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Author Manuscript
Faculty of Biology and Medicine Publication

This paper has been peer-reviewed but does not include the final publisher proof-corrections or journal pagination.

Published in final edited form as:

serval
serveur académique lausannois

UNIL | Université de Lausanne
Faculté de biologie
et de médecine

Examining non-response bias in substance use research – are late respondents proxies for non-respondents?

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Word count: 4131

Abstract

Background. Non-response is a major concern among substance use epidemiologists. When differences exist between respondents and non-respondents, survey estimates may be biased. Therefore, researchers have developed time-consuming strategies to convert non-respondents to respondents. The present study examines whether late respondents (converted former non-participants) differ from early respondents, non-consenters or silent refusers (consent givers but non-participants) in a cohort study, and whether non-response bias can be reduced by converting former non-respondents.

Methods. 6099 French- and 5720 German-speaking Swiss 20-year-old males (more than 94% of the source population) completed a short questionnaire on substance use outcomes and socio-demographics, independent of any further participation in a cohort study. Early respondents were those participating in the cohort study after standard recruitment procedures. Late respondents were non-respondents that were converted through individual encouraging telephone contact. Early respondents, non-consenters and silent refusers were compared to late respondents using logistic regressions. Relative non-response biases for early respondents only, for respondents only (early and late) and for consenters (respondents and silent refusers) were also computed.

Results. Late respondents showed generally higher patterns of substance use than did early respondents, but lower patterns than did non-consenters and silent refusers. Converting initial non-respondents to respondents reduced the non-response bias, which might be further reduced if silent refusers were converted to respondents.

Conclusion. Efforts to convert refusers are effective in reducing non-response bias. However, converted late respondents cannot be seen as proxies of non-respondents, and are at best only indicative of existing response bias due to persistent non-respondents.

Keywords: non-response bias, early respondent, later respondent, substance use, young men.

1. Introduction

Non-response is a serious problem in epidemiological and substance use studies. When response rates are low, survey validities are often questioned due to the risk of non-response bias, occurring when survey estimates based on respondent outcomes differ from those of the total sample that included non-respondents (Lahaut et al., 2003). The magnitude of non-response bias is defined as a function of the non-response rate and the difference between respondents and non-respondents (Biemer and Lyberg, 2003). Because data on non-respondents are usually not available, standard survey methodologies commonly recommend attaining higher response rates in order to prevent the risk of non-response bias (Alreck and Settle, 1995; Babbie, 2007; Singleton and Straits, 2005).

During the last few decades, participation rates in survey research have sharply declined (Bradburn, 1992; Galea and Tracy, 2007; Steeh, 1981; Tolonen et al., 2006; Tourangeau, 2004). In order to realize acceptable response rates and minimize the risk of non-response bias, researchers have developed time-consuming and expensive strategies in attempts to convert reluctant or hesitating participants to (late) respondents. These can be incentives, reminders, or encouraging telephone calls, etc. The use of these strategies presupposes that late respondents resemble non-respondents more than initial respondents do. Therefore, increasing response rates by converting reluctant or hesitating participants to respondents should reduce the magnitude of response bias, because the pool of respondents becomes more representative of the total sample.

However, the assumption above has been challenged by other researchers, who suggest that in circumstances where the cause of non-response is related to topic sensitivity or saliency, the relationship between response rate and non-response bias is not clear-cut (Groves, 2006; Groves and

Peytcheva, 2008). Sensitive questions are seen as intrusive, embarrassing or threatening to disclosure because they touch on topics that are socially undesirable and are thought to negatively affect non-response rates (Tourangeau and Yan, 2007). Unlike topic sensitivity, topic saliency reflects survey characteristics that are perceived by some individuals to be interesting and thus motivate participation (Groves and Peytcheva, 2008; Groves et al., 2004; Heberlein and Baumgartner, 1978). Thus, when a low response rate is due to topic sensitivity or lack of saliency, increasing response rate by the conversion of initial non-respondents to late respondents may not reduce the non-response bias. This is because late respondents (often converted only after much effort) are mostly those of the initial non-respondents that saw the topic as sufficiently salient and not too sensitive, whereas the remaining holdouts do not participate because they perceive the topic sensitivity and saliency in the opposite. Consequently, early and late respondents are more or less similar, but both differ substantially from the remaining non-respondents. Thus, survey estimates based on both early and late respondents do not change with increasing response rates, but differences between non-respondents and early or late respondents do increase.

Substance use is often considered a sensitive topic (Bradburn and Sudman, 1979; Singer, 1978). Numerous studies have examined non-response bias in substance use surveys, but have shown no clear patterns of results. Compared to respondents in some research, non-respondents reported higher use of alcohol (Goldberg et al., 2006; Heath et al., 2001; McCoy et al., 2009; Torvik et al., 2012; Wild et al., 2001; Zhao et al., 2009), cigarettes (Boström et al., 1993; Cunradi et al., 2005; Goldberg et al., 2006; Hill et al., 1997; Korkeila et al., 2001; McCoy et al., 2009; Smith and Nutbeam, 1990; Torvik et al., 2012; Woodruff et al., 2000) or cannabis (Zhao et al., 2009). In contrast, some studies showed no significant differences between non-respondents and respondents on alcohol use (Cunradi et al., 2005; Gmel, 2000; Korkeila et al., 2001; Kypri et al., 2004; Strote et

al., 2002; Trinkoff and Storr, 1997; Ullman and Newcomb, 1998), tobacco use (Strote et al., 2002; Ullman and Newcomb, 1998) or cannabis use (Ullman and Newcomb, 1998) outcomes. Regarding alcohol use, some studies have even found that non-respondents more often were abstainers (Lahaut et al., 2002; Lahaut et al., 2003; Torvik et al., 2012) and drank less than respondents (Cranford et al., 2008; Hill et al., 1997).

Inconsistencies across studies raise the issue of substance use among non-respondents. There are usually no data available to compare non-respondents with respondents, since they did not complete any questionnaires. In existing studies of non-response bias in substance use outcomes, researchers have employed three distinct methods as proxy measures for non-respondents: a) using very short questionnaires to follow-up non-respondents and comparing their answers with that of regular respondents (Boström et al., 1993; Cranford et al., 2008; Hill et al., 1997; Smith and Nutbeam, 1990; Strote et al., 2002); b) comparing early and late survey respondents (Korkeila et al., 2001; Kypri et al., 2004; Lahaut et al., 2002; Lahaut et al., 2003; Trinkoff and Storr, 1997; Ullman and Newcomb, 1998; Zhao et al., 2009); and c) comparing baseline characteristics of respondents to dropouts at subsequent follow-ups in longitudinal designs (Cunradi et al., 2005; Gmel, 2000; Goldberg et al., 2006; Heath et al., 2001; McCoy et al., 2009; Torvik et al., 2012; Wild et al., 2001).

Each of these methods has limitations. The first two approaches use late respondents as proxies for non-respondents because they assume that they would have been non-respondents had the data collection stopped earlier, or had the questionnaire not been shortened. The model underlying these approaches has been called the "continuum of resistance" (Lin and Schaeffer, 1995) and pre-supposes that all non-participants are similar to each other and that if they eventually participated in the survey, their responses would mimic those who are the most difficult to engage. These methods

consistently fail to obtain data on the most reluctant non-respondents who would very rarely participate in the survey. Studies comparing baseline characteristics of respondents to dropouts in follow-up may partly overcome this limitation. Nevertheless, initial non-respondents are missed at baseline, and dropping out at follow-up could be related to a condition that was not present at baseline (e.g. increased substance use). The present study aims at overcoming these handicaps. Over the course of one year, a near-census of young army conscripts was asked to participate in a cohort study. At the enrolment phase, a short questionnaire on substance use was distributed among them who were early (response without extra effort), late respondents (response after increased efforts, i.e. encouraging telephone calls), silent refusers (giving consent, but not participating), or non-consenters (not participating and not consenting) to the cohort study. The overall response rate for the short questionnaire was 94%. This approach allows an analysis of whether late respondents differ significantly from early respondents or silent refusers or non-consenters on the substance use outcomes they reported in the short questionnaire.

In this study two competing hypothesis were tested:

a) Late respondents are more similar to non-respondents than to early respondents, thus efforts undertaken to increase response rate can decrease the non-response bias.

b) Late respondents are more similar to early respondents than to non-respondents because only those non-respondents who perceive the topic as being least sensitive or most salient can be converted into late respondents after special efforts to increase the response rate; strategies to increase response rate would have no effect on non-response bias.

2. Methods

2.1 Enrolment Procedure, Information and Consent

The data of the present study were collected during the enrolment phase of the Cohort Study on Substance Use Risk Factors (C-SURF) at army recruitment centres in Switzerland, where military recruitment is mandatory. All males around age 20 are evaluated to determine their eligibility for military, civil or no service. There is no pre-selection for this conscription, thus a virtual census of the Swiss male population of the age is eligible for study inclusion. When conscripts reported to the recruitment centre, research staff informed them about the procedures of the cohort study and invited them to participate. All conscripts were given a written information sheet and a consent form, as well as a five-minute questionnaire containing questions on demography, alcohol, tobacco and cannabis use. No consent was needed for this part, because questionnaires were anonymous for those not consenting, and individuals were informed that they could stop answering at any time, according to the principles in the Helsinki declaration. C-SURF was approved by the Ethics Committee for Clinical Research of the Lausanne University Medical School (Protocol No. 15/07).

Within two weeks after enrolment, conscripts who gave consent were invited by mail or email to complete either a paper and pen or an online questionnaire taking approximately one hour. Questions asked about socio-demographics, family background, social and psychological functioning, and substance use of alcohol, tobacco, cannabis and other illicit drugs. In order to increase response rates, reminders were sent to those who failed to return the questionnaire within two weeks. If individuals still did not respond three weeks later, they were contacted by telephone. Encouraging telephone calls (ETC) were conducted at this stage in order to better understand the conscripts' lack of response and encourage them to pursue their involvement in the study. ETC aimed at getting in direct person-to-person contact with by means of basic communication tools partially inspired from motivational interviewing techniques (Miller and Rose, 2009). One of the centres involved in the study (the Alcohol Treatment Centre in Lausanne) has particular strengths in

providing brief motivational interviewing (Bertholet et al., 2010; Gaume et al., 2013; Gmel et al., 2013), and experts in motivational interviewing performed the training of staff. Training was focused on avoiding a confrontational style and on using open-ended questions to get potential participants involved in reflections on their participation instead of provoking simple "yes" or "no" answers that may have led to abrupt rejection of further participation. Thus, the interview was conducted in a form to renew or increase their initial motivation for study participation and compliance. The present study compares non-consenters, silent refusers, and early respondents (before ETC) to late respondents (after ETC) on the substance use and socio-demographic measures gathered with the short five-minute questionnaire, which was completed as a paper and pencil questionnaire already in the recruitment centres. Thus, although there may be mode effects with the long baseline questionnaire (telephone, paper-pencil, or online) the data of the present study are not influenced by mode effects as for the short five-minute questionnaire only one single mode (paper-pencil) was used.

2.2 Setting and Participants

Enrolment took place weekly between August 23, 2010 and July 31, 2011, in two of six army recruitment centres located in (French-speaking) Lausanne and (German-speaking) Windisch. These two centres service 15 of 26 cantons in Switzerland, encompassing all French-speaking cantons.

There were 7,011 French-speaking males reporting to the Lausanne recruitment centre. Among them, 627 (8.9 %) were never seen by the research staff because they were either ill or were randomly selected to participate in another study (CH-X; Mohler-Kuo et al., 2006). These dropouts were random and should not have influenced our findings. Of the 6,384 (91.1%) informed conscripts, 4,430 (69.4 %) gave written consent to participate in the cohort study and 1,954 (30.6 %)

declined. Among the 4,430 consenters, 2,197 (49.6%) responded before ETC began (early respondents), 1,123 (25.3%) after ETC (late respondents), and 1,110 (25.1%) did not complete the cohort study questionnaire (silent refusers). Thus, 74.9% of the French-speaking consenters ultimately participated. Whether consenting or not, 6,099 (95.5%) of the 6,384 informed conscripts completed the short questionnaire.

There were 7,382 German-speaking males attending the Windisch recruitment centre. Among them, 1,202 (16.3 %) were never seen by the research staff because they were ill or not informed of the study by the military staff due to administrative procedures. These dropouts were unrelated to the study. Of the 6,180 (83.7%) informed conscripts, 2,604 (42.1%) gave written consent to participate in C-SURF and 3,576 (57.9 %) declined. Among the consenters, 1,529 (58.7%) responded before ETC (early respondents), 612 (23.5%) after ETC (late respondents), and 463 (17.8%) did not fill out the cohort questionnaire (silent refusers). Thus, 82.2% of the German-speaking consenters ultimately participated. Whether consenting or not, 5,720 (92.5%) of the 6,180 conscripts completed the short questionnaire**.**

2.3 Measures

Alcohol use. Three questions assessed alcohol use: usual quantity and frequency, plus frequency of risky single occasion drinking (RSOD), defined as occasions with at least six standard drinks. Drinking frequency was evaluated with an open-ended question about the average number of days per week on which alcohol was usually consumed. Choices for non-weekly users were "2-3 times a month" (coded 38/52), "once a month or less" (coded 6/52), or "never" (coded 0). Quantity was assessed with an open-ended question for number of standard drinks on drinking days. Pictures of standard drinks containing approximately 10-12 grams of pure alcohol were provided. Number of

drinking days per week times usual number of drinks on drinking days yielded weekly volume. Drinking status differentiated between abstainers and drinkers. At-risk volume drinking was defined as 21 or more drinks per week, while at-risk for RSOD was defined as having these occasions at least monthly.

Tobacco use. Participants were asked how often they smoked or whether they were former or never smokers. Smoking status differentiated between non-smokers and occasional or daily smokers. At-risk smoking was defined as daily smoking.

Cannabis use. Frequency of cannabis use in the past 12 months was measured with categories of "never", "once a month or less often", "2-4 times a month", "2-3 times a week", and "4 times or more often a week". Cannabis use status differentiated between non-users and users. At-risk cannabis was defined as at least twice a week.

Covariates. Highest completed education contained three categories of schooling: primary (9 years), secondary (about 12 years), and tertiary (13 years or more). Urbanicity distinguished between those living in urban (more than 10,000 inhabitants) or rural (less than 10,000 inhabitants) areas.

2.4 Statistical analyses

Differences in substance use outcomes for early and late respondents, silent refusers and non-consenters were analysed using cross-tabulations and chi-square tests. Early respondents, silent refusers and non-consenters were compared to late respondents on substance use outcomes using logistic regressions, both unadjusted and adjusted for the two covariates listed above. Differences

between silent refusers and non-consenters were also tested with logistic regressions. Finally, prevalence of substance use outcomes and corresponding relative non-response bias was computed for the total population of early and late respondents, silent refusers and non-consenters, for early respondents only, for respondents only (both early and late) and for consenters (respondents and silent refusers). Relative non-response bias was defined as:

$$Relative\ bias = \left(\frac{N_{nr}}{N_{tot}} \times (\overline{Y}_{nr} - \overline{Y}_r) \right) \div \overline{Y}_{tot},$$ where $\frac{N_{nr}}{N_{tot}}$ is the non-response rate, $(\overline{Y}_{nr} - \overline{Y}_r)$ is the

difference in means between respondents and non-respondents, and $\overline{Y}_{tot}$ is the total mean of respondents and non-respondents.

3. Results

Descriptive statistics of all substance use outcomes and covariates for early and late respondents, as well as silent refusers and non-consenters are presented in Table 1. Significant differences were found between types of respondents/non-respondents in the distribution of all substance use outcomes and covariates in both French- and German-speaking individuals. Generally, early respondents reported the lowest prevalence of substance use and at-risk substance use, followed by late respondents. This was true for at-risk drinking volume, at-risk RSOD, smoking status, at-risk smoