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Violent adolescents and their educational environment: a multilevel analysis.
et
Youths carrying a weapon or using a weapon in a fight: what makes the difference?

THESE

preparée sous la direction du Docteur Joan-Carles Suris, Privat-Docent et Maître d'Enseignement et de Recherche
avec la co-direction du Professeur Fred Paccaud, Directeur de l'Institut de médecine sociale et préventive
avec la collaboration du Professeur Pierre-André Michaud, médecin chef de l'Unité multidisciplinaire de santé des adolescents
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Par

Judit THURNHERR

Médecin diplômée de la Confédération Suisse

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Rapport de synthèse

Cette recherche s'intéresse (1) au port et à l'utilisation d'armes chez les adolescents ainsi que (2) aux rôles des facteurs environnementaux et individuels dans la violence juvénile. Les données étaient tirés de SMASH 2002 (Swiss multicenter adolescent survey on health 2002), étude dans laquelle un échantillon représentatif de 7548 étudiants et apprentis âgés entre 16 et 20 ans vivant en Suisse ont été interrogés

Dans une première étude, les adolescents ayant porté une arme (couteau, masse, coup de poing américain, pistolet/autre arme à feu, spray) durant l'année précédant l'enquête étaient comparés avec ceux n'ayant pas porté d'arme. Ensuite, dans le sous-échantillon de porteurs d'armes, ceux ayant uniquement porté l'arme étaient comparés avec ceux ayant utilisé une arme dans une bagarre. Des facteurs individuels, familiaux, scolaires et sociaux ont été étudiés à l'aide d'analyses bivariées et multivariées.

13.7% des jeunes vivant en Suisse ont porté une arme dans l'année précédant l'enquête. 6.2% des filles porteuses d'armes et 19.9% des garçons porteurs d'armes ont fait usage de l'arme dans une bagarre. Chez les garçons et chez les filles, les porteurs d'armes étaient plus souvent délinquants et victimes de violence physique. Les garçons porteurs d'armes étaient plus souvent des apprentis, à la recherche de sensations fortes, porteurs de tatouages, avaient une mauvaise relation avec leurs parents, étaient dans des bagarres sous l'influence de substances, et avaient des relations sexuelles à risque. En comparaison avec les porteuses d'armes, les filles utilisatrices d'armes étaient plus souvent fumeuses quotidiennes. Les garçons ayant utilisé leur arme étaient plus souvent nés à l'étranger, vivaient dans un milieu urbain, étaient des apprentis, avaient un mauvais contexte scolaire, avaient des relations sexuelles à risque et étaient impliqués dans des bagarres sous l'influence de substances. Nos résultats montrent que porter une arme est un comportement relativement fréquent chez les adolescents vivant en Suisse et qu'une proportion non négligeable de ces porteurs d'armes ont utilisé l'arme dans une bagarre. De ce fait, une discussion sur le port d'arme devrait être incluse dans l'entretien clinique ainsi que dans les programmes de prévention visant les adolescents.

Dans une deuxième étude, la violence juvénile était définie comme présente si l'adolescent avait commis au moins un des quatres délits suivants durant l'année précedant l'enquête: attaquer un adulte, arracher ou voler quelque chose, porter une arme ou utiliser une arme dans une bagarre. Des niveaux écologiques étaient testés et résultaient en un modèle à trois niveaux pour les garçons (niveau individuel, niveau classe et niveau école) et, à cause d'une faible prévalence de la violence chez les filles, en un modèle à un niveau (individuel) pour les filles. Des variables dépendantes étaient attribuées à chaque niveau, en se basant sur la littérature.

Le modèle multiniveaux des garçons montrait que le niveau école (10%) et le niveau classe (24%) comptaient pour plus d'un tiers de la variance inter-individuelle dans le comportement violent. Les facteurs associés à ce comportement chez les filles étaient être victime de violence physique et la recherche de sensations fortes. Pour les garçons, les facteurs explicatifs de la violence étaient pratiquer des relations sexuelles à risque, être à la recherche de sensations fortes, être victime de violence physique, avoir une mauvaise relation avec les parents, être déprimé et vivre dans une famille monoparentale au niveau individuel, la violence et les actes antisociaux au niveau de la classe et être apprenti au niveau de l'école. Des interventions au niveau de la classe ainsi qu'un règlement explicit en ce qui concerne la violence et d'autres comportements à risque dans des écoles devraient être prioritaires pour la prévention de la violence chez les adolescents. En outre, la prévention devrait tenir compte des différences entre les sexes.

Violent Adolescents and Their Educational Environment: A Multilevel Analysis

Judit Thurnherr, MD, André Berchtold, PhD, Pierre-André Michaud, MD, Christina Akre, MA, Joan-Carles Suris, MD, PhD

ABSTRACT: ***Objective:*** **This study examined the respective roles of personal and environmental factors in youth violence in a nationally representative sample of 7548 postmandatory school students and apprentices ages 16–20 years in Switzerland.** ***Methods:*** **Youth violence was defined as having committed at least one of the following in the previous 12 months: attacking an adult, snatching something, carrying a weapon, or using a weapon in a fight. Different ecological levels were tested, resulting in a three-level model only in males (individual, classroom, and school) as the low prevalence of female violence did not allow for a multilevel analysis. Dependent variables were attributed to each level. For males, the classroom level (10%) and the school level (24%) accounted for more than one third in interindividual variance.** ***Results:*** **Factors associated with violence perpetration in females were being a victim of physical violence and sensation seeking at the individual level. In males, practicing unsafe sex, sensation seeking, being a victim of physical violence, having a poor relationship with parents, being depressed, and living in a single-parent household at the individual level; violence and antisocial acts at the classroom level; and being in a vocational school at the school level showed a correlation with violence perpetration.** ***Conclusion:*** **Interventions at the classroom level as well as an explicit school policy on violence and other risk behaviors should be considered a priority when dealing with the problem of youth violence. Furthermore, prevention should take into account gender differences.**

*(J Dev Behav Pediatr 29:*351–359, 2008) **Index terms:** adolescence, adolescent behavior, ecology, violence.

In Europe and in the United States, youth violence is a major public health problem. It is one of the most visible forms of violence in society, present in every day's news. The highest rates of homicides in the world (28.3 per 100,000) are found among young males ages 15–29 years.[1] Homicides represent only the tip of the violence iceberg: nonfatal assaults are estimated to be 20 to 40 times more frequent than homicides.[2] In Western and Central Europe, the level of nonfatal violent juvenile crime increased during the 1990s, mainly due to the increase of violence of a less serious nature, while violence leading to the death of the victim has not increased substantially.[3]

From the Research Group on Adolescent Health, Institute of Social and Preventive Medicine, Centre Hospitalier Universitaire Vaudois, and University of Lausanne, Lausanne, Switzerland.

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Address correspondence to: Joan-Carles Suris, MD, PhD, Research Group on Adolescent Health, Institute of Social and Preventive Medicine, Bugnon 17, 1005 Lausanne, Switzerland; E-mail: joan-carles.suris@chuv.ch

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Violence is not clearly defined in the literature. Items used in different studies include homicides and nonfatal attacks, assaults and mayhem, robbery, blackmail, bullying, weapon carrying, gang fights, and rape.[4–12] Some studies differentiate between physical violence and verbal or relational violence such as bullying.[13] The World Health Organization defines violence as "the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation."[2] In a qualitative study, American middle school adolescents questioned on the subject defined violence as physically fighting or throwing punches, using profanity, arguing, or releasing frustration as well as the use of a weapon.[14]

Violent youths have many impacts on society: through continuous aggressive behavior from childhood to adulthood of lifetime offenders (lifetime offenders accounting for approximately 25% of violent youths), many violent adolescents become violent adults, often committing more serious offenses at that age.[2] Furthermore, physical fighting is related to other risk behaviors in adolescents, such as suicide attempts, weapon carrying, drug abuse, driving while intoxicated, and unsafe sex.[13,15,16] Besides the direct consequences for the perpetrators, violent youths cause adolescent victims who are more likely to engage in suicidal and violent behavior.[17]

In Switzerland, we have witnessed an increase in juvenile offenses during the past 20 years, particularly violent offenses.[18,19] However, inconsistent reporting and unsub-

stantial data have caused these trends to become a matter for debate.[3] The Swiss Federal Office of Statistics[20] reports for 2003 that 13% of the convictions of minors involved violent acts, corresponding to 0.2% of the residents in Switzerland younger than 18 years of age. Among these, there are gender and age disparities, with 89% of the convictions in male minors and 80% in adolescents between 15 and 18 years of age.

Many studies examine risk factors in youth violence.[2,7,21] The factors identified are divided into individual factors (e.g., male gender, early drug use, victim of maltreatment/abuse, psychological and behavioral characteristics), relational factors (e.g., family and peer influences), school influences (e.g., academic failure, frequent school changes, truancy), community factors (e.g., urban area, gangs, guns, drugs, community disorganization), and societal factors (e.g., demographic and social changes, media, political structures, income inequality, violent surroundings). American adolescents questioned about the reasons kids fight list gossip, boyfriend or girlfriend issues (e.g., jealousy), boredom, anger, wanting to impress others as well as influence peers, and the fear of a bad reputation.[1,4] However, these studies focus mostly on at-risk populations of US adolescents, which limits the generalization of the results. Smith-Khuri et al[5] showed similar frequencies of violence-related behaviors in European and US adolescents, but the literature on risk factors for violent behavior in European youths is sparse.

The transition from childhood to adulthood is not exclusively dependent on the individual. It takes place in a setting in which adolescents are influenced by their surroundings, the society, and the community in which they live. Bronfenbrenner[22] studied the ecology of human development and defined the environment as the interaction of different settings more or less far from the developing human being. His model includes systems at four distinct levels and emphasizes the interconnections found between systems and levels that affect what happens within them. The microsystem consists of the individual, the activities, perceived roles, and interpersonal relationships at school, with peers, or with family. The mesosystem defines the interactions of different microsystems in which the subject is actively participating. The exosystem includes microsystems not directly linked to the subject, but in which events occur that affect the subject or the microsystem. The school policy for violent behavior is a good example. Finally, the macrosystem refers to consistencies (e.g., provided through policies and laws) of lower order systems (micro-, meso-, exo-) at the level of a culture or a country.

When analyzing problems such as violence using a classic approach, we do not consider the ecology with its different systems. This simplification of reality leads to results being more easily interpretable but also less accurate. On the contrary, a multilevel approach associates variables at their given levels, thus being more precise but also more difficult to interpret. Birnbaum et al[23] provides an example of a multilevel analysis regarding violence in youths: they analyzed the interaction of school functioning (an index including nine variables such as average school attendance of students, student mobility, proportion of key school staff who left school at midyear, etc.) and violent behavior among young adolescents. This school functioning index explained a substantial portion of the school compound of violence, although the extra-individual variance was very small. However, this study had several limitations such as sampling methods, non-anonymous data collection, and results at the limit of significance.

Switzerland is a confederation of 26 cantons and three main language areas. The federal and cantonal governments share the responsibility of the educational system, whereas the cantons operate almost autonomously. This leads to 26 different school systems, with their own policy regarding risk behaviors. Furthermore, we have a particular educational system: after 9 years of mandatory school, a majority of adolescents choose to do an apprenticeship, where they get the practical education in a company and the theoretical basis at vocational school. High school students are full-time students preparing for university. These diversities of school systems and living areas may have an effect on adolescent behavior.

The goal of the present study was to examine the correlation between personal and environmental factors and youth violence. Based on the hypothesis that adolescents are largely influenced by their environment and social connections, which are mainly composed of school friends and family members, we conducted an ecological multilevel analysis including risk factors at the individual, classroom, and school levels. We address the following questions: (1) How large a share of the variance in youth violence is education associated? (2) What are the factors explaining this extraindividual variance? We hypothesize that adolescents living in an environment where school peers tend to engage in risk behaviors and where the connections to school are judged as poor by a majority of pupils are, independent of individual risk factors, at an increased risk of violent behavior.

METHODS

Procedure and Sample

Data were drawn from the 2002 Swiss Multicenter Adolescent Survey on Health (SMASH02), a cross-sectional study conducted among a nationally representative sample (N = 7548, weighted: 7429) of postmandatory public school students and apprentices ages 16–20 years living in Switzerland. Law enforcement–related schools or institutions were not included in the sample. The survey was carried out using an anonymous paper and pencil questionnaire that was administered in the classroom by trained health professionals external to the school system in the absence of the teachers.

In Switzerland, the education system is mostly public, the private sector accounting for only 5% of the school-age population. Most adolescents age 16–20 attend postmandatory education, one third of them as full-time students and the rest as apprentices. Apprentices have dual training: 1 or 2 days of classes per week, while the rest of their time is devoted to working in a company related to their field of training.

The sample is a random cluster of 579 classrooms (in Switzerland, students in a classroom are together for most courses). Language area (n = 3), type of school (n = 2), type of apprenticeship (n = 9), and years of study (≤4) were used as stratification criteria. The 565 items of the questionnaire cover sociodemographic background, physical and mental health, quality of relationships, and various health-related lifestyles (e.g., sensation seeking, sexuality, violence, substance use). A description of the questionnaire and sampling method has been published elsewhere.[24] The survey was approved by the ethical committee of the Medicine Faculty in Lausanne.

Dependent Variable

We defined violence as having committed at least one of the following four offenses of physical violence in the 12 months preceding the survey: (1) attacking an adult; (2) snatching a handbag, purse, or cellular phone; (3) carrying a weapon; (4) using a weapon in a fight. A knife, bat, knuckle duster, gun or other firearm, pepper or other types of spray were considered weapons. Although carrying a weapon is not a violent behavior per se, we have decided to include it because of the particular Swiss context: the legislation in Switzerland prohibits the purchase, trade, and possession of switchblade knives and brass knuckles. The purchase of guns and other firearms needs a registration certificate, which is handed out to persons ages 18 years and older who prove a precise need and have passed a theoretical and practical examination. However, this weapon can be passed on to another private person without restriction. Sprays of poisonous category 3 (including pepper sprays) are not considered weapons and therefore can freely be purchased by persons aged 18 years and older.

Independent Variables

Based on the literature, we defined independent variables influencing violent behavior in youths. They were either attributed to the individual or ecological level.

Individual Level Variables

Personal factors included age, depressive mood ("do you often feel depressed without knowing why?"), having been victim of physical violence in the past 12 months, and sensation seeking. Age was used as a continuous variable for preliminary analyses and, for analytic reasons, dichotomized for multilevel analyses. Reaching the age of consent at 18 years served as cutoff point. For sensation seeking, we developed a five-item scale based on the work of Gniech et al[25] Cronbach's alpha was .80. The scale was dichotomized, with subjects in the higher quartile being considered as high sensation seekers.

We used family variables such as the family structure (single-parent household/other) and the quality of the parent-adolescent relationship. To measure the quality of the parent-adolescent relationship, we developed a six-item inventory. We took five items from the Inventory of Parent and Peer Attachment.[26] These items tapped adolescents' perception of their parents' acceptance ("my parents accept me as I am"), understanding ("my parents understand me"), trustfulness ("I have confidence in my parents"), and sensitivity to their emotional state ("my parents know when I am sad"), as well as their own use of their parents as confidants ("I often tell my problems to my parents"). In addition, we created an item tapping adolescents' perception of how much their parents trusted them ("my parents trust me") (Cronbach's overall alpha in the present study was .85.). The scale was dichotomized, with those in the higher quartile being considered as having a bad relationship with their parents. The SMASH02 provides family data only from the subject's point of view. Therefore, although the family may represent a level in itself, we included the family variables at the individual level.

To measure the quality of the relationship with peers, we used a four-item inventory. We took all four items from the Inventory of Parent and Peer Attachment.[26] These items tapped adolescents' perception of peer acceptance, trustfulness, and sensitivity to their emotional state, as well as their own use of peers as confidants. Cronbach's overall alpha in the present study was .77. As for other scales, being in the higher quartile was considered as having a poor relationship with peers.

School variables were poor school grades (agreeing or not to the statement "I have good grades at school") and truancy (skipping school at least once a month).

We defined unsafe sex, the only health risk behavior associated with the individual level, as two or more positive answers to the following: (1) having had sex before 15 years of age, (2) having had more than three partners in their lifetime, (3) not using a condom at last intercourse, (4) having been pregnant or made partner pregnant.

Ecological Level Variables

We calculated the ecological level variables by using the classroom or school median of each variable for its pupils. We first determined the median value for the pupils in a particular classroom and then assigned that value to each pupil. For example, in a classroom with 50% of the students classified as violent, all students completing the questionnaire in that classroom that day were scored as being in a violent classroom. With this method, even students who did not answer the question had a variable attributed. Variables attributed to the ecological levels were violence, academic track (apprentice/student), and school connectedness. School connectedness was measured with five items used in different earlier studies,[27,28] with a Cronbach's alpha of .61. The scale was dichotomized, with those in the higher quartile being considered as having a poor school connectedness. As adolescent substance use and delinquency are related to peer behavior,[29] we also associated these risk behaviors to the extraindividual levels. Substance use included four different variables: daily smoking, alcohol misuse (having been drunk at least once in the past 30 days), cannabis use (having smoked cannabis at least once in the past 30 days), and the use of other illegal drugs (having consumed designer drugs, medicine to get high, cocaine, or heroine at least once in the past 30 days). Kuntsche et al[30] showed that adolescents with a high-risk drinking pattern, defined as the accumulation of binge drinking, drinking frequently, and getting drunk twice a month or more,

showed a substantial increase in violent behavior. We considered this in our analysis by analyzing alcohol misuse rather than alcohol use. Antisocial acts were defined as having voluntarily destroyed something not belonging to oneself, stolen or taken something, set fire to something, or sold drugs including cannabis at least once in the past 12 months.

Statistical Analysis

Taking into account gender differences in violent behavior,[2,7,31] we conducted all analyses separately for females and males. For males only, we used a multilevel modeling strategy to explore the effects of individual and ecological variables on youth violence. Most studies that address youth violence have used ordinary regression models that do not take into account the clustering effects from the social environment. Multilevel analysis enables us to analyze more accurately the mechanisms of youth violence by attributing variance partly to the individual level, partly to levels nested one into another.

In preliminary analyses, we tested different levels to define the best ones for our analysis. The first level consisted of the individual. The sampling of the SMASH02 survey consists of random clusters of classes, and we therefore used the classroom as the second level. To determine the third level, we ran a model consisting of three levels, without independent variables, and compared the design effect with a model containing only the individual and classroom levels.[32] By doing so, we were able to determine the third level that added the highest variance and thus the most information to our model. We tested possible third levels: schools, cantons, language areas, German versus Latin (French and Italian) speaking areas, urban versus rural, and vocational versus high school students. While the schools as the third level showed a larger design effect than the two-level model, the other third levels tested revealed no major importance to our model (data not shown). For males, extraindividual variance was in the classroom and the school level. However, as the prevalence of violence among females was quite low, it did not allow for a multilevel analysis. Therefore, for further models, we used a three-level structure (individual, classroom, and school levels) for males and only an individual level for females.

To define the independent variables to be included in the multilevel analysis, we performed an individual analysis of each variable and stepwise backward multivariate logistic regression analyses of the variables of the corresponding levels. For males, all extraindividual variables were included in both the classroom and school levels to test the more convenient level. For the following multilevel analysis, we used all variables that remained significant in the stepwise multivariate regression.

Multilevel Analysis

The determination of the best multilevel model for males followed a two-step strategy:

Step 1: Multilevel models including only one explanatory variable at a time were computed for each remaining explanatory variable at its own level of measurement (individual variables at the individual level, classroom variables at the classroom level, and school variables at the school level).

Step 2: All significant variables from Step 1 were then associated to a global multilevel model with explanatory variables at each level. We did not include interaction effects. A backward elimination method was used to remove nonsignificant fixed and random effects until reaching the final model for males, with only the significant terms included.

Descriptive statistics as well as individual variable analysis and multivariate logistic regressions were performed with Stata 9.2 (StataCorp, College Station, TX), which allows computation of coefficient estimates and variances taking into account sampling weights, clustering, and stratification procedures. For the multilevel analysis, we used LISREL 8.8 (SSI).

RESULTS

The main characteristics of our sample are shown in Table 1. Compared to females, males are more often apprentices, sensation seekers, and victims of physical violence and engage in other risk behaviors, whereas they are less connected to school and friends and feel less often depressed.

Prevalence of Violence

Of 7429 adolescents, 16.9% reported having committed at least one violent act in the past 12 months. Males (24.1%) engaged in physical violence more frequently than females (8.3%; odds ratio adjusted for age [AOR] = 3.5; 95% confidence interval [CI]: 2.7–4.4). For using a weapon in a fight, being male increased the odds eightfold (95% CI: 5.1–12.7), while for carrying a weapon, the gender difference was less marked (AOR = 3.6; 95% CI: 2.6–4.9). The most frequent violent offense for males and females was carrying a weapon.

Considering violent offenders only, 43.1% of males and 45.3% of females committed offenses repeatedly (three times or more in the past 12 months) and 35.8% of males and 12.0% of females accumulated different types of violence (Table 2).

Analysis at the Individual Level

In the individual variable analysis for males, all variables were statistically associated with violence except having a bad relationship with peers. For females, a significant association was found between violence and depression, being a victim of physical violence, sensation seeking, having a poor parent-adolescent relationship, and having poor school grades and unsafe sex practices.

In the stepwise logistic regression, being a victim of physical violence, sensation seeking, having a poor parent-adolescent relationship, and practicing unsafe sex remained significantly associated with both genders, whereas younger age, being depressed, and living in a single parent household was only statistically significant

Table 1. Characteristics of Study Sample: Point Prevalence

Characteristics	Females (N = 3385)	Males (N = 4044)
Demographic factors		
Age, yr, mean (95% CI)	17.8 (17.8–17.9)	18.0 (17.8–18.1)
Language		
German	67.5 (61.8–72.7)	64.1 (58.3–69.5)
French	25.7 (21.2–30.9)	27.4 (22.5–32.9)
Italian	6.8 (4.8–9.6)	8.5 (6.1–11.8)
Urban	41.8 (37.8–46.0)	42.8 (39.6–46.0)
Foreign nationality	14.3 (12.2–16.7)	16.1 (14.0–18.5)
School factors		
Apprentice	**63.0 (56.8–68.8)**	**78.7 (74.5–82.4)**
Poor school grades	21.6 (19.0–24.4)	23.0 (20.6–25.5)
Poor school connectedness	**28.1 (25.5–31.0)**	**35.3 (31.7–39.0)**
Truant	24.6 (21.2–28.2)	21.8 (19.3–24.5)
Family factors		
Poor relationship with parents	24.3 (21.2–26.4)	22.9 (20.9–24.9)
Single-parent household	24.9 (23.2–26.4)	22.5 (20.4–24.7)
Friends factors		
Rejected by/alienated from friends	**9.7 (8.0–11.7)**	**17.6 (15.8–19.5)**
Individual factors		
Depression	**37.8 (35.4–40.2)**	**22.4 (20.4–24.5)**
Sensation seeking	**15.5 (13.7–17.5)**	**39.4 (37.0–41.9)**
Victim of physical violence	**6.2 (5.3–7.3)**	**12.0 (10.7–13.6)**
Risk behaviors/attitudes		
Unsafe sex	11.7 (9.9–13.8)	14.1 (12.3–16.2)
Smoker	**34.8 (31.6–38.3)**	**40.3 (37.5–43.0)**
Alcohol misuse	**18.1 (16.1–20.3)**	**39.5 (36.7–42.3)**
Cannabis use	**26.4 (23.8–29.2)**	**40.1 (37.7–42.6)**
Other drug use	**5.5 (4.4–6.7)**	**11.0 (9.1–13.3)**
Antisocial acts	**21.9 (20.2–23.7)**	**45.5 (43.5–47.6)**
Violent classrooms	**10.9 (6.9–15.0)**	**0.4 (0–1.1)**
Violent schools	**6.2 (0.9–11.4)**	**0.8 (0–2.3)**
Violent classrooms in violent schools	**20.0 (4.3–35.7)**	**100**

Results are given as percentage (95% confidence interval). Bold type indicates $p < .05$.

for males. The strongest associations with violence were practicing unsafe sex for males (AOR = 3.1; 95% CI: 2.3-4.3) and being a victim of physical violence for females (AOR = 3.0; 95% CI: 1.9-4.8) (Table 3).

Analysis at the Extraindividual Level

As expected, a classroom counting more than half of the pupils as having engaged in violent or antisocial acts was associated with violent behavior for the individual student in both the individual variable and stepwise multivariate analyses. For males, being apprentice and being part of a classroom with a high level of alcohol misuse remained statistically significant in the stepwise multivariate analysis (Table 4). Males showed the same association of violence with school variables as with classroom variables, except for alcohol misuse, which did not remain significant (Table 5).

Multilevel Analysis

The goal of the multilevel analysis was to determine the correlation between the educational surrounding and adolescent violent behavior. For males, we determined from the model without independent variables that 10% of the interindividual variance was at the classroom level and 24% was at the school level (detailed results not shown).

The final model for males consisted of three levels: the individual level with six independent variables, the classroom level with two independent variables, and the school level with one independent variable. At the individual level, practicing unsafe sex (AOR = 2.8; 95% CI: 2.2-3.5), sensation seeking (AOR = 2.6; 95% CI: 2.2-3.1), and being a victim of physical violence (AOR = 2.2; 95% CI: 1.7-2.7) increased the risk of violence more than twofold. Adolescents having a poor relationship with parents (AOR = 1.8; 95% CI: 1.5- 2.2), feeling depressed (AOR = 1.5; 95% CI: 1.2-1.8), and living in a single-parent household (AOR = 1.3; 95% CI: 1.1-1.6) had an increased risk of being violent, while age was not significant in the final model. Being in a violent classroom was the strongest factor predicting violence in males (AOR = 4.2; 95% CI: 3.2-5.5). A classroom engaging in antisocial acts was also associated with violent behavior for the individual (AOR =1.6; 95% CI: 1.3-1.9), whereas alcohol misuse at the classroom level did not remain significant in the final model. The trend for interclassroom variance is highest for depressed students, followed by living in a single-parent household, being a victim of physical violence, having a poor relationship with parents, and sensation seeking. At the school level, being in a vocational school was positively correlated with violence (AOR = 1.3; 95% CI: 1.0-1.6). Being depressed showed the highest interschool variance, followed by having a poor relationship with parents, practicing unsafe sex, living in a single-parent household, and being a victim of physical violence (Table 6).

DISCUSSION

Study Findings and Significance

In our study we found that 16.9% of students had performed at least one violent act in the previous year, the proportion being significantly more important among males than among females. A minority of youths is responsible for the violence highlighted in the media, but these individuals often commit delinquent acts repeatedly.

A possible explanation for the gender differences in violent behavior is that while males show more externalizing problematic behaviors (e.g., violence, substance use) females engage in internalizing behaviors (e.g., eat-

Table 2. Point Prevalence Given as Percentage (95% Confidence Interval) of Types of Violence Committed in the Past Year by Gender and Adjusted Odds Ratios (95% Confidence Interval) with Females as Reference Category

Total Sample	Females (N = 3385)	Males (N = 4044)	AOR
Total violence	**8.3 (6.9–10.0)**	**24.1 (21.7–26.5)**	**3.5 (2.7–4.4)**
Attacked an adult	**2.2 (1.7–2.8)**	**9.5 (8.0–11.3)**	**4.6 (3.4–6.3)**
Snatched a handbag, purse, or cell phone	**0.5 (0.3–0.9)**	**2.4 (1.8–3.0)**	**4.8 (2.6–8.9)**
Carried a weapon	**6.0 (4.7–7.8)**	**18.7 (16.5–21.0)**	**3.6 (2.6–4.9)**
Used a weapon in a fight	**0.8 (0.5–1.2)**	**5.7 (4.7–6.9)**	**8.0 (5.1–12.7)**
Violent Adolescents	**Females (N = 282)**	**Males (N = 973)**	**AOR**
Repeat offender (more than twice in the past 12 mo)	45.3 (33.3–58.0)	43.1 (38.9–47.4)	0.9 (0.5–1.5)
Offender of different types of violence	**12.0 (8.1–17.5)**	**35.8 (31.1–40.9)**	**4.1 (2.5–6.6)**

CI, confidence interval; AOR, odds ratio adjusted for age. Bold type indicates $p < .05$.

ing disorders, depression).[33,34] In addition, girls express aggressiveness through relational violence rather than through the overt physical violence measured in our study.[13,35] Therefore, females engaging in overt violent behavior act in a gender-atypical way, which seems to be less tolerated and more punished by peers, parents, and educators, thus putting females at a greater risk of psychosocial maladjustment.[36] However, although females act less often overtly violent, they should not be neglected in research or in prevention programs.

At the individual level, we found an association between engaging in violent behavior and being a victim of physical violence in both gender and feeling depressed in males. These findings agree with those of Cleary,[17] who reported an interaction between adolescent victimization and suicidal and violent behaviors. Thus, as a way of coping with their experiences, adolescent victims of physical violence seem to engage in hetero- and autoaggressive behaviors. The association of violence and unsafe sex in males and sensation seeking in both genders points to a clustering effect of risk behaviors and a search for excitement. Furthermore, two family variables, poor relationship with parents and single-parent household, were associated with violence in males. Adolescents having experienced conflicts at home seem to use physical violence more easily than those having a good family circle and living in an intact family.

Our results suggest that male adolescent violent behavior is substantially influenced by the educational environment. In schools and classrooms, students tend to cluster into groups of peers. We hypothesize that by being surrounded by peers favoring risk behaviors, especially violence and antisocial acts, adolescents tend to adopt these behaviors. By doing so, they may ensure their own place

Table 3. Analysis of the Explanatory Factors at the Individual Level by Gender

	Females			Males		
	Violent (N = 281.8)	Nonviolent (N = 3103)	AOR[a]	Violent (N = 972.6)	Nonviolent (N = 3071)	AOR[a]
Age, yr	18.0 (17.8–18.1)	17.8 (17.8–18.1)	NS	17.9 (17.8–18.3)	18.0 (17.7–17.9)	**0.9 (0.8–1.0)**
Depression	**52.3 (41.2–63.2)**	**36.4 (34.1–38.9)**	NS	**31.8 (28.4–35.4)**	**19.4 (17.1–22.0)**	**1.5 (1.1–1.9)**
Victim of physical violence	**19.0 (13.8–25.6)**	**5.1 (4.3–6.0)**	**3.0 (1.9–4.8)**	**22.0 (19.1–25.2)**	**8.9 (7.5–10.5)**	**2.3 (1.8–2.9)**
Sensation seeking	**27.1 (20.4–35.0)**	**14.5 (12.8–16.4)**	**1.7 (1.1–2.6)**	**58.3 (54.2–62.3)**	**33.5 (30.8–36.2)**	**2.5 (2.0–3.0)**
Poor parent-child relationship	**44.3 (32.3–57.0)**	**22.4 (20.1–25.0)**	**2.4 (1.2–4.7)**	**33.6 (30.1–37.2)**	**19.5 (17.5–21.6)**	**1.7 (1.4–2.1)**
Single-parent household	33.3 (20.7–49.0)	24.1 (22.0–26.4)	NI	**27.6 (24.4–31.0)**	**20.9 (18.5–23.4)**	**1.3 (1.0–1.6)**
Rejected by/alienated from peers	17.8 (15.3–20.6)	17.5 (15.3–19.9)	NI	12.0 (8.0–17.7)	9.5 (7.8–11.6)	NI
Bad school grades	**29.2 (21.9–37.8)**	**20.9 (18.4–23.6)**	NS	**28.3 (24.6–32.4)**	**21.3 (18.8–24.0)**	NS
Truancy	29.7 (22.3–38.3)	24.1 (20.8–27.8)	NI	**25.8 (21.6–30.5)**	**20.5 (17.8–23.5)**	NS
Unsafe sex	**22.0 (16.0–29.6)**	**10.8 (9.0–12.9)**	**2.0 (1.4–2.9)**	**28.2 (24.1–32.6)**	**9.6 (7.8–11.9)**	**3.1 (2.3–4.3)**

AOR, adjusted odds ratio; NS, suppressed because nonsignificant; NI, not included in the multivariate analysis. We compared each factor with the dependent variable violence. Results are given as percentage (95% confidence interval). The AOR columns provide the adjusted odds ratio and corresponding 95% confidence interval from a logistic regression using all significant factors Bold type indicates $p < .05$.
[a]Stepwise multivariate analysis.

Table 4. Analysis of the Explanatory Factors at the Classroom Level for Males

	Violent (N = 972.6)	Nonviolent (N = 3071)	AOR[a]
Violence	**23.5 (15.7–33.6)**	**5.4 (3.1–9.1)**	**4.1 (3.2–5.3)**
Apprentice	**86.6 (82.7–89.8)**	**76.1 (71.4–80.3)**	**1.5 (1.2–1.9)**
Poor school connectedness	23.4 (17.8–30.0)	20.3 (15.3–26.4)	NI
Smoker	**38.5 (31.4–46.2)**	**29.9 (24.4–36.0)**	NS
Binge drinking	**32.8 (26.1–40.4)**	**23.7 (18.8–29.3)**	**1.3 (1.0–1.6)**
Cannabis	29.3 (23.0–36.5)	24.8 (19.9–31.3)	NI
Drugs	5.3 (1.3–19.3)	2.3 (0.7–7.4)	NS
Antisocial acts	**47.8 (40.1–55.7)**	**30.4 (24.4–37.3)**	**1.5 (1.1–1.9)**

AOR, adjusted odds ratio; NI, not included in the multivariate analysis; NS, suppressed because nonsignificant. We compared each factor with the dependent variable violence. Results are given as percentage (95% confidence interval). The last column provides the AOR and corresponding 95% confidence interval from a logistic regression using all significant factors. Bold type indicates $p < .05$.
[a]Stepwise multivariate analysis.

in the group and, through the protection of the group, avoid victimization.

These results are consistent with previous research indicating that the school climate is correlated with youth violence. It has been shown that schools having a good climate, an explicit policy against violence and other risk behaviors, and a high connectedness with students have a protective effect against violence and play a buffering role in the exposure to violent acts and other risk factors for violence.[37–41]

Males are substantially influenced by the classroom and the school, with more than one third of the interindividual variance detected in the model attributed to the educational levels. Males seem to cluster in groups of violent offenders, most often composed of pupils in the same classroom, as male violent behavior does not seem to affect the relationship with peers, which may go along with our theory that violent males socialize with each other. Moreover, being surrounded by violent individuals may tend to normalize this behavior.

During adolescence, peer influence increases while parent influence diminishes. At the same time, adolescents socialize mostly with peers at school. These facts may explain why the classroom and the school levels contribute substantially to the variance of its pupils' violent behavior, be it on the school grounds or outside. We therefore suggest that preventive programs at school aimed at decreasing violence and antisocial acts should be a priority when combating violence in youths. Mytton et al[42] found in their meta-analysis that school-based violence prevention programs reduce the aggressive behavior of high-risk youths.

Our results are innovative in the way that they associate well-known risk factors for violence with the corresponding levels rather than applying them to the individual. Knowing that certain risk behaviors are undertaken by groups or gangs of adolescents and that groups often cluster several risk behaviors (such as violence and substance use), it seems more realistic to associate the factors at a larger level. These findings seem to indicate that preventive work should take into account the gender difference.

Strengths and Limitations of the Present Study

The 2002 Swiss Multicenter Adolescent Survey on Health (SMASH02) is a large, nationally representative survey. Of the different third levels tested, only the school level had a considerable impact on the outcome of our analysis. We postulate that our results are influenced by neither regional disparities such as culture and language nor by the pronounced federalism of our country. We thus conclude that the outcome can be generalized. Research on adolescent violence mainly concentrates on

Table 5. Analysis of the Explanatory Factors at the School Level for Males

	Violent (N = 972.6)	Nonviolent (N = 3071)	AOR[a]
Violence	**6.1 (2.7–13.2)**	**1.5 (0.7–3.3)**	**3.1 (2.1–4.5)**
Apprentice	**86.8 (82.9–90.0)**	**76.2 (71.5–80.4)**	**2.0 (1.6–2.5)**
Poor school connectedness	12.7 (8.5–18.6)	12.0 (8.6–16.4)	NI
Smoker	29.9 (23.3–37.4)	24.8 (18.9–31.7)	NI
Binge drinking	20.0 (14.4–27.1)	16.5 (11.9–22.6)	NI
Cannabis	21.1 (14.1–30.3)	14.7 (10.0–20.9)	NS
Drugs	0.2 (0.0–1.1)	0.1 (0.0–0.4)	NI
Antisocial acts	**27.4 (19.7–36.8)**	**18.0 (913.2–24.1)**	**1.5 (1.0–2.1)**

AOR, adjusted odds ratio; NI, not included in the multivariate analysis; NS, suppressed because nonsignificant. We compared each factor with the dependent variable violence. Results are given as percentage and 95% confidence interval. The last column provides the AOR and corresponding 95% confidence interval from a logistic regression using all significant factors. Bold type indicates $p < .05$. [a]Stepwise multivariate analysis.

Table 6. Multilevel Analysis: Final Model for Males

	Odds Ratio (95% CI)	Variance Classroom Level	Variance School Level
Level I			
Depressed	1.5 (1.2–1.8)	0.75	0.09
Victim of physical violence	2.2 (1.7–2.7)	0.51	0.10
Sensation seeking	2.6 (2.2–3.1)	0.39	NS
Poor relationship with parents	1.8 (1.5–2.2)	0.46	0.07
Single-parent household	1.3 (1.1–1.6)	0.65	0.05
Unsafe sex	2.8 (2.2–3.5)	NS	0.06
Level II			
Classroom violence	4.2 (3.2–5.5)	NI	NS
Classroom antisocial acts	1.6 (1.3–1.9)	NI	NS
Level III			
School apprentice	1.3 (1.0–1.6)	NI	NI

CI, confidence interval; NI, not included in the multivariate analysis; NS, suppressed because nonsignificant. For multilevel analysis, the variance at the individual level is fixed to 1 by convention and is therefore not estimated.

males, as females engage less often in violent behavior. Along the same lines, the relatively low prevalence of female violence in our sample did not allow inclusion of females in the multilevel analyses in order to highlight the substantial gender differences. Nevertheless, the impact of our findings at the individual level may lead us to a more gender-appropriate approach to youth violence.

Some limitations have to be considered. First, the SMASH02 is a school-based survey, resulting in not considering dropouts and absent students, both of which are engaging more often in violent behavior.[21,43] The mean percentage of adolescents between 16 and 20 years not included in our educational system is approximately 10%, and a further 5% are supposed to be absent on the day of the survey. We may thus underestimate the prevalence of violent behavior among adolescents. Second, as our data are cross-sectional, causality cannot be assumed. Third, the SMASH02 survey is based on a self-reporting questionnaire. Although completed anonymously, the results may be biased inasmuch as participants (especially males) may overreport risk behavior to impress others, while others (especially females) may underreport, fearing social/legal consequences.[45] However, several studies indicate that anonymous data collection in school-based surveys increase the reliability of self-reports in an adolescent population.[46,47] Fourth, while high school students, being full-time students, are mainly influenced by their school environment, apprentices are more exposed to the influence of the company at which they work. The rather adult social environment of apprentices may lead to an earlier adoption of adult behaviors, such as substance use and sexual activity.[48–50] This may limit the comparison of the school and classroom influence between high school students and apprentices. Fifth, we do not possess information about the violence policy of the schools in our sample. Therefore, the impact of different school policies cannot be assessed. Sixth, we cannot know from our data the classroom and school sizes. From this point of view, small classes or schools have higher probabilities of being classified as violent. Seventh, the extraindividual variance found at the school level may in part represent variance of other, more distant levels, such as the surrounding area of a school. However, postmandatory schools in Switzerland usually receive students from different regions, which makes it less likely that the variance found at the school level reflects only differences at the neighborhood level.

CONCLUSION

The goal of this study was to find out to what extent the educational environment influences violent behavior of adolescents. We showed that the school and classroom have a major influence, accounting for a large share of interindividual variance. Not only a violent school or classroom but also other risk behaviors were associated with violence at the individual level. Thus, the problem of violence in youths is not exclusively a problem of the individual, but also to a large extent of the system in which adolescents live. These findings should be considered when dealing with youth violence. Furthermore, preventive work and explicit policies on violence and other risk behaviors in schools may reduce the prevalence of adolescent violence.

In addition, the difference between males and females with regard to violence is substantial and should thus be taken into account by professionals, providing a gender-specific approach to the issue.

Future research on youth violence may explore the role of the family in an ecological perspective. Furthermore, obtaining more insight into the differences between male and female functioning deserves closer attention in an attempt to better adapt preventive services to the gender-adjusted needs.

REFERENCES

1. Reza A, Mercy JA, Krug E. Epidemiology of violent deaths in the world. *Inj Prev.* 2001;7:104–111.
2. World Health Organization. *World Report on Violence and Health.* Geneva: World Health Organization; 2002.
3. Estrada F. Juvenile crime trends in post-war Europe. *Eur J Criminal Policy Res.* 1999;7:23–42.
4. Eisner M, Killias M. Country survey; Switzerland. *Eur J Criminol.* 2004;1:257–293.
5. Smith-Khuri E, Iachan R, Scheidt PC. et al. A cross-national study of violence-related behaviors in adolescents. *Arch Pediatr Adolesc Med.* 2004:158:539–544.
6. MacDonald JM, Piquero AR, Valois RF, Zullig KJ. The relationship between life satisfaction, risk-taking behaviors, and youth violence. *J Interpers Violence.* 2005;20:1495–1518.
7. Ellickson PL, McGuigan KA. Early predictors of adolescent violence. *Am J Public Health.* 2000;90:566–572.
8. Durant RH, Cadenhead C, Pendergrast RA, et al. Factors associated with the use of violence among urban black adolescents. *Am J Public Health.* 1994;84:612–617.
9. Valois RF, McKeown RE, Garrison CZ, Vincent ML. Correlates of aggressive and violent behaviors among public high school adolescents. *J Adolesc Health.* 1995;16:26–34.

10. Kuntsche EN. Hostility among adolescents in Switzerland? Multivariate relations between excessive media use and forms of violence. *J Adolesc Health*. 2004;34:230–236.
11. Tolan PH, Gorman-Smith D, Henry DB. The developmental ecology of urban males' youth violence. *Dev Psychol*. 2003;39: 274–291.
12. Halliday-Boykins CA, Graham S. At both ends of the gun: testing the relationship between community violence exposure and youth violent behavior. *J Abnorm Child Psychol*. 2001;29:383–402.
13. Rhee D, Yun SC, Khang YH. Co-occurrence of problem behaviors in South Korean adolescents: findings from Korea Youth Panel Survey. *J Adolesc Health*. 2007;40:195–197.
14. Quinn GP, Bell-Ellison BA, Loomis W, Tucci M. Adolescent perceptions of violence: formative research findings from a social marketing campaign to reduce violence among middle school youth. *Public Health*. 2007;121:357–366.
15. Sosin DM, Koepsell TD, Rivara FP, Mercy JA. Fighting as a marker for multiple problem behaviors in adolescents. *J Adolesc Health*. 1995;16:209–215.
16. Melzer-Lange MD. Violence and associated high-risk health behavior in adolescents. Substance abuse, sexually transmitted diseases, and pregnancy of adolescents. *Pediatr Clin North Am*. 1998;45:307–317.
17. Cleary SD. Adolescent victimization and associated suicidal and violent behaviors. *Adolescence*. 2000;35:671–682.
18. Killias M, Lucia S, Lamon P, Simonin M. Juvenile delinquency in Switzerland over 50 years: assessing trends beyond statistics. *Eur J Criminal Policy Res*. 2004;10:111–122.
19. Mohler-Kuo M, Wydler H, Zellweger U, Gutzwiller F. Differences in health status and health behaviour among young Swiss adults between 1993 and 2003. *Swiss Med Wkly*. 200622;136:464–472.
20. Federal Office of Statistics. *Statistique des jugements pénaux des mineurs, en 2003*. Neuchâtel: Federal Office of Statistics; 2005.
21. Borum R. Assessing violence risk among youth. *J Clin Psychol*. 2000;56:1263–1288.
22. Bronfenbrenner U. Basic concepts. In: *The Ecology of Human Development*. Cambridge, MA: Harvard University Press; 1979: 16–42.
23. Birnbaum AS, Lytle LA, Hannan PJ, et al. School functioning and violent behavior among young adolescents: a contextual analysis. *Health Educ Res*. 2003;18:389–403.
24. Jeannin A, Narring F, Tschumper A, et al. Self-reported health needs and use of primary health care services by adolescents enrolled in post-mandatory schools or vocational training programmes in Switzerland. *Swiss Medical Wkly*. 20058;135:11–18.
25. Gniech G Oettling T, Brohl M. Untersuchungen zur Messung von "Sensation Seeking." Bremer Beiträge zur Psychologie Nr. 110. Universität Bremen; 1993.
26. Armsden GC, Greenberg MT. The inventory of parent and peer attachment: Individual differences and their relationship to psychological well-being in adolescence. *J Youth Adolesc*. 1987; 16:427–454.
27. Flammer A, Alsaker FD, Grob A. Fragebogen Alltag und Schule von Kindern und Jugendlichen in der Schweiz und in Norwegen. Bern, Switzerland: Institut für Psychologie, Universität Bern; 1994.
28. Ingenkamp K. *Landauer Skalen zum Sozialklima (LASSO 4-13)*. Weinheim: Beltz Test; 1987.
29. Prinstein MJ, Boergers J, Spirito A. Adolescents' and their friends' health-risk behavior: factors that alter or add to peer influence. *J Pediatr Psychol*. 2001;26:287–298.
30. Kuntsche EN, Gmel G, Annaheim B. *Alkohol und Gewalt im Jugendalter*. Lausanne, Switzerland: Schweizerische Fachstelle für Alkohol-und andere Drogenprobleme (SFA); 2006.
31. Eaton DK, Kann L, Kinchen S, et al. Youth risk behavior surveillance—United States, 2005. *J Sch Health*. 2006;76:353–372.
32. Hox JJ. Multilevel *Analysis: Techniques and Applications*. Hillsdale, NJ: Laurence Erlbaum Associates; 2002.
33. Raty LKA, Larsson G, Soderfeldt BA, Wilde Larsson BM. Psychosocial aspects of health in adolescence: the influence of gender, and general self-concept. *J Adolesc Health*. 2005;36:530.
34. Sandoval M, Lemos S, Vallejo G. Self-reported competences and problems in Spanish adolescents: a normative study of the YSR. *Psicothema*. 2006;18:804–809.
35. Cairns RB, Cairns BD, Neckerman JJ, et al. Growth and aggression: 1. Childhood to early adolescence. *Dev Psychol*. 1989;25:320–330.
36. Crick NR. Engagement in gender normative versus nonnormative forms of aggression: links to social-psychological adjustment. *Dev Psychol*. 1997;33:610–617.
37. Brookmeyer KA, Fanti KA, Henrich CC. Schools, parents, and youth violence: a multilevel, ecological analysis. *J Clin Child Adolesc Psychol*. 2006;35:504–514.
38. Smith PK, Ananiadou K, Cowie H. Interventions to reduce school bullying. *Can J Psychiatry*. 2003;48:591–599.
39. Maes L, Lievens J. Can the school make a difference? A multilevel analysis of adolescent risk and health behaviour. *Soc Sci Med*. 2003;56:517–529.
40. Patton G, Bond L, Butler H, Glover S. Changing schools, changing health? Design and implementation of the Gatehouse Project. *J Adolesc Health*. 2003;33:231–239.
41. Bond L, Patton G, Glover S, et al. The Gatehouse Project: can a multilevel school intervention affect emotional wellbeing and health risk behaviours? *J Epidemiol Community Health*. 2004;58: 997–1003.
42. Mytton JA, DiGuiseppi C, Gough DA, et al. School-based violence prevention programs: systematic review of secondary prevention trials. *Arch Pediatr Adolesc Med*. 2002;156:752–762.
43. Blum RW, Halcon L, Beuhring T, et al. Adolescent health in the Caribbean: risk and protective factors. *Am J Public Health*. 2003; 93:456–460.
44. Sheley JF, Wright JD. Motivation for gun possession and carrying among serious juvenile offenders. *Behav Sci Law*. 1993;11:375–388.
45. Brener ND, Billy JO, Grady WR. Assessment of factors affecting the validity of self-reported health-risk behavior among adolescents: evidence from the scientific literature. *J Adolesc Health*. 2003;33:436–457.
46. Deleted in proof.
47. Kann L, Brener ND, Warren CW, et al. An assessment of the effect of data collection setting on the prevalence of health risk behaviors among adolescents. *J Adolesc Health*. 2002;31:327–335.
48. Michaud PA, Berchtold A, Jeannin A, et al. Secular trends in legal and illegal substance use among 16 to 20 year old adolescents in Switzerland. *Swiss Med Wkly*. 2006;136:318–326.
49. Kohn L, Dramaix M, Favresse D, et al. Trends in cannabis use and its determinants among teenagers in the French-speaking community of Belgium. *Rev Epidemiol Sante Publique*. 2005;53:3–13.
50. Michaud PA, Narring F, Dubois-Arber F, Paccaud F. [Health survey of 15-20-year-old adolescents in French-speaking Switzerland]. *Schweiz Med Wochenschr*. 1993;123:1883–1895.

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HEALTH EDUCATION RESEARCH

Pages 10

Youths carrying a weapon or using a weapon in a fight: what makes the difference?

Judit Thurnherr, Pierre-André Michaud, André Berchtold, Christina Akré and Joan-Carles Suris*

Abstract

The objective of this study was to characterize weapon-carrying adolescents and to assess whether weapon carriers differ from weapon users. Data were drawn from a cross-sectional school-based survey of 7548 adolescents aged 16–20 years in Switzerland. Youths carrying a weapon were compared with those who do not. Subsequently, weapon carriers were divided into those who had used it in a fight and those who had not. Individual, family, school and social factors were analyzed using bivariate and stepwise multivariate analysis. For both genders, delinquent behavior and being victim of physical violence were associated with weapon carrying. For males, quarreling while intoxicated, being an apprentice, being sensation seekers, having a tattoo, having a poor relationship with parents and practicing unsafe sex were also related to weapon carrying. Compared with weapon carriers, female weapon users were more likely to be regular smokers. Male weapon users were foreign born, urban and apprentices; had poor school connectedness; practiced unsafe sex and quarreled while intoxicated. Carrying a weapon is a relatively frequent behavior among youths in Switzerland and a sizeable proportion of weapon carriers have used it in a fight. Weapon carrying should be part of the clinical assessment and preventive counseling of adolescents. Preventive programs specific for at-risk youth groups need to be developed.

Research Group on Adolescent Health, Institute of Social and Preventive Medicine, Centre Hospitalier Universitaire Vaudois and University of Lausanne, Bugnon 17, 1005 Lausanne, Switzerland
***Correspondence to: J.-C. Suris.**
E-mail: joan-carles.suris@chuv.ch

Introduction

Weapon carrying among adolescents is an ongoing matter of concern. Violent offenses committed with a weapon are the most dangerous offenses, often leading to serious injury, disability or death [1]. Knowing that adolescents and young adults are particularly vulnerable to violent behavior and that persons carrying a weapon are more often implicated in physical fights, it is obvious that weapon carrying is a risk behavior that deserves attention [1–4]. In addition to these direct consequences, weapon carrying is related to hospitalization as a consequence of criminal offenses as well as it is an established risk factor for other risk behaviors in adolescence [1, 5].

Carrying a weapon is a common type of violence in youth: 18.5% of American high school students report having carried a weapon in the previous month, 5.7% of them having carried a gun [6]. The Health Behavior in School-Aged Children survey reported a prevalence of weapon carrying in the preceding 30 days ranging from 10 to 22% for boys and from 2 to 5% for girls in five European countries, the United States and Israel [2].

Diverse motivations for weapon carrying have been identified: on the one hand, the association of weapon carrying and high rates of local youth violence as well as a history of sexual or physical abuse and violent victimization point at a need for self-protection and self-defense [7]. On the other

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hand, an association of weapon carrying and other delinquent and antisocial behaviors has been shown, thus rather pointing at a clustering effect of risk behaviors by vulnerable adolescents [8].

Risk factors for weapon carrying include being male, a history of substance use, living in unsafe surroundings, witnessing violence, having been a victim of violence, having high availability of weapons, a history of delinquency other than carrying a weapon and poor academic performance [9, 10]. Additionally, previous studies have shown an association between risk behaviors including violence and weapon carrying and behaviors such as being tattooed and sensation seeking [9, 11, 12].

The legislation in Switzerland prohibits the purchase, trade and possession of switchblade knives and brass knuckles. The purchase of guns and other firearms needs a registration certificate, which is handed out to persons aged 18 years and older who prove a precise need and have passed a theoretical and practical exam. However, this weapon can be passed on to another private person without restriction. Sprays of poisonous Category 3 (including pepper sprays) are not considered as weapons and therefore freely purchasable for persons aged 18 years and older. Even though the purchase of a weapon is prohibited for adolescents under age 18 years, a substantial part of youth living in Switzerland carry a weapon: Kuntsche and Klingemann [13] found that 10.6% of youths aged 15 years had carried a weapon to school.

Although there is a substantial amount of literature concerning weapon-carrying adolescents and their characteristics [2, 4, 9, 14], few researchers have been interested in characterizing adolescents using their weapon: in a longitudinal study, Henrich *et al.* found that weapon violence exposure and weapon violence commission were correlated and that the connectedness to parents and school are protecting factors for weapon violence exposure and use [29]. Furthermore, to our knowledge, there are no publications analyzing the differences between those adolescents carrying a weapon and those using a weapon in a fight.

To address these gaps, the objectives of the present research are (i) to characterize adolescents living in Switzerland and carrying a weapon and (ii) by analyzing the subsample of weapon-carrying youths, to depict the differences between those who have used it in a fight and those who have not. Based on Jessor's [15] problem behavior theory, we hypothesize that adolescents using a weapon in a fight belong to the youth group at high risk for other deleterious behaviors, thus engaging in substance use, delinquency and unsafe sex. On the contrary, youths with a history of victimization would carry their weapon for self-defense and would thus be less implicated in other high-risk behaviors.

Patients and methods

Procedure and sample

Data were drawn from the 2002 Swiss Multicenter Adolescent Survey on Health (SMASH02), a cross-sectional study conducted among a nationally representative sample (N = 7548, 48.5% females) of post-mandatory public school students and apprentices aged 16–20 years living in Switzerland. The survey was carried out through an anonymous paper-and-pencil questionnaire that was administered in the classroom in the absence of the teachers by trained health professionals external to the school system.

In Switzerland, the education system is mostly public, and the private sector includes only 5% of the school-aged population. Most adolescents aged 16–20 years attend post-mandatory education, one-third of them as full-time students and the rest as apprentices. Apprentices have a dual formation: 1 or 2 days of class per week, while the rest of their time is devoted to work in a company related to their field of training. Full-time students prepare themselves for university studies. Being a full-time student is often related to a higher educational and socioeconomic status of parents. However, apprenticeship in Switzerland is known to be a very good formation/training with the possibility to continue further studies at university.

The sample is a random cluster of 579 classes. Language area (n = 3), type of school (n = 2), type

of apprenticeship (n = 9) and year of study (up to four) were used as sampling stratification criteria. The 565 items of the questionnaire cover sociodemographic background, somatic and mental health, quality of relationships and various health-related behaviors (e.g. sensation seeking, sexuality, violence). A description of the questionnaire and sampling method has been published elsewhere [16]. The survey was approved by the ethical committee of the Medicine Faculty in Lausanne.

Criterion variables

We used dichotomous measures for the criterion variables: [1] carrying a weapon was defined as having carried a switchblade knife, bat, brass knuckle, gun or other firearm or pepper spray or other spray at least once in the 12 months preceding the survey. Having used one of these weapons in a fight in the 12 months preceding the survey was coded as positive for [2] using a weapon. Pepper sprays are often considered as a tool for defense. However, in adolescents who use it in a fight, the purpose of the spray is clearly of an offensive nature. We therefore included pepper sprays in our analysis.

Predictor variables

Based on the literature review and Bronfenbrenner ecological model [17], we divided the predictor variables into three groups: personal, family and school/friends. Additionally, a fourth group of predictor variables including other risk behaviors was also created.

Personal factors included age, place of birth (Switzerland/other), residency (rural/urban), depressive mood, having been a victim of physical violence in the last 12 months, having a tattoo and sensation seeking. Depressive mood was assessed through the Depressive Tendencies Scale, which is based on eight items and covers depressed symptomatology and feelings of sadness, hopelessness and unhappiness. Several studies have shown that this is a valid and reliable instrument [e.g. 18, 19]. In the present study, Cronbach's alfa was 0.89. For sensation seeking, a five-item scale was developed on the basis of the work of Gniech *et al.* [20]. Cronbach's alfa was 0.80 in this study. Both scales range from 0 (low) to 3 (high).

Family variables such as family structure (single-parent household/other), educational level of both parents (more versus less than the 9 years of mandatory education) and quality of parent–adolescent relationship were used. To measure the quality of the parent–adolescent relationship, we developed a six-item inventory. We took five items from the Inventory of Parent and Peer Attachment [21]. These items measured adolescents' perceptions of their parents' acceptance, understanding, trustfulness and sensitivity to their emotional state, as well as their own use of their parents as confidants. In addition, we created an item tapping the adolescents' perception on how much their parents trusted them (Cronbach's overall alfa in the present study was 0.85).

As school variables, we defined academic track (apprentice/student), poor school grades and truancy (skipping school at least once a month). We measured school connectedness with five items used in previous studies [22, 23], with a Cronbach's alfa of 0.61 in this study. To measure the quality of the relationship with peers, we used a four-item inventory. We took all four items from the Inventory of Parent and Peer Attachment [21]. These items measured adolescents' perceptions of their peers' acceptance, trustfulness and sensitivity to their emotional state, as well as their own use of their peers as confidants (Cronbach's overall alfa in the present study was 0.77).

Risk behaviors included daily smoking, alcohol misuse (having been drunk at least once in the last 30 days), cannabis use (having consumed cannabis at least once in the last 30 days), other drug use (such as having consumed designer drugs, medicine to get high, cocaine or heroine at least once in the last 30 days), quarrelling while intoxicated ('Have you been involved in a quarrel while under the influence of alcohol or illegal drugs?'), unsafe sex (defined by two or more positive answers to (i) having had sex before age 15 years, (ii) having had more than three partners in their lifetime, (iii) not using a condom at last intercourse and (iv)

having been pregnant or partner becoming pregnant) and delinquency other than carrying/using a weapon. We considered respondents as being delinquent if they had committed one or more of the following offenses in the 12 months preceding the survey: (i) attacked an adult; (ii) snatched or stolen a handbag, purse or cellular phone; (iii) destroyed voluntarily something not belonging to them; (iv) stolen or taken something; (v) set fire to something and (vi) sold drugs including cannabis.

Statistical analyses

We first analyzed the whole study sample for the prevalence of carrying any weapon as well as for each type of weapon, comparing males and females and controlling for age. Second, we determined the characteristics of adolescents carrying a weapon compared with those who do not. Finally, we used the subsample of all respondents reporting to have carried a weapon to compare those who had used it in a fight with those who had not. The two latter comparisons were done separately by gender, as males are more likely than females to carry a weapon [2, 6].

We conducted a bivariate analysis with Pearson's chi-squared tests reporting prevalence and 99% confidence interval (CI) for categorical variables and Student's *t*-test reporting means and 99% CI for continuous variables. All variables significantly ($P \leq 0.01$) associated with adolescent's weapon carrying and weapon use (plus age, even if not significant) were included in stepwise multivariate regressions. Statistical analyses were performed with Stata 9.2 [24], which allows computing coefficient estimates and variances taking into account the sampling weights, clustering and stratification procedure.

Results

Prevalence of carrying a weapon

Our study showed that 13.7% of adolescents living in Switzerland carried a weapon in the last 12 months, with males showing a significantly higher prevalence (19.9%) than females (6.2%). While males mostly carry a knife, females are more likely to carry pepper spray (Table 1).

Bivariate analysis

For females, sensation seeking, a history of being a victim of physical violence, feeling depressed, having a tattoo, using illegal substances other than cannabis and engaging in risk behaviors including unsafe sex, quarrelling while intoxicated and delinquency were significantly associated with weapon carrying. For males, being an apprentice, being a sensation seeker, being a victim of physical violence, feeling depressed, having a tattoo, having a poor relationship with parents and having low school connectedness and all studied risk behaviors were significantly associated with weapon carrying (Table 2).

Multivariate analysis

Female weapon carriers were more often engaging in delinquent behaviors (adjusted odds ratio, 99%

Table I. *Point prevalence (given as percentage and 99% CI) and types of weapon carrying in the total sample (weighted)*

Type of weapons carried	Females (N = 3385)	Males (N = 4044)	Adjusted odds ratio
Any weapon	6.2 (4.4–8.5)	19.9 (17.1–23.1)	**3.8 (2.6–5.6)**
Knife	1.5 (1.0–2.1)	11.5 (9.4–13.9)	**8.7 (5.7–13.3)**
Bat	0.2 (0.0–0.8)	4.1 (2.8–5.8)	**25.0 (5.2–119.6)**
Brass knuckle	0.2 (0.1–0.5)	3.3 (2.1–5.1)	**15.3 (5.8–40.6)**
Gun/other firearm	0.5 (0.3–1.0)	5.3 (4.1–6.8)	**11.0 (5.6–21.9)**
Pepper spray/other spray	4.6 (2.9–7.1)	4.1 (3.1–5.4)	0.9 (0.5–1.5)
Other	0.3 (0.1–0.6)	2.0 (1.3–2.9)	**7.0 (3.0–16.7)**

Odds ratios (99% CI) adjusted for age with females as reference category. In bold: $P < 0.01$.

Table 2. *Weapon carrying: point prevalence (given as percentage and 99% CI) and adjusted odds ratios (99% CI) of the whole sample*

	Males			Females		
	No weapon (N = 3239)	Carrying weapon (N = 805)	Adjusted odds ratio[a]	No weapon (N = 3176)	Carrying weapon (N = 209)	Adjusted odds ratio[a]
Personal						
Age (mean)	18.0 (17.8–18.2)	17.9 (17.7–18.1)	NS	17.8 (17.7–18.0)	18.1 (17.7–18.5)	NS
Foreign born	13.5 (10.8–16.7)	15.7 (10.9–22.1)	NA	12.1 (10.0–14.4)	8.7 (4.4–16.4)	NA
Urban living	41.6 (36.9–46.5)	47.3 (41.3–53.3)	NA	41.7 (36.7–46.8)	44.1 (27.3–62.4)	NA
Apprentice	**76.6 (70.4–81.8)**	**87.4 (82.0–91.3)**	1.7 (1.2–2.4)	63.2 (55.3–70.4)	60.3 (36.1–80.4)	NA
Sensation seeker (mean)	**1.6 (1.6–1.7)**	**2.0 (1.9–2.1)**	1.7 (1.3–2.2)	**1.2 (1.1–1.3)**	**1.5 (1.3–1.7)**	NS
Victim of physical violence	**9.4 (7.7–11.6)**	**22.5 (18.3–27.3)**	2.1 (1.4–3.0)	**5.4 (4.4–6.7)**	**18.4 (10.6–30.1)**	3.0 (1.4–6.3)
Depressed (mean)	**0.5 (0.5–0.6)**	**0.8 (0.7–0.9)**	NS	**0.8 (0.7–0.9)**	**1.1 (0.9–1.3)**	NS
Having a tattoo	**5.2 (3.9–7.0)**	**15.2 (11.3–20.1)**	1.8 (1.1–3.1)	**8.6 (7.0–10.6)**	**15.9 (8.8–27.2)**	NS
Family						
Single-parent household	21.5 (18.4–25.0)	26.4 (22.1–31.1)	NA	24.0 (21.3–27.0)	37.9 (18.2–62.6)	NA
Poor relation with parents	**19.9 (17.3–22.8)**	**34.7 (30.0–39.8)**	1.6 (1.1–2.1)	23.0 (20.0–26.4)	43.1 (23.6–65.0)	NA
Poor educational level of mother	21.8 (18.6–25.4)	23.7 (17.1–31.8)	NA	21.7 (18.9–24.9)	16.7 (9.4–28.1)	NA
Poor educational level of father	13.6 (11.3–16.3)	13.8 (10.4–18.0)	NA	14.6 (11.8–17.8)	12.2 (6.5–21.8)	NA
School/peers						
Poor school connectedness	**32.4 (27.1–38.2)**	**47.0 (40.2–53.9)**	NS	27.1 (23.1–31.5)	44.1 (24.4–65.7)	NA
Poor school grades	**21.7 (18.4–25.5)**	**28.0 (22.5–34.1)**	NS	21.2 (18.0–24.8)	27.3 (16.2–42.0)	NA
Truancy	20.9 (17.4–24.9)	25.4 (19.7–32.1)	NA	24.3 (20.0–29.1)	28.9 (17.6–43.6)	NA
Poor relation with peers	9.9 (7.4–13.2)	10.9 (8.0–14.8)	NA	4.8 (3.6–6.4)	7.9 (3.5–16.8)	NA
Risk behaviors						
Regular smoker	**35.8 (31.8–40.0)**	**58.3 (51.6–64.8)**	NS	33.9 (30.0–38.0)	49.0 (30.3–68.0)	NA
Alcohol misuse	**35.3 (31.3–39.5)**	**56.2 (49.9–62.2)**	NS	17.6 (15.1–20.4)	25.4 (15.0–39.7)	NA
Cannabis use	**36.0 (32.4–39.8)**	**56.5 (50.6–62.2)**	NS	25.7 (22.4–29.2)	37.6 (23.2–54.7)	NA
Other drug use	**8.7 (6.6–11.3)**	**20.6 (13.9–29.3)**	NS	**5.1 (3.8–6.8)**	**10.6 (5.6–19.3)**	NS
Unsafe sex	**10.5 (8.2–13.4)**	**28.5 (23.0–34.7)**	1.7 (1.1–2.7)	**10.9 (8.6–13.7)**	**24.7 (14.5–38.7)**	NS
Quarrel while under the influence of substance	**3.3 (2.1–5.1)**	**18.4 (12.0–27.2)**	2.9 (1.3–6.3)	**2.0 (1.4–2.8)**	**7.3 (3.4–14.9)**	NS
Delinquent other than weapon carrying	**39.6 (36.9–42.5)**	**78.0 (72.4–82.7)**	3.5 (2.6–4.8)	**21.1 (18.4–24.1)**	**53.3 (34.5–71.1)**	3.9 (1.5–9.9)

In bold: $P < 0.01$. NA, non-applicable; NS, non-significant.
[a]Backward multivariate analysis.

CI: 3.9, 1.5–9.9) and having a history of being a victim of physical violence (3.0, 1.4–6.3).

The most important factors related to weapon carrying in males were engaging in other delinquent acts (3.5, 2.6–4.8) and quarrelling while intoxicated (2.9, 1.3–6.3). Sensation seeking (1.7, 1.3–2.2), being a victim of physical violence (2.1, 1.4–3.0), having a tattoo (1.8, 1.1–3.1), practicing unsafe sex (1.7, 1.7–2.7), being an apprentice (1.7, 1.2–2.4) and having a poor relationship with parents (1.6, 1.1–2.1) also showed a significant association with weapon carrying (Table 2).

Weapon use

Male weapon carriers used their weapon almost three times more often in a fight than female weapon carriers (2.9, 1.6–5.0), although no

differences were found between genders for each individual weapon (Table 3).

Bivariate analysis

Weapon-using females were significantly more often victims of physical violence and regular smokers. We found a positive association between males using a weapon in a fight and being foreign born, living in an urban area, being apprentice, having a tattoo, having a low school connectedness, using illegal drugs other than cannabis, having unsafe sex, quarrelling while intoxicated and delinquency.

Multivariate analysis

For female weapon users, being a regular smoker (4.9, 1.0–23.3) was the only variable that remained significant. Compared with those who did not report using a weapon in a fight, males who did use a weapon in a fight were more likely to report quarrelling while intoxicated (3.1, 1.7–5.8), being foreign born (2.7, 1.4–5.1), being apprentices (2.6, 1.2–5.7), practicing unsafe sex (2.1, 1.2–3.6), living in an urban surrounding (2.0, 1.2–3.3) and having a poor school connectedness (1.9, 1.0–3.6) (Table 4).

Discussion

Weapon carrying is a frequent risk behavior among adolescents living in Switzerland. Males are significantly more often implicated in this behavior: one in five adolescent males carried a weapon compared with one in 16 girls. This gender difference has been reported in previous studies [3, 4, 6, 8, 9, 25, 26]. The prevalence of weapon carrying found in our study corresponds to previous research in Switzerland [1], whereas the percentage of adolescents carrying a weapon such as gun, knife or club in the United States is higher [6]. Still, the prevalence of adolescents in Switzerland carrying a weapon is sufficiently high to cause concern because to carry a weapon may lead to the use of this weapon in a violent offense [10, 27]. Our results indicate that more than one in four males and one in eight females carrying a weapon have come to use it in a fight.

Contrary to previous research indicating that the odds of carrying a weapon increase until reaching a peak prevalence at mid-adolescence ~15 years of age [4, 8], we found no difference in age between groups in our study. Nonetheless, considering that we do not know from our data at what age youths start carrying a weapon, prevention for weapon carrying should take place early in adolescence.

For males as for females, the most important factor associated with carrying a weapon is to commit other delinquent offenses. For males, quarreling while intoxicated and sensation seeking are also associated. This may be seen as a clustering of different risk behaviors. Steinman and Zimmerman [28] advance this point even further: they consider carrying a weapon as a more serious behavior than other risk behaviors, putting those adolescents at a higher risk.

Both genders showed a significant association of weapon carrying and being a victim of physical violence. We have two possible explanations for this phenomenon: adolescents having been victims

Table 3. *Point prevalence (given as percentage and 99% CI) of weapon using in the subsample of weapon-carrying adolescents*

Type of weapons used	Females (N = 209)	Males (N = 805)	Adjusted odds ratio
Any weapon	12.2 (6.3–22.3)	28.7 (23.6–34.3)	**2.9 (1.4–6.1)**
Knife	3.6 (1.4–8.6)	7.8 (5.3–11.6)	2.3 (0.8–6.5)
Bat	2.1 (0.3–13.3)	11.9 (8.4–16.5)	6.2 (0.8–45.6)
Brass knuckle	3.8 (1.6–8.9)	9.7 (6.3–14.6)	2.7 (1.0–7.6)
Gun/other firearm	0.6 (0.1–4.8)	3 (1.4–6.5)	4.8 (0.5–43.6)
Pepper spray/other spray	8.1 (3.7–17.0)	8.2 (5.6–11.8)	1.0 (0.4–2.4)
Other	0.8 (0.1–5.2)	5.0 (2.9–8.4)	6.3 (0.9–45.2)

Odds ratios (99% CI) adjusted for age with females as reference category. In bold: $P < 0.01$.

Table 4. *Weapon using: point prevalence (given as percentage and 99% CI) and adjusted odds ratios (99% CI) of the subsample of weapon-carrying adolescents*

	Males			Females		
	Carry weapon (N = 574)	Use weapon in fight (N = 231)	Adjusted odds ratio[a]	Carry weapon (N = 183)	Use weapon in fight (N = 25)	Adjusted odds ratio[a]
Personal						
Age (mean)	17.9 (17.7–18.1)	17.9 (17.5–18.3)	NS	18.2 (17.7–18.6)	17.6 (17.0–18.3)	NS
Foreign born	**10.7 (6.7–16.8)**	**28.0 (18.2–40.5)**	2.7 (1.4–5.1)	7.3 (3.3–15.6)	18.5 (5.7–45.8)	NA
Urban living	**42.3 (36.2–48.6)**	**59.7 (48.4–70.1)**	2.0 (1.2–3.3)	42.8 (24.8–63.0)	53.5 (26.0–79.0)	NA
Apprentice	**85.0 (78.6–89.7)**	**93.3 (86.5–96.8)**	2.6 (1.2–5.7)	57.6 (32.0–80.0)	80.0 (52.9–93.4)	NA
Sensation seeker (mean)	2.0 (1.8–2.1)	2.2 (2.0–2.3)	NA	1.5 (1.3–1.6)	1.9 (1.4–2.4)	NA
Victim of physical violence	21.9 (17.0–27.7)	24.1 (16.4–34.0)	NA	**14.7 (7.7–26.2)**	**45.3 (22.0–70.8)**	NS
Depressed (mean)	0.8 (0.7–0.8)	0.9 (0.7–1.0)	NA	1.1 (0.9–1.3)	1.1 (0.6–1.6)	NA
Having a tattoo	**11.2 (7.4–16.5)**	**25.3 (16.4–37.0)**	NS	13.4 (6.6–25.3)	34.2 (14.7–60.9)	NA
Family						
Single-parent household	24.1 (19.5–29.4)	32.1 (22.2–43.9)	NA	37.4 (15.8–65.6)	41.2 (18.5–68.4)	NA
Poor relation with parents	30.8 (24.5–37.9)	44.5 (33.3–56.3)	NA	41.7 (20.1–67.1)	52.8 (27.6–76.7)	NA
Poor educational level of mother	22.2 (15.6–30.5)	27.4 (17.5–40.1)	NA	16.8 (8.8–29.7)	16.2 (4.8–42.9)	NA
Poor educational level of father	12.0 (8.5–16.8)	18.1 (11.9–26.7)	NA	12.4 (6.2–23.3)	10.9 (2.3–38.9)	NA
School/peers						
Poor school connectedness	**41.9 (35.4–48.7)**	**59.7 (45.8–72.1)**	1.9 (1.0–3.6)	42.6 (20.7–67.8)	54.8 (28.2–78.9)	NA
Poor school grades	25.7 (20.0–32.4)	33.7 (24.3–44.5)	NA	24.7 (13.8–40.3)	45.5 (20.3–73.2)	NA
Truancy	22.8 (16.0–31.3)	32.0 (21.8–44.3)	NA	29.0 (16.5–45.7)	28.3 (11.7–54.1)	NA
Poor relation with peers	11.6 (7.7–17.1)	9.3 (5.2–16.0)	NA	5.8 (2.4–13.5)	22.4 (5.3–60.1)	NA
Risk behaviors						
Regular smoker	55.2 (46.3–63.7)	66.2 (53.4–77.1)	NA	**44.8 (25.9–65.3)**	**79.8 (51.7–93.6)**	4.9 (1.0–23.3)
Alcohol misuse	55.3 (48.0–62.4)	58.4 (45.9–69.8)	NA	22.3 (12.3–36.8)	48.2 (22.3–75.0)	NA
Cannabis use	53.3 (46.7–59.7)	64.5 (53.0–74.5)	NA	37.3 (21.5–56.3)	40.1 (17.7–67.4)	NA
Other drug use	**17.1 (10.8–26.2)**	**29.1 (18.7–42.3)**	NS	9.3 (4.3–19.1)	19.8 (7.2–44.0)	NA
Unsafe sex	**21.2 (16.5–26.9)**	**46.5 (35.0–58.4)**	2.1 (1.2–3.6)	21.5 (11.8–36.0)	47.2 (21.7–74.3)	NA
Quarrel while under the influence of substance	**12.3 (6.5–22.0)**	**33.7 (23.3–45.9)**	3.1 (1.7–5.8)	5.5 (2.1–13.4)	20.1 (6.2–48.9)	NA
Delinquent other than weapon carrying	**73.8 (67.4–79.3)**	**88.4 (79.2–93.8)**	NS	52.1 (30.9–72.6)	61.9 (35.8–82.6)	NA

In bold: $P < 0.01$. NA, non-applicable; NS, non-significant.
[a]Backward multivariate analysis.

of physical violence tend to protect themselves carrying a weapon and adolescents carrying a weapon live in a more violent surrounding with an increased risk for victimization. A prospective study of US adolescents showed a reciprocal link between exposure to violence and committing weapon violence [29], thus consistent with both our explanations.

Being tattooed showed a significant association with weapon carrying in males. In previous studies, having tattoos has been linked to risk behaviors in adolescents such as interpersonal violence and substance use [11, 12]. These associations showed a large variance, according to the age at body modification, whether the tattoo was of an amateur or

professional nature and the motif and the location of the tattoo. In addition, body art represents far more than just an indicator of risk behaviors [30]. It may, for example, represent a wish for uniqueness or the search for self-identity. Professionals should therefore abstain from stigmatizing tattooed adolescents. However, the presence of a tattoo may serve as a starting point for a discussion about weapon carrying, violence and other risk behaviors in an adolescent patient.

Male apprentices carry a weapon more frequently than students. In contrast to full-time students, apprentices spend most of their working time in a company where they get a practical education. They enter professional life at a younger age, being influenced rather by adults than by same-age peers. These surroundings may push them to adopt more easily adult risk behaviors. In this line, other studies have reported that, compared with students, apprentices are more likely to use substances [31, 32] and to be sexually active [33]. The gender difference in this case could be attributed to the different types of apprenticeships males and females follow.

An interesting fact is that, although being an important risk factor for weapon carrying for both genders, being a victim of physical violence is not related to using a weapon in a fight. This seems to indicate that adolescents who have been victim of violence carry a weapon mainly for self-defense.

For both genders, we highlight a strong association between the use of a weapon in a fight and other risk behaviors, indicating a clustering effect of diverse risk behaviors by highest risk youth groups.

In our analysis, the use of a weapon in a fight among males is related to being foreign born, which can be interpreted as a proxy for race, ethnicity and cultural differences. The association of weapon carrying and race/ethnicity has been shown to be mediated by factors such as family socioeconomic status (SES) and the perception of neighborhood crime [9]. SMASH02 did not include questions about SES. We thus used the education of both parents as a proxy, which was not significantly associated with either weapon carrying or weapon using in the multivariate analysis. However, we cannot say whether the association of weapon use and being foreign born is only present because of the confounding factors of SES and neighborhood characteristics or if, as stated by Jackman [34], cultural differences in social acceptance of violence may partially explain this association. As mentioned for tattoos, health professionals should rather use this characteristic as a starting point for discussion than as a way of stigmatizing foreign-born youths.

Strengths and limitations

The main strength of our research is that it is based on a large, nationally representative sample of adolescents. From this point of view, the results can be generalized to all adolescents living in Switzerland. Additionally, to our knowledge, this is the first study focusing not only on weapon carrying but also on the difference between carrying a weapon and using it in a fight.

Nevertheless, some limitations need to be stressed. First, SMASH02 does not include information on absent students and dropouts, both of them known to engage more often in weapon carrying and other health risk behaviors [5, 9]. The mean percentage of adolescents between 16 and 20 years not included in our educational system is ~10%, and a further 5% are presumed to be absent on the day of the survey. We may thus underestimate the prevalence of weapon carrying and use among adolescents. Second, as our data are cross-sectional, causality cannot be assumed. Furthermore, we have no information about when adolescents started to carry and use weapons. We may therefore mix adolescents having carried a weapon for defense for a long time without using it with others who just started to carry a weapon for an offensive reason which may precede its use later on. Third, SMASH02 is based on a self-reporting questionnaire. Although completed anonymously, the results may be biased inasmuch as participants (especially males) may overreport risk behaviors, in order to impress others, while others (especially females) may underreport, fearing social/legal consequences [35, 36]. However, several studies indicate that when data are collected anonymously their reliability increases [36, 37]. Fourth, relatively

small prevalence rates did not allow us to further divide our sample for additional analysis such as by types of weapons or interaction tests between weapon carrying, weapon using, history of violent victimization, sensation seeking and other risk behaviors. Fifth, we do not have data regarding community or family violence that could also influence our findings. Sixth, we do not have information regarding violence against peers, which could explain, at least in part, why adolescents carry a weapon. Seventh, our data do not allow us to differentiate those using a weapon offensively from those using it defensively. Finally, in general, females engage less often in overt physical violence including weapon carrying and use [6, 8, 26]. Although we have a large sample, few girls reported using a weapon in a fight. Therefore, the power of our analyses for girls using a weapon in a fight is limited, and thus Type II errors cannot be excluded. Even so, as the literature on young females' weapon carrying and use is extremely scarce, we believe that our results are important as a first step to understand their characteristics.

Conclusion

Carrying a weapon is a relatively frequent behavior among youths in Switzerland and a sizeable proportion of those who carry a weapon have used it in a fight. As this behavior is associated with other risk behaviors, health professionals dealing with adolescents should include weapon carrying in their clinical assessment and preventive counseling.

Urban foreign-born male adolescents who quarrel while intoxicated are the most at risk of using a weapon in a fight, and therefore, culturally sensitive prevention approaches need to be developed to decrease violence in this specific population of youths.

Nevertheless, as our study is exploratory, further research is needed to confirm and clarify our findings.

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Conflict of interest statement

None declared.

References

1. Killias M, Haas H. The role of weapons in violent acts. *J Interpers Violence* 2002; **17**: 14–32.
2. Pickett W, Craig W, Harel Y *et al.* Cross-national study of fighting and weapon carrying as determinants of adolescent injury. *Pediatrics* 2005; **116**: e855–63.
3. Durant RH, Getts AG, Cadenhead C *et al.* The association between weapon carrying and the use of violence among adolescents living in and around public housing. *J Adolesc Health* 1995; **17**: 376–80.
4 Kodjo CM, Auinger P, Ryan SA. Demographic, intrinsic, and extrinsic factors associated with weapon carrying at school. *Arch Pediatr Adolesc Med* 2003; **157**: 96–103.
5 Brener ND, Collins JL. Co-occurrence of health-risk behaviors among adolescents in the United States. *J Adolesc Health* 1998; **22**: 209–13.
6. Eaton DK, Kann L, Kinchen S *et al.* Youth risk behavior surveillance—United States, 2005. *J Sch Health* 2006; **76**: 353–72.
7 Cook PJ, Ludwig J. Does gun prevalence affect teen gun carrying after all? *Criminology* 2004; **41**: 27–54.
8. Leeb RT, Barker LE, Strine TW. The effect of childhood physical and sexual abuse on adolescent weapon carrying. *J Adolesc Health* 2007; **40**: 551–8.
9. Simon TR, Richardson JL, Dent CW *et al.* Prospective psychosocial, interpersonal, and behavioral predictors of handgun carrying among adolescents. *Am J Public Health* 1998; **88**: 960–3.
10. Kodjo CM, Auinger P, Ryan SA. Prevalence of, and factors associated with, adolescent physical fighting while under the influence of alcohol or drugs. *J Adolesc Health* 2004; **35**: 346.

11. Carroll ST, Riffenburgh RH, Roberts TA *et al.* Tattoos and body piercings as indicators of adolescent risk-taking behaviors. *Pediatrics* 2002; **109**: 1021–7.
12. Roberts TA, Ryan SA. Tattooing and high-risk behavior in adolescents. *Pediatrics* 2002; **110**: 1058–63.
13. Kuntsche EN, Klingemann HK. Weapon-carrying at Swiss schools? A gender-specific typology in context of victim and offender related violence. *J Adolesc* 2004; **27**: 381–93.
14. Rudatsikira E, Singh P, Job J *et al.* Variables associated with weapon-carrying among young adolescents in southern California. *J Adolesc Health* 2007; **40**: 470–3.
15. Jessor R. Problem-behavior theory, psychosocial development, and adolescent problem drinking. *Br J Addict* 1987; **82**: 331–42.
16. Jeannin A, Narring F, Tschumper A *et al.* Self-reported health needs and use of primary health care services by adolescents enrolled in post-mandatory schools or vocational training programmes in Switzerland. *Swiss Med Wkly* 2005; **135**: 11–8.
17 Bronfenbrenner U. *The Ecology of Human Development.* Cambridge, Harvard University Press: 1979. p.16–42.
18. Alsaker FD. Pubertal timing, overweight, and psychological adjustment. *J Early Adolesc* 1992; **12**: 396–419.
19. Holsen I, Kraft P, Vittersø J. Stability in depressed mood in adolescence: results from a 6-year longitudinal panel study. *J Youth Adolesc* 2000; **29**: 61–78.
20. Gniech G, Oettling T, Brohl M. *Untersuchungen zur Messung von "Sensation Seeking"*. Bremer Beiträge zur Psychologie Nr.110. 1993. Universität Bremen, Germany.
21. Armsden GC, Greenberg MT. The Inventory of Parent and Peer Attachment: individual differences and their relationship to psychological well-being in adolescence. *J Youth Adolesc* 1987; **16**: 427–54.
22. Flammer A, Alsaker FD, Grob A. *Fragebogen Alltag und Schule von Kindern und Jugendlichen in der Schweiz und in Norwegen.* 1994. Bern, Switzerland: Institut für Psychologie, Universität Bern.
23. Ingenkamp K. *Landauer Skalen zum Sozialklima (LASSO 4-13).* 1987. Weinheim, Germany: Beltz Test.
24 Stata Corporation. *Stata Statistical Software, Release 9.2 [Computer Program].* College Station, TX: Stata Corporation, 2005
25. Molnar BE, Miller MJ, Azrael D *et al.* Neighborhood predictors of concealed firearm carrying among children and adolescents: results from the project on human development in Chicago neighborhoods. *Arch Pediatr Adolesc Med* 2004; **158**: 657–64.
26. Lowry R, Powell KE, Kann L *et al.* Weapon-carrying, physical fighting, and fight-related injury among U.S. adolescents. *Am J Prev Med* 1998; **14**: 122–9.
27. Taiwo T, Goldstein S. Drug use and its association with deviant behaviour among rural adolescent students in South Africa. *East Afr Med J* 2006; **83**: 500–6.
28. Steinman KJ, Zimmerman MA. Episodic and persistent gun-carrying among urban African-American adolescents. *J Adolesc Health* 2003; **32**: 356–64.
29. Henrich CC, Brookmeyer KA, Shahar G. Weapon violence in adolescence: parent and school connectedness as protective factors. *J Adolesc Health* 2005; **37**: 306–12.
30. Armstrong ML, Roberts AE, Owen DC *et al.* Toward building a composite of college student influences with body art. *Issues Compr Pediatr Nurs* 2004; **27**: 277–95.
31. Kohn L, Dramaix M, Favresse D *et al.* Trends in cannabis use and its determinants among teenagers in the French-speaking community of Belgium. *Rev Epidemiol Sante Publique* 2005; **53**: 3–13.
32. Michaud PA, Berchtold A, Jeannin A *et al.* Secular trends in legal and illegal substance use among 16 to 20 year old adolescents in Switzerland. *Swiss Med Wkly* 2006; **136**: 318–26.
33. Michaud PA, Narring F, Dubois-Arber F *et al.* Health survey of 15–20-year-old adolescents in French-speaking Switzerland. *Schweiz Med Wochenschr* 1993; **123**: 1883–95.
34. Jackman MR. Violence in social life. *Annu Rev Sociol* 2002; **28**: 387–415.
35. Sheley JF, Wright JD. Motivation for gun possession and carrying among serious juvenile offenders. *Behav Sci Law* 1993; **11**: 375–88.
36. Brener ND, Billy JO, Grady WR. Assessment of factors affecting the validity of self-reported health-risk behavior among adolescents: evidence from the scientific literature. *J Adolesc Health* 2003; **33**: 436–57.
37. Kann L, Brener ND, Warren CW *et al.* An assessment of the effect of data collection setting on the prevalence of health risk behaviors among adolescents. *J Adolesc Health* 2002; **31**: 327–35.

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