

# Self-Generated Identification Codes in Longitudinal Prevention Research with Adolescents: A Pilot Study of Matched and Unmatched Subjects

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**Abstract** Self-generated identification codes (SGICs) are an increasingly utilized methodological feature of longitudinal prevention research among adolescents. This study sought to test the differences between the matched and unmatched groups at baseline on a number of background, health, and well-being and risk behavior measures in a prevention study among 13- to 16-year-old Icelandic adolescents where a SGIC was constructed and used to link individual-level respondent data over two data collection points one year apart. We use pilot data from two Reykjavik city secondary schools collected as part of the population study Youth in Iceland in February 2010 and 2011 ( $N=366$ , SGIC matching rate 61 %). Baseline results for the matched and unmatched participants are compared. Findings indicate that the unmatched subjects are both more likely to be substance users than their matched counterparts as well as being more likely to be boys and/or from disrupted families. Five out of the seven scaled measures for risk and protective factors and personality indicators reveal no difference between the matched and unmatched subjects and the significantly different measures reveal

small effect sizes between the two groups. However, the effect sizes for substance use are significantly different between the matched and unmatched groups for all seven substance use measures with effect sizes from 0.52 to 1.32. These findings therefore indicate that the measurement validity of adolescent risk behaviors such as substance use may be put in jeopardy when using SGIC and that unmatched subjects may be more likely to distrust the SGIC process.

**Keywords** Self-generated identification codes · Adolescence · Prevention research · Anonymous link

## Introduction

Self-generated identification codes (SGICs) have become an increasingly utilized methodological feature of longitudinal prevention research among adolescents (Gorman 2009; Tagliabue et al. 2011; Yurek et al. 2008). SGICs normally use a set of personally relevant questions to which the respondent's answers would not change to enable matched identification over multiple time points of data collection. These might include a combination of letters and digits from the respondent's first name, mother's name, and date of birth, which form a unique identifier for each study participant that together form the SGICs. Over the course of two or more repeated measures the SGIC is then used to link individual data while preserving respondent anonymity. A more detailed narrative about the nature and history of SGICs has been provided by Yurek et al. (2008) and Schnell et al. (2010).

The aim of the practice of using SGICs is to overcome the complexity and administrative burden of linking sensitive individual-level data over multiple time points without the need to acquire direct personal details (e.g., full names,

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social security numbers, or other unique personal identifiers that reveal traceable identity) and informed consent that may compromise the anonymity of potential respondents or their willingness to participate. Thus, the use of SGICs should contribute to considerably more accurate estimates of change over time in a given study population, yield higher response rates, and decrease sample attrition than studies that directly collect personal information. In research with adolescents, using SGICs to link data with multiple responses for each individual may also be more convenient to researchers than acquiring personal information, which further complicates the process of obtaining approval from Institutional Review Boards and informed consent from potential participants and their parents or guardians.

The use of SGICs, however, is not without potential problems. One of the main concerns associated with the use of SGICs—especially in adolescent prevention research—is the nature of the non-response or “unmatched” group compared to that of the “matched” group. The size of the “unmatched” group tends to increase in proportion relative to the length of time between measure points (Schnell et al. 2010; Yurek et al. 2008). The longer period of time that elapses between measures across time points, the smaller the matched proportion of participants. Although the utility of SGICs has been improved somewhat recently, for example by using a set of identity questions that are more convenient to form individually specific SGICs, problems associated with such practice still remain. Studies with adolescents have reported a sizable difference in health risk behavioral outcome measures between the matched and unmatched groups (e.g., DiIorio et al. 2000; Kearney et al. 1984). Recently, Schnell et al. (2010) highlighted concerns about the high proportion of non-matched subjects in studies that use SGIC to link data across multiple time points and make suggestions for improvements.

Nevertheless, recent studies (e.g., Foxcroft and Lowe 1995; Galanti et al. 2007; Siliquini et al. 2011) that have used a SGIC approach to data linking have usually not provided information about the difference between the matched and the unmatched groups on independent and/or dependent variables. Exceptions to this include, for example, a study by Pérez et al. (2010), where the authors reported on a comprehensive list of background, independent and outcome variables between the matched and unmatched groups. In short, they found a significant difference between all 10 measures tested, including gender, education levels, family structure, family income, and three measures of substance use (Pérez et al. 2010, pp.131). The same applies to a study by Morgenstern et al. (2008) in which alcohol use was compared by the matched and unmatched groups at baseline. The study found a much higher prevalence on lifetime binge-drinking for the unmatched group (23 %), compared to the matched group (11 %).

