse

Was considered to be present if the response was 'yes' and not present if the response was 'no' to a question of whether the adolescent has been forced to have sexual intercourse.

Access to lethal weapon

Was obtained from the number of times respondents reported bringing a gun to school in the previous 30 days. Responses were categorized as easy access to lethal weapon (≥ 1 time), and no access.

School safety concerns

Were assessed with the number of times an individual received threats with a gun, a knife or a club while on school property in the previous 12 months. Responses were categorized as threat to safety present or absent.

Table 1. Distribution of socio-demographic characteristics, and health risk and suicidal behaviors of respondents participating in 2005 Colorado YRBS, according to gender.

| Variable | Female sample | | Male sample | |
|-----------------------------|------------------------|---------------------------|------------------------|---------------------------|
| | Frequency ^a | (Weighted %) ^b | Frequency ^a | (Weighted %) ^b |
| Total | 700 | (49.9) | 798 | (50.1) |
| Age | | | | |
| 12-14 | 186 | (9.8) | 149 | (8.4) |
| 15-18 | 513 | (39.3) | 636 | (42.5) |
| Race | | | | |
| Latino | 138 | (13.0) | 111 | (8.8) |
| White | 458 | (32.2) | 541 | (36.2) |
| Black and others | 101 | (3.9) | 125 | (5.8) |
| Smoking | | | | |
| Non-smokers | 387 | (35.1) | 397 | (35.0) |
| Quitters | 19 | (2.1) | 32 | (3.0) |
| Current smokers | 109 | (11.8) | 132 | (13.0) |
| School security | | | | |
| No Threats | 649 | (46.2) | 703 | (46.1) |
| Threats present | 50 | (2.9) | 83 | (4.8) |
| Sex abuse | | | | |
| Abuse present | 59 | (4.1) | 16 | (1.1) |
| No abuse | 638 | (45.0) | 767 | (49.9) |
| Alcohol use | | | | |
| Non-alcoholics | 171 | (10.1) | 189 | (11.5) |
| Moderate drinkers | 424 | (29.6) | 469 | (30.6) |
| High drinkers | 105 | (9.5) | 122 | (8.7) |
| Self image | | | | |
| Normal weight | 405 | (28.9) | 470 | (30.4) |
| Low weight | 93 | (5.9) | 163 | (10.6) |
| Overweight | 198 | (14.3) | 149 | (9.9) |
| Sadness/hopelessness | | | | |
| Yes | 251 | (17.8) | 120 | (7.3) |
| No | 445 | (31.1) | 666 | (43.7) |
| Self rated health | | | | |
| Good | 630 | (44.4) | 741 | (48.3) |
| Poor | 67 | (4.7) | 43 | (2.6) |
| Problem behaviors | | | | |
| 0 | 305 | (19.8) | 241 | (15.5) |
| 1 | 206 | (14.3) | 244 | (14.8) |
| 2 | 98 | (7.7) | 155 | (10.9) |
| 3 | 52 | (4.3) | 80 | (4.9) |
| 4-7 | 39 | (3.0) | 66 | (4.9) |

Table 1. Contd.

| | | | | |
|--------------------------|-----|--------|-----|--------|
| Suicidal ideation | | | | |
| Yes | 139 | (8.9) | 75 | (4.7) |
| No | 557 | (40.0) | 711 | (46.3) |
| Suicidal planning | | | | |
| Yes | 107 | (6.9) | 58 | (3.7) |
| No | 591 | (42.1) | 727 | (47.2) |
| Suicidal attempt | | | | |
| Yes | 69 | (5.0) | 27 | (1.7) |
| No | 578 | (45.9) | 656 | (47.4) |

YRBS=Youth Risk Behavioral Survey; ^a Raw frequencies of the number of adolescents participating in the 2005 Colorado YRBS; ^b Represent the population of adolescents in the state. Numbers and percentages may not add to the total due to missing values and rounding errors; Variable weights were applied to account for sample survey design and non-responses. The percentage weights represent the population of adolescents in the state; *P* values (≤ 0.05) are based on Rao-Scott χ^2 tests showed statistically significant differences between males and females (0.0001).

Socio-demographic characteristics

This Included age, race and gender.

Statistical analysis

All analyses were conducted with SAS version 9.1.3 (SAS Institute Inc, Cary, NC). Descriptive statistics and odds ratios (OR) with their 95% confidence interval were computed. The main predictor and covariates in all models included SRH, age, sex, hopelessness/sadness, self-reported perception of image, access to lethal weapon, problem behaviors, school safety concerns and sexual abuse. These covariates were selected based on prior knowledge of their relationship to SRH, depressive-related symptoms and suicidal behaviors. To determine the risks of suicidal behaviors, we controlled only for demographic covariates in the first step and in the second step, we included all variables. In the final analysis, we assessed whether the effect of suicide attempt was the result of suicidal thoughts or due to unknown effects of previous suicide plans (confounding). Additional analyses stratified by gender used the same modeling approach. Data weights were included in all analyses to compensate for the unequal sampling selection probabilities associated with the survey design, students' selection from schools and oversampling of minority populations across the state. Possible multi-collinearity among the variables was assessed before inclusion in models, but no evidence was found.

RESULTS

Table 1 shows socio-demographic and health behavior characteristics of respondents together with the prevalence of suicidal behaviors. Almost equal proportions of

males and females were represented in this cohort of participants. However, racial distribution indicates that the majority was non-Hispanic white (68.4%) followed by the Latino population (21.6%) and the least were non-Hispanic black and other racial groups; the distribution of which is similar to the racial distribution across the state. Health risk behaviors were more common among boys than girls. For example, 13% of boys vs. 12% of girls were current smokers and in almost all categories of multiple health risks, boys were more likely to report a higher prevalence of risks than girls. Likewise, boys were more likely to report a higher prevalence of favorable self assessed health (48.3 vs. 44.4%). However, reported prevalences of suicidal behaviors in the preceding 12 months were higher among girls than boys. Although 8.9% of girls vs. 4.7% of boys reported thinking about committing suicide, and 6.9% vs. 3.7% of girls and boys respectively made specific plans about committing suicide 12 months earlier, and only 5% of girls vs. 1.7% of boys actually attempted suicide at least once. In addition, girls were significantly more likely to report sexual abuse 4% vs. 1% of boys, poor perception of body image as overweight 14.3% of girls vs 9.9% of boys, feeling sad or hopelessness 17.8% of girls vs. 7.3% of boys, and to assess their health as poor 4.3% of girls vs. 2.6% of boys.

Multivariable analyses

In Table 2, after accounting for other exposure variables

Table 2. Factors associated with suicidal behaviors among adolescents participating in 2005 Colorado YRBS.

| Variable | Odds Ratio (95% confidence interval) | | | | | |
|-----------------------------|--------------------------------------|-------------------------|-------------------------------|-------------------------|------------------------------|-------------------------|
| | Suicide ideation | | Suicide planning ^a | | Suicide attempt ^b | |
| | Model [†] | Full Model [§] | Model [†] | Full Model [§] | Model [†] | Full Model [§] |
| Gender | | | | | | |
| Male | Reference | Reference | Reference | Reference | Reference | Reference |
| Female | 2.13 (1.34, 3.37) | 1.07 (0.59, 1.96) | 1.99 (1.20, 3.30) | 1.31 (0.72, 2.38) | 3.83 (2.02, 7.26) | 1.87 (0.85, 4.08) |
| School security | | | | | | |
| No Threats | Reference | Reference | Reference | Reference | Reference | Reference |
| Threats present | 2.03 (0.99, 4.14) | 0.65 (0.31, 1.35) | 4.25 (2.20, 8.21) | 2.07 (1.01, 4.30) | 4.70 (2.31, 9.54) | 2.16 (0.90, 5.18) |
| Sex abuse | | | | | | |
| No | Reference | Reference | Reference | Reference | Reference | Reference |
| Yes | 5.98 (2.76, 12.96) | 1.91 (0.85, 4.30) | 3.89 (1.73, 8.75) | 1.17 (0.47, 2.96) | 6.59 (2.74, 15.90) | 1.66 (0.64, 4.28) |
| Self image | | | | | | |
| Normal weight | Reference | Reference | Reference | Reference | Reference | Reference |
| Low weight | 1.61 (0.91, 2.86) | 1.57 (0.86, 2.90) | 1.01 (0.54, 1.88) | 0.87 (0.43, 1.75) | 1.74 (0.83, 3.67) | 1.57 (0.65, 3.80) |
| Overweight | 2.80 (1.74, 4.50) | 1.78 (1.03, 3.13) | 2.47 (1.44, 4.24) | 1.57 (0.88, 2.81) | 3.43 (1.76, 6.69) | 1.66 (0.77, 3.56) |
| Sadness/hopelessness | | | | | | |
| No | Reference | Reference | Reference | Reference | Reference | Reference |
| Yes | 14.99 (8.80, 25.53) | 11.83 (6.74, 20.77) | 9.55 (5.50, 16.58) | 5.57 (3.14, 9.86) | 37.21 (14.35, 96.45) | 17.40 (5.93, 51.10) |
| Self rated health | | | | | | |
| Good | Reference | Reference | Reference | Reference | Reference | Reference |
| Poor | 4.48 (2.42, 8.28) | 2.22 (1.10, 4.52) | 3.27 (1.68, 6.37) | 1.35 (0.61, 3.01) | 5.78 (2.71, 12.34) | 2.23 (0.91, 5.72) |
| Problem behaviors | | | | | | |
| 0 | Reference | Reference | Reference | Reference | Reference | Reference |
| 1 | 1.78 (1.00, 3.18) | 1.59 (0.74, 3.20) | 1.93 (0.93, 4.00) | 1.33 (0.59, 3.04) | 2.12 (0.80, 5.61) | 1.16 (0.34, 3.92) |
| 2 | 2.48 (1.20, 5.13) | 2.23 (0.83, 6.10) | 3.73 (1.68, 8.29) | 2.28 (0.87, 6.01) | 3.92 (1.28, 11.96) | 2.05 (0.56, 7.57) |
| 3 | 9.15 (4.41, 19.01) | 6.86 (2.31, 20.34) | 4.48 (1.91, 10.50) | 1.39 (0.42, 4.62) | 10.55 (3.64, 30.57) | 2.87 (0.64, 12.89) |

Table 2. Contd.

| | | | | | | |
|-----|--------------------|--------------------|--------------------|-------------------|---------------------|--------------------|
| 4-7 | 7.37 (3.30, 16.45) | 4.03 (1.26, 12.92) | 9.25 (4.07, 21.04) | 2.58 (0.76, 8.70) | 18.23 (6.19, 53.66) | 3.63 (0.79, 16.75) |
|-----|--------------------|--------------------|--------------------|-------------------|---------------------|--------------------|

Results are weighted to be representative of all high school students in Colorado and are adjusted for the complex survey design using PROC SURVEY logistic; [†] Model was adjusted for age, race, physical activity, and access to gun; [§] Full model includes all variables shown in the table simultaneously and potential confounders (alcohol, smoking categories). Age, race, physical activity, and access to gun were not included in the full model because they were not significant in the earlier model. The inclusion of the potentially confounding variables in models was based on their theoretical relationships with the exposures and the outcome variables, and they were controlled by including them in the full main effects model simultaneously; In the full model, current smokers and quitters compared to non smokers were significantly at risks for suicide planning [(OR: 2.45; 95% CI: 1.13, 5.29) and OR: 3.96; 1.04, 15.14] respectively.

Table 3. Odds ratios of suicidal behaviors among respondents participating in the 2005 YRBS, by gender.

| Variable | Suicidal Behaviors (Female sample, n=700) | | | Suicidal Behaviors (Male sample, n=798) | | |
|-----------------------------|---|--------------------|---------------------|---|--------------------|---------------------|
| | Ideation | Planning | Attempt | Ideation | Planning | Attempt |
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| School threats | | | | | | |
| No threats | Reference | Reference | Reference | Reference | Reference | Reference |
| Threats present | 1.35 (0.49, 3.70) | 2.11 (0.75, 5.96) | 1.90 (0.61, 5.99) | 2.23 (0.80, 6.19) | 5.35 (2.05, 13.97) | 12.84 (3.37, 48.96) |
| Sex abuse | | | | | | |
| No abuse | Reference | Reference | Reference | Reference | Reference | Reference |
| Abuse present | 4.16 (1.53, 11.34) | 1.41 (0.48, 4.17) | 3.61 (1.31, 9.97) | 0.84 (0.07, 9.69) | 3.94 (0.67, 23.18) | n/a |
| Self image | | | | | | |
| Normal weight | Reference | Reference | Reference | Reference | Reference | Reference |
| Low weight | 1.92 (0.86, 4.32) | 0.48 (0.15, 1.50) | 1.81 (0.64, 5.14) | 1.85 (0.76, 4.48) | 1.88 (0.75, 4.74) | 4.27 (1.01, 18.00) |
| Overweight | 3.56 (1.97, 6.43) | 2.59 (1.33, 5.04) | 2.63 (1.22, 5.64) | 1.23 (0.49, 3.09) | 1.69 (0.66, 4.35) | 4.35 (1.15, 16.46) |
| Sadness/hopelessness | | | | | | |
| Not present | Reference | Reference | Reference | Reference | Reference | Reference |
| Present | 12.00 (5.62, 25.63) | 7.16 (3.31, 15.48) | 11.73 (4.10, 33.61) | 14.29 (6.68, 30.60) | 6.42 (2.86, 14.40) | n/a |
| Self rated health | | | | | | |
| Good | Reference | Reference | Reference | Reference | Reference | Reference |
| Poor | 3.96 (1.85, 8.50) | 2.37 (0.98, 5.71) | 4.13 (1.71, 9.98) | 1.55 (0.41, 5.87) | 1.07 (0.24, 4.76) | 0.68 (0.07, 6.81) |

Table 3. Contd.

| Problem behaviors | | | | | | |
|--------------------------|---------------------|-------------------|--------------------|--------------------|--------------------|-----------|
| 0 | Reference | Reference | Reference | Reference | Reference | Reference |
| 1 | 2.48 (1.03, 5.97) | 1.74 (0.60, 5.07) | 1.11 (0.30, 4.06) | 0.89 (0.30, 2.70) | 0.91 (0.25, 3.35) | n/a |
| 2 | 3.58 (1.20, 10.68) | 2.82 (0.82, 9.64) | 2.29 (0.57, 9.14) | 0.96 (0.27, 3.48) | 2.09 (0.51, 8.59) | n/a |
| 3 | 10.11 (2.92, 35.05) | 1.79 (0.39, 8.17) | 3.79 (0.80, 18.01) | 5.31 (1.54, 18.31) | 3.20 (0.82, 12.52) | n/a |
| 4-7 | 12.67 (3.16, 50.87) | 6.63 (1.42, 3.39) | 5.82 (1.13, 29.94) | 2.47 (0.59, 10.37) | 3.77 (0.78, 18.21) | n/a |

OR=Odds ratio; YRBS=Youth Risk Behavioral Survey, 2005. Results are weighted to be representative of all high school students in Colorado and are adjusted for the complex survey design using PROC SURVEY logistic. Smoking and alcohol consumption were accounted for as potential confounders based on their theoretical relationships with the exposures and the outcome variables. All statistically significant associations (i.e., 95% confidence intervals for the OR does not include 1.00). N/A: Not enough samples were available to compute stable effect estimates. ^b All statistically significant associations (that is, 95% confidence interval for the OR does not include 1.00) are presented in bold font.

and potential confounders (full model), some behavioral and cognitive risk factors for different types of suicidal behaviors were no longer statistically significant. Compared with adolescents who perceived their body image as normal, those perceiving their body image as overweight were at a significant risk of thinking about suicide (OR: 1.78), but not for other suicidal behaviors. Likewise, adolescents who rated their health as poor or having two or more co-occurring health risks were more likely to think about suicide. Overall, consistent and strong relationships were found among suicidal behaviors and respondents' report of being sad or feeling hopelessness in the past 12 months: OR's were respectively 11.83 for suicidal ideation, 5.57 for suicidal planning, and 17.40 for suicide attempt.

Table 3 presents gender differences in psychosocial and cognitive factors associated with adolescent suicidal behaviors. Among boys, there was a strong relationship between perceived threats from the school environment

and the risk of suicidal planning (OR: 5.35), and suicide attempt (OR: 12.84). No such statistically significant relations were found for girls. However, among girls, sexual abuse was a strong risk for suicidal ideation (OR: 4.16) and suicidal attempt (OR: 3.61). With regards to perception of body image and the risk of suicidal behavior, only boys perceiving their body image as overweight were at a higher risk of suicide attempt (OR: 4.35). Adolescents' report of sadness or feeling of hopelessness 12 months prior to the survey was significantly associated with almost all suicidal behaviors among boys and girls, but the effect appears to be more consistent for girls than boys. Poor assessment of general health (SRH) was significantly associated with suicidal ideation (OR: 3.96) and suicidal attempt (OR: 4.13) among girls, but limited effect was found among boys. Likewise, girls reporting of one or more co-occurring health behavioral risks were associated with increased risks of suicidal ideation, but this effect was observed only for

boys reporting three health behavioral risks. In addition, girls with ≥ 4 problem behaviors were consistently at higher risks for all suicidal behaviors. Table 4 shows strong associations among suicidal ideation (OR: 53.99), suicidal planning (OR: 13.50) and the risk of suicidal attempt. Among suicidal behaviors examined in the study, suicidal ideation stands out clearly, as having a much stronger relationship with attempted suicide than suicidal planning in both the total cohort and separately by gender.

DISCUSSION

In this study, after controlling for alcohol consumption, smoking and other socio-demographic correlates, we demonstrated strong effects of poor self-assessed health, having multiple health behavioral risks and poor body image perception on adolescent risks of suicidal behaviors. Our analysis is a unique contribution to the field of suicide prevention

Table 4. Adjusted Odds Ratios (OR's) and 95% confidence intervals (CI) of the occurrence of suicidal attempt among adolescents presented separately for males and females using multivariable logistic regression models for participants in Colorado Youth Risk Behavioral Survey, 2005.

| | Predictor ^a | OR (95% confidence interval) ^b |
|------------------|------------------------|---|
| Total population | Suicidal ideation | 53.99 (23.41, 124.49) |
| | Suicidal planning | 13.50 (6.78, 26.88) |
| Females | Suicidal ideation | 69.93 (22.86, 213.96) |
| | Suicidal planning | 9.13 (3.88, 21.45) |
| Males | Suicidal ideation | 34.87 (7.97, 152.61) |
| | Suicidal planning | 27.36 (8.03, 93.26) |

Results are weighted to be representative of all high school students in Colorado and further adjustment made for the complex survey design using SAS PROC SURVEY logistic. ^aAll models adjusted for smoking and alcohol consumption as potential confounders. ^bFor each model, adolescents who neither thought of suicide nor made plans on how to end their lives served as the reference category. Statistically significant associations (that is, 95% confidence interval of the OR does not include 1.00).

research and represents an important step to gaining more insights on how different adolescent's risk factors can operate to increase suicidal behaviors among young people. In addition, adolescent risks of suicidal behaviors was statistically related to expression of sadness or feeling hopelessness in the 12 months period. This is in contrast with the findings by Lewinsohn et al. (2001) that demonstrated no risk of suicide ideation or suicide attempt among adolescents reporting hopelessness, although Mann et al. (1999) had earlier shown hopelessness to be a consistent predictor of completed suicide. Although Lewinsohn et al. (2001) investigation was a longitudinal study, their findings were limited to a specific geographic region in western Oregon, and thus the ability to generalize across the state and nation was restricted. Likewise, Mann's study was restricted to clinical samples. Being sad or feeling hopelessness generates a cognitive sense of distorted and constricted view of the future as bleak with no alternatives to the present crisis and thus limited options for improved health and social outcomes (Maris et al., 2001). Often, events experienced as negative during adolescence (e.g., engaging in multiple behavioral risks, poor grades in school, sexual and physical abuse, threats from school) have the potential to be cognitively ascribed as suggesting adverse consequences for the future (Panzarella et al., 2006). In these situations, the individual negatively characterizes himself or herself as incapable of overcoming any future adversities and likely becomes more vulnerable to developing depression particularly in the presence of other negative events. Almost 90% of attempted suicides or completed suicides

are diagnosed with depression, and depressed adolescents face increased risks of hospitalization, cognitive and psychosocial impairments, as well as higher future suicide attempts (Fergusson and Woodward, 2002; Hallfors et al., 2004). Pediatric care practitioners could use this as an opportunity to provide increased assurances and motivations for adolescents reporting sadness or expressing no hope for the future. Asking about adolescents suicidal intents in a clinical setting may provide a relief for the suicidal individual because their presumed communication intent for help is heard by someone (AAP committee on adolescence, 2000).

Poor SRH showed clear gender differences among boys and girls in relation to suicidal behaviors. Girls reporting poor self assessed health were at increased risk of suicidal ideation and suicidal attempt compared with girls reporting good self assessed health, but no such effects were found among boys. This is consistent with the results of a study that explored predictors of adolescent self assessed health and found females as consistently rating their health 'poor' even when lifestyles and other psychological variables were controlled (Vingilis et al., 2002). The findings of this study and others suggests that SRH might play a significant role in understanding the etiology of completed suicide and other mental and social health malfunctioning associated with suicidal ideation and suicidal attempts (Reinherz et al., 2006). Thus, framing of adolescents SRH as analyzed might also reflect an underlying proximate psychosocial and mental health functioning as well as other factors related to behavioral determinants

associated with improved social and developmental outcomes. In addition, the results of the study supports emerging evidence of excess female self reported general ill-health linked to poor psychosocial and physical health, with consequence for depressive disorders and suicidal behaviors (Räty et al., 2005; Sweeting and West, 2003). Not surprisingly, girls with at least one co-occurring health behavioral risks were more likely to think about committing suicide, and this effect was even more prominent for girls engaged in 4 to 7 problem behaviors. Contrary to previous studies suggesting that access to guns is a predictor for fatal suicide attempts and completion, we did not find access to guns a factor in suicide ideation or suicide attempt (Grossman et al., 2005). The reason might be related to error of reporting carrying guns to school because it is illegal or reduced statistical power to detect meaningful effects. Future studies could examine the relationships among access to household guns and adolescent suicidal behaviors across the state in multilevel contexts.

Our findings have also implications for school health programs. Given the societal stigma associated with suicide and suicidal behaviors, adolescents reporting suicidal thoughts or attempting suicide are likely to deny ever being suicidal even though no specific tests currently exists. This may pose a greater challenge for early warning signs and subsequent referral for treatment. However, our study suggests that many warning signs consistent with suicidal behaviors such as adolescents' reporting of unsafe school environment, poor SRH, low self-esteem, sexual abuse, substance use, and depressive disorders could be assessed as proxy indicators. Suicide completion could be a traumatic event for the school environment, as the loss of a student could trigger other student suicide attempts or spiral emotional distress among students, teachers and school administrators. Individuals surviving suicide should not be neglected and must be actively sought to be integrated into school programs. Adopting a public health approach to adolescent suicide prevention also entails recognizing the multiplicity of factors involved including individual characteristics, school, family, and community contexts. Whether dictated by a desire to seek attention or intent to manipulate others, the cumulative effect of those psychosocial impairments may hinder adolescents' ability to be successful learners and become productive adults. Therefore, school health programs must be at the forefront of the battle against adolescent suicidal behaviors prevention interventions. Enhancing the capacity of teachers and school counselors to identify early signs of adolescent mental distress for subsequent evaluation by school nurses would prevent further

progression of suicidal behaviors in the adolescent population. Suicidal adolescents would then receive an appropriate referral to pediatric mental care practitioners, in a manner that respects their privacy and does not exacerbate the stigma. Schools could also link suicidal adolescents to community resources, including experienced adult mentorships and service learning opportunities. The active use of community-based resources to address antecedent adolescent suicidal risks will in the long term reduce stigmas attached to suicidal behaviors and thus, re-orient communities to accept mental health issues as treatable and suicidality a preventable human condition.

There are several limitations to this study. Firstly, the key defining characteristics of non fatal or fatal suicidal behaviors are intent and locus of harm on the individual suicidal person (De Leo et al., 2004; Maris et al., 2001). One of the primary difficulties in suicidology research is establishing intent for different suicidal behaviors (Maris et al., 2001). Given that many of the adolescents non-fatal suicidal behaviors might be attempts to seek attention or to manipulate others, it was almost impossible with our data to differentiate adolescents with suicidal intent from others who were being manipulative, which may lead to misclassification of different suicidal behaviors. Future studies could ask additional questions regarding the motive or intent for different suicidal behaviors in order to develop specific tailored interventions for different groups across cultural contexts. Secondly, self-report of risk behaviors may be subject to errors and social desirability bias. This is likely to result in either exposure or outcome misclassification. Thirdly, early childhood abuse is known to be associated with violence and other destructive behaviors during adolescence (Dube et al., 2001; Kim et al., 2006). The YRBS data did not include violence exposure in early childhood, which could have confounded our results. Finally, it has been suggested that populations with multiple health risks may have an underlying death wish (suicidal intent), and that smoking or alcohol might actually precede occurrence of these risk and suicidal behaviors (De Leo et al., 2004; Maris et al., 2001). Given the cross-sectional nature of our data, we could neither establish a temporal sequence nor infer those causal relationships. In addition, if smoking or alcohol is the major antecedent risk for suicidal psychopathologies, then adjustment of these variables may be unwarranted, and we may have over-controlled for the effects of confounders in our models. However, the strong association observed after adjustment, is in agreement with similar studies of suicidal behaviors among young people (Mercy et al., 2001; Nock et al., 2008).

These limitations notwithstanding, the main strength of the study was the use of a relatively large sample of respondents from a population-based sample, thus enabling us to generalize to broader adolescent population across the state, than would be possible if we had used a clinic-based sample. Results of this study suggest that females are at a higher risk of being suicidal compared to males and that their suicidal behaviors are more likely to be related to factors that are gender specific. In addition, suicidal attempt is the most important predictor of future completed suicide compared to persons with no prior history. Furthermore, suicidal ideation and suicidal planning are the most important predictors of suicidal attempt, although only 10 to 15% of suicide attempters will eventually endure suicide, often with more lethal methods (Brodsky et al., 2001; Maris et al., 2001). Previous investigations have suggested that the higher non-fatal suicide attempt rates among females are related to changes in personal intimate relationships, family responsibilities, and higher cultural expectations for girls compared to boys (Maris et al., 2001). In addition, findings from other studies indicate that sexually abused children are more likely to live with both physical and intolerable psychological pain, and efforts to end this pain often lead to suicidal behaviors (Martin et al., 2004). Whatever the motives might be (to seek assistance or communicate intent), girls' suicidal behaviors appears to be strongly linked to issues that are clearly gender-based, and for which specific interventions are needed to address those specific concerns. Perceived threats while at school constituted a major risk for suicide attempt among boys in our study. Feeling insecure while at school may be related to expectation of violence such as being bullied and, or potential for physical harm, and boys are more likely to be victims or perpetrators than girls (Arseneault et al., 2006; Dube et al., 2001; Kim et al., 2006; Nansel et al., 2003; Sourander et al., 2001).

Conclusion

Results from this study suggest that on one hand, girls endure more antecedent suicidal risk factors in adolescence which results in higher suicidal behaviors. On the other hand, boys' suicidal behaviors are strongly related to being threatened in the school environment. Nonetheless, adolescent perceptions of health as good or poor appear to play a significant role in the understanding of these behaviors. These subtle differences might be of significance to clinicians, public health officials and school health programs seeking to improve adolescent's wellbeing.

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