A more recent example of a rationale for the use of SGICs comes from a study by Isensee et al. (2012), where the authors justified their use of SGICs by citing Galanti et al. (2007), stating that: “To permit a linking of individual information on subsequent surveys, each questionnaire was labeled with a seven-digit individual code generated by the student, a procedure that had been tested in previous studies” (Isensee et al. 2012, pp. 33). The “test” referred to is the Galanti et al. (2007) study. The fact, on the other hand, is that Galanti et al. (2007) concluded that errors affected at least a fifth of the responses in their validity study when using a nine digit SGIC with less than 70 % matching for all nine digits even though there were only 4 weeks between measure points. Their conclusion was that “Self-generation of anonymous codes is a feasible, but not a very efficient, procedure to link longitudinal data among adolescents. Relatively easy derivation and iterative matching procedures are crucial for achieving high efficiency of this type of anonymous linkage” (Galanti et al. 2007, pp. 174). The non-matching portion of subjects one year apart in the Isensee et al. (2012) study was about 30 % but their baseline findings were not reported in comparison to the matched group.

This brief overview of the use of SGICs calls into question the nature of findings based on SGICs that have been used to link responses for individuals over time, and highlights the need for further improvement and validation of methods by which SGICs are employed to link data in large-scale studies. This is especially important in adolescent health and risk behavior measurement where the aim is often to assess the frequency of non-normative behaviors, sensitive, and sometimes even illicit actions where the respondents’ confidence that the data collection and analysis procedures will preserve anonymity and confidentiality is paramount to the validity of the reported findings. The methodological literature on this issue (see Schnell et al. 2010 for a review) has mostly focused on improving the measurement and potential matching of subjects in using the SGIC but not reported on study findings that include a comparison between the matched and unmatched participants on variables associated with health and risk behaviors. The fact that studies using SGICs generally do not provide information about the non-matched group is therefore of concern. Although some studies that use SGICs to link individual-level data have partly reported on the difference between the matched and unmatched groups, no study has been specifically designed to test this difference on many factors.

This pilot study sought to fill this gap in the literature by providing a test of the differences between the matched and unmatched groups at baseline on a number of background, health, and well-being and risk behavior measures in a prevention study among 13- to 16-year-old Icelandic

adolescents where a SGIC was constructed and used to link individual-level respondent data over two data collection points one year apart.

## Method

### Sample

This study utilized pilot data from the series of surveys called Youth in Iceland, which monitor trends in a wide range of demographic, behavioral, and health-related variables (Sigfusdottir et al. 2009). Conducted by the Icelandic Centre for Social Research and Analysis (ICSRA), in collaboration with the Icelandic Ministry of Education, Science, and Culture, the survey on which we report was conducted during February of 2010 and again in February 2011. It includes students aged 13 to 16 years who were enrolled in the 8th and 9th (13 to 15 years of age) grades in 2010 and 9th and 10th grades (14 to 16 years of age) in 2011 in two Reykjavik city secondary schools. Both are area-based secondary schools that enroll students from several smaller primary schools from the nearby areas. Under ICSRA oversight, teachers at each school supervised questionnaire completion on-site. All students who attended school on the day that the survey was scheduled completed the questionnaires within their regular classrooms. Students were instructed not to write their name, social security number, or any other identifying information anywhere on the questionnaire booklet. They were instructed to complete the entire booklet, but to ask for help if they had any problems or any questions for clarification. Before submitting the questionnaire, students were asked to fill out a SGIC form that contained five items with tick mark boxes for digits and alphabetical letters. The items were: (1) “mark x for the second letter in your first name”, (2) “mark x for the number digit of your birthday during the month you were born”, (3) “mark x for the second letter in your mothers’ first name”, (4) “mark x for the third letter in your father’s first name”, and (5) “mark x for the first letter in your first primary school (that is the school you first went to)”. Upon completion students were asked to place their completed booklet and SGIC sheet in an envelope provided for that purpose, and seal the envelope before returning it to the supervising teacher. The total number of responses for the two schools was 366 for both waves of data collection and of those 192 were successfully matched for all 5 SGIC digits. Given the likelihood of measurement error (unintentionally marking a wrong SGIC digit in either wave 1 or 2) a further 31 individuals were matched on 4 out of five SGIC digits between waves for a total of 223 matched subjects or 61 %. The additional 31 that were matched on four out of five SGIC digits were double checked with

regards to age, gender, and grade. Although the study was designed with only a five-digit SGIC system, on no occasion did two or more participants have the same SGIC. Also, between 2010 and 2011, around 30 students in the baseline population switched schools. If these students are not counted, the matching reaches just over 66 % (223/366); however, due to the nature of the SGIC as a matching technique we are unable to identify those students so they are kept in the analysis as a part of the non-matched group. All aspects of data collection, including participant involvement based on passive parental consent, were conducted in accordance with Icelandic guidelines for the protection of research subjects. For the use of the SGIC the Personal Protection Authority of Iceland, which is a legal institution that oversees personal protection of research subjects and other personal information, was contacted and they revealed no need to interfere in the process because anonymity was secured.

### Measures

Approximately 90 % of the estimated 320,000 inhabitants of Iceland are of Norse-Celtic decent, with 80 % of the population belonging to the Lutheran State Church and no other religious institution having more than 3 % of the population registered in its services (Statistics Iceland 2011). Because of this homogeneity, exogenous variables such as race and religion, which are often used in research in other countries, were not included in this study.

### Background Variables

*Gender* Gender was coded 1 for girls (50.7 %) and 0 for boys.

*Family Structure* Family structure was measured with the question “Who lives in your home”: Response categories range from 1 = Both parents, 2 = Mother but not father, 3 = Father but not mother, 4 = Mother and her partner, 5 = Father and his partner, 6 = I live on my own, 7 = I live equally much but separately with my mother and father, 8 = I live with different arrangements. This variable was collapsed to form a dichotomized measure with 0 = Both parents (65.4 %) and 1 = Other forms.

*Parental Education* The educational background of parents remains one of the strongest predictors for adolescent well-being and development. Parental education was measured with two questions headed with “What is the highest level of education by your (a) mother and (b) father”. Responses range from 1 = College graduate, 2 = Vocational school graduate, 3 = high school graduate, 4 = Secondary school or less, 5 = don’t know. Categories 2–5 were collapsed into one to form a measure with 1 = college graduate and 2 = other.

### *Substance Use and Peer Related Risk Factors*

**Substance Use** The questions forming lifetime; cigarette smoking, alcohol use, drunkenness, cannabis use, and last 30 day; alcohol use, and drunkenness, were: “How often, if ever, have you (a) smoked a cigarette, (b) had a drink of alcohol of any kind, (c) had a drink of alcohol during last 30 days, (d) become drunk in your lifetime, (e) become drunk during last 30 days, and (f) used cannabis substances (hashish or marijuana) in your lifetime”. Response categories ranged from 1 = Never, 2 = Once, 3 = 2–5 times, 4 = 6–9 times, 5 = 10–19 times, 6 = 20–39 times, and 7 = 40 times or more often. In all instances the scores were summed to form a dichotomized variables with 0 = Never, and 1 = Once or more often.

**Acquiring Alcohol from Peers** A question about whether respondents had ever acquired alcohol from their friends was: “How often, if ever, have your friends or acquaintances given you alcohol”. Responses categories were 1 = Never, 2 = Once, 3 = Twice, 4 = 3–5 times, 5 = 6–9 times, and 6 = 10 times or more often. This measure was collapsed to form a dichotomized variable with 0 = Never and 1 = Once or more often.

**Late Outside Hours** Late outside hours were measured with the question “How often, if ever, during last 7 days have you gone out with your friends and been back home after midnight”. Response categories range from 1 = Never, 2 = Once, to 8 = Seven times. Scored were summed to form a dichotomized variable with 0 = Never and 1 = Once or more.

### *Community and Family Risk and Protective Factors*

**Parental Alcohol Use and Offering of Alcohol** Parents’ alcohol use was measured with the questions “How often, if ever, does your (a) father, and/or (b) mother drink alcohol so he/she becomes drunk”. Response categories range from 1 = No, not that I know of, 2 = Yes, but very rarely, 3 = Yes, sometimes, 4 = Yes, often, and 5 = Yes, very often. Responses were collapsed to form a dummy coded measure with 0 = No and 1 = Yes. Another question pertaining if respondents had ever been offered alcohol from their parents was put forth. Response categories were 1 = No, never, 2 = Yes, I sometimes get to taste alcohol with mom and/or dad, 3 = Yes, I sometimes get a full glass of alcohol from my mother or father, and 4 = Yes, I often get alcohol from my mother and/or father. As before, the scores were summed to form a dichotomized measure with 0 = No, never, and 1 = Yes.

**Time Spent with Parents** The amount of time adolescents spend with their parents, as opposed to what they actually do with them, has emerged as an important protective factor for substance use initiation and progression (see Kristjansson

et al. 2010; Sigfusdottir et al. 2009). Time spent with parents was measured with two questions headed with “How well do the following apply to you: I spend time with my parents (a) outside school hours on working days, and (b) during weekends?” Responses range from 1 = Almost never, 2 = Seldom, 3 = Sometimes, 4 = Often, and 5 = Almost always. The variables were summed to form a scale ranging from 2 to 10.

**Parental Support** Parental support was measured with the Perceived Parental Support Scale (Kristjansson et al. 2011) with five items headed with the sentence: “How easy or hard is it for you to receive the following from your parents”: (a) caring and warmth, (b) discussions about personal affairs, (c) advice about the studies, (d) advice about other issues (projects) of yours, and (e) assistance with things. These five items were collapsed to form a scale and then squared due to positive skew.

**Parental Monitoring** The monitoring of parents has long been known to be an important protective factor for adolescent substance use and risk behaviors (Sigfusdottir et al. 2009, 2010, 2011). We measure parental monitoring with two questions headed with the statement “How well do the following statements apply to you”: (a) my parents follow where I am during evenings, and (b) my parents follow with whom I am during the evenings. Response categories were 1 = does not apply to me at all, 2 = applies to me rather badly, 3 = applies to me rather well, and 4 = applies to me very well. These scores were summed to form a scale.

**Intergenerational Closure** As a further evidence of parental and community protection the respondents were asked (a) if their parents knew their friends and (b) if their parents knew the parents of their friends, a well-documented and protective social capital factor labeled “intergenerational closure” (Coleman 1988; Thorlindsson et al. 2007), and headed by the same statement as the parental monitoring questions. These scores were also summed to form a scale.

**School Well-Being** The well-being of adolescents in schools is important for their welfare. We used the following seven items to measure school well-being headed with the sentence “How well do the following statements apply to you”: (a) The studies are an important objective, (b) I enjoy my studies, (c) I feel that I am well prepared for classes, (d) I feel that I put enough effort into my studies, (e) I feel good in school, (f) I don’t want to switch schools, and (g) I get along well with my teachers. These items were summed to form a scale.

**Self-Image** The participants’ self-image was measured with the Offer self-image scale (Offer 1969) which contains the following seven statements: (a) when I think about how I



will look in the future I am pleased, (b) I find myself ugly and unattractive, (c) I am happy with my body, (d) I am happy with the physical changes that I have been through over the last few years, (e) I feel strong and healthy, (f) I am content with my life, and (g) I am happy. These items were summed to form a scale.

**Depressed Mood** Level of depression was measured with nine out of ten items from the SCL-90 outpatient psychiatric evaluation scale by Derogatis et al. (1973) headed by the question “how often during the past week have you felt any of the following mental or physical discomforts”: (a) you were sad or had little interest in doing things, (b) had little appetite, (c) you felt lonely, (d) cried easily or wanted to cry, (e) had sleeping problems, (f) felt sad or blue, (g) not exited in doing things, (h) you were slow or had little energy, and (i) felt the future seemed hopeless. The variable scores were summed to form a scale. Due to negative skew, the scale distribution was altered with a natural logarithmic transformation.

#### Data Analyses

Baseline data from the 2010 data collection are used in the analysis. First, we analyzed the prevalence of substance use and other dichotomized risk factors and examine differences between the matched and unmatched subjects with a chi square test. Next, we run a univariate analysis of variance for scaled measures to test for effects between matched and unmatched subject while controlling for potential school level nesting in the data. We further assessed the effects size for all reported significant differences based on the Cohen’s *d* coefficient (Cohen 1992) for group mean differences and two-by-two frequency tables. Finally, we employ a multivariate logistic regression model using all background and independent variables in the study as predictors to account for potential overlap between them using the matching of subjects at wave 2 as outcome.

#### Results

Table 1 includes results for all categorical measures in the study, Table 2 includes findings for the scaled measures, and Table 3 looks into potential overlap between the background and independent variables in a multivariate model. As shown in Table 1, there are proportionally more girls in the matched group and matched subjects are also more likely to live with both biological parents than the unmatched participants. No difference was found for parental education between the two groups. The effect sizes for the background variables are generally small or around 0.3 for both significantly different measures.

The unmatched subjects are significantly more likely to have smoked cigarettes in their lifetime as well to have used alcohol (all four measures) and cannabis substances. The unmatched subjects are also more likely to have been outside after midnight during the last 7 days and to report their mothers’ alcohol use. No difference was found between the matched and unmatched subjects for the measures on father drunkenness and if parents had offered alcohol to participants. Effect sizes range from small or 0.32, 0.33, and 0.35 for mothers’ drunkenness, lifetime alcohol use and acquiring alcohol from friends, respectively, to high, or 1.19 and 1.32 for lifetime cannabis use and drunkenness during last 30 days, respectively.

Table 2 shows the results for scaled measures in the study, or family and community risk and protective factors. Only two of seven scales show a difference between the matched and unmatched subjects, school well-being and parental monitoring. Effect sizes for both measures are 0.25 and 0.40, respectively.

Table 3 shows the odds ratios of matching for background and independent variables to account for overlap between them. In short, only 3 out of 19 measures are statistically significant in the multivariate analysis; those that have been outside after midnight during the last 7 days are significantly less likely to be matched than those who have not been outside after midnight during last 7 days, and the same applies to those not living with both biological parents. They are less likely to be matched on their SGIC at time 2 than those who currently live with both biological parents. On the other hand, higher level of school well-being increases the odds of being in the matched group at time 2.

#### Discussion

This study was designed particularly to test the differences in responses of 13–16-year-old adolescent participants in a health risk behavior and substance use survey where a SGIC was employed to link data over two time points one year apart. The findings reveal an interesting picture of the difference between matched and unmatched subjects. They indicate that the unmatched subjects are both more likely to be current and previous substance users than their matched counterparts as well as being more likely to be boys and/or from disrupted families. Five out of the seven scaled measures for risk and protective factors and personality indicators reveal no difference between the matched and unmatched subjects and the significantly different measures of school well-being and parental monitoring reveal small effect sizes for the differences between the two groups. The effect sizes for the substance use variables are of much greater concern. Not only is there a significant difference between the matched and unmatched groups for

**Table 1** Percentages and effect sizes for differences in categorical measures

Variable	Matched (%)	Unmatched (%)	$\chi^2$	Effect size
Girls	56.4	44.0	6.14*	0.28
Lives with both biological parents	71.3	58.4	7.47**	0.32
Mother has college degree	65.8	59.4	1.62	ns
Father has college degree	55.0	50.6	0.68	ns
Lifetime cigarette smoking 1+	11.3	24.3	11.82**	0.52
Lifetime alcohol use 1+	31.8	45.5	7.83**	0.33
Alcohol use during last 30 days 1+	6.8	17.9	11.50**	0.64
Drunk in lifetime 1+	9.0	21.3	12.07**	0.55
Drunk during last 30 days 1+	1.4	10.7	16.24**	1.32
Has acquired alcohol from friends 1+	15.5	25.7	6.35*	0.35
Lifetime cannabis use 1+	1.4	8.3	11.05**	1.19
Outside after midnight 1+ during last 7 days	11.6	25.7	13.24**	0.55
Father becomes drunk	32.9	36.6	0.62	ns
Mother becomes drunk	21.7	32.8	6.20*	0.32
Parents offered alcohol	15.5	16.2	0.04	ns

\* $p < 0.05$ ; \*\* $p < 0.01$

all substance use measures but the effect sizes are also much larger than for the background factors and the significantly different scales. The effect sizes for lifetime smoking is 0.52, for lifetime drunkenness it is 0.55, and for outside hours after midnight it is 0.55, which are considered medium in size (Cohen 1992). The effect size for the difference in alcohol use during the last 30 days is larger or 0.64 but for drunkenness during last 30 days and lifetime cannabis use it is over 1.0 which entails a large effect size (Cohen 1992). Our multivariate analyses further suggest that a considerable overlap exists between the variables in our analysis. Only 3 out of 19 measures revealed significant differences between the matched and unmatched groups, having been outside after midnight once or more during last 7 days, family structure, and school well-being. As shown in Table 3, these findings are all in expected direction which underlines the context of the statistical relationships of substance use found in our univariate analyses. Participants that come from disrupted families, have spent time outside after midnight during last 7 days, and score lower on the school well-being

scale, represent a typical example of a group more likely to have used substances (see, e.g., Kristjansson et al. 2010; Sigfusdottir et al. 2009). In order to further validate the proposed findings we employed a  $\chi^2$  test on the last question in the survey: “How well do you think the questions in the questionnaire applied to you and your daily life” (responses: very well, well, neither, badly, very badly) between the matched and unmatched groups. This analysis revealed no differences between the two groups ( $\chi^2 = 5.44(4)$ ,  $p = 0.25$ ).

This study has several limitations. First, data from only two urban schools are used in the analyses. For validation purposes, we ran separate tests on all the substance use measures in the analysis between these two schools together versus all other schools combined in the city of Reykjavik. It revealed no significant differences between the two groups. Second, previous studies (for reviews see Schnell et al. 2010; Yurek et al. 2008) have typically shown a matching ratio of around 70 % or higher in studies carried out with adolescents and measure points one year apart. In this light,

**Table 2** Distributional properties, means, and effect sizes for differences in scaled measures

Measures	Distributional properties					Matched		Unmatched		ANOVA	
	N items	Range	Alpha	Skew	Kurtosis	Mean	SD	Mean	SD	F	Effect size
School well-being	7	7–35	0.81	−0.75	0.96	28.00	4.16	26.13	5.17	7.91**	0.40
Time with parents	2	2–10	0.77	−0.41	−0.17	7.44	1.75	7.08	2.02	2.43	ns
Parental support	5	25–400	0.88	−1.06	0.44	325.65	82.85	306.6	104.49	2.16	ns
Parental monitoring	2	2–8	0.88	−0.89	0.17	6.58	1.50	6.17	1.75	3.28*	0.25
Interg. closure	2	2–8	0.84	−0.20	−0.63	5.43	1.52	5.35	1.78	1.22	ns
Self-image	7	9–28	0.85	−0.71	0.22	22.22	4.04	22.19	4.48	0.28	ns
Depressed mood	9	2.20–3.58	0.90	0.61	−0.48	2.63	0.34	2.65	0.40	0.16	ns

**Table 3** Odds ratios from logistic regression models accounting for overlap between background and independent variables (matched subjects = 1)

Variables	B (S.E)	Wald	Exp(B)	Sig.
Lifetime cigarette smoking 1+	-0.38 (0.40)	0.92	0.68	0.34
Lifetime alcohol use 1+	-0.61 (0.37)	2.69	0.54	0.10
Lifetime cannabis use 1+	-0.69 (0.78)	0.79	0.50	0.38
Has acquired alcohol from friends 1+	0.64 (0.45)	1.96	1.89	0.16
Outside after midnight 1+ during last 7 days	-0.82 (0.37)	4.98	0.44	0.03
Father becomes drunk	0.56 (0.35)	2.61	1.75	0.11
Mother becomes drunk	-0.27 (0.38)	0.52	0.76	0.47
Parents offered alcohol	0.21 (0.39)	0.30	1.23	0.59
School well-being	0.09 (0.04)	5.26	1.09	0.02
Time with parents	-0.04 (0.08)	0.29	0.96	0.59
Parental support	0.00 (0.00)	0.00	1.00	0.98
Parental monitoring	0.06 (0.10)	0.30	1.06	0.58
Interg. closure	-0.07 (0.09)	0.60	0.93	0.44
Self-image	-0.05 (0.04)	1.39	0.95	0.24
Depressed mood	-0.00 (0.03)	0.00	1.00	0.98
Girls	-0.08 (0.29)	0.07	0.93	0.80
Lives with both biological parents	-0.69 (0.29)	5.71	0.50	0.02
Mother has college degree	0.18 (0.32)	0.34	1.20	0.56
Father has college degree	-0.23 (0.30)	0.59	0.79	0.44

our matching ratio is somewhat low, or 61 %, but would have been approximately 66 % if students not eligible for matching due to switching schools had not been included in the unmatched group as stated before. We believe there to be at least two reasons for this. The first one concerns the nature of data collection in the Youth in Iceland studies where teachers handle the on-site procedures in line with guidelines from the ICSRA. These guidelines are the same in all schools and for methodological reasons were not altered particularly for this sub-project of the Youth in Iceland studies. Students therefore did not receive specific instructions or information about the nature of the SGIC matching sheets but were merely handed them to fill out after completing the questionnaires. Clear explanations including examples outlined by teachers or research assistants on a blackboard are probably a feasible way to maximize the accuracy of the SGIC reports and trust in the process among students. The second reason is more macro and concerns an overall atmosphere of distrust in Iceland in the aftermath of the country's financial collapse in 2008, from which the country still has not been fully recovered. This may add to our low matching rates but represents a specific cohort effect that we have little or no way to influence. Third, our study relies entirely on self-reported data, although this applies to both the matched and unmatched groups of subjects.

Based on our matching rate, it seems evident that future studies need to improve the SGIC process to decrease the risk of losing students that are purposefully trying to avoid matching. In addition to the points above, three potential improvements come to mind. First, the use of rigorous data

cleaning procedures to assess data quality. As a part of our own data collection we eliminated responses from all participants that; (1) respond to less than 15 % our questionnaire, (2) claim to have used a “fake” substance that does not exist, (3) give inconsistent responses such as claiming to have been drunk during the last 30 days but also never to have had a drink of alcohol, (4) provide systematic responses to scales. A useful additional set of recommendations on data cleaning and quality assessment of self-reported responses has been put forth in the random response literature (see, e.g., Huang et al. 2012; Meade and Craig 2012).

Second, as mentioned before, the privacy of respondents may be of concern to them. In line with this notion, Ong and Weiss (2000) carried out an experiment with undergraduate college students and found privacy, measured as trust in anonymous responding, to exert a much greater impact on answers about cheating on exams than normalization of such acts. Their findings mirror our experience in the current study that it appears vital that students can trust the anonymity of their responses despite the use of SGIC. Sufficient physical distance between respondents, the use of sealed envelopes for the filled questionnaires, and a delivering process that ensures confidentiality, are therefore important.

The third recommendation that may be beneficial in future research is to specially incentivize participants for a matching SGIC. This would be separate from other potential incentives such as to enhance rates of participation. We were unable find any published studies that have attempted to do

this in this particular context but it might be a good additional tactic to other suggestions.

Notwithstanding the limitations, the study also has several strengths. First, a sound methodology of school-based data collection was employed that has been utilized for over a decade and a half in Iceland. Second, we make use of standardized questions on substance use that are also used in international substance use surveys in the same age group (e.g., Hibell et al. 2009). Finally, several standardized scaled measures on social and behavioral factors were used in the analyses (e.g., Coleman 1988; Derogatis et al. 1973; Kristjansson et al. 2011; Offer 1969).

In sum, the findings of this study indicate that the measurement validity of adolescent risk behaviors such as substance use may be put in jeopardy when using SGIC and that unmatched subjects may be more likely to distrust the SGIC process. This claim is further supported by the fact that the same magnitude of difference as measured in the respective effect sizes was not observed for other measures in the study.

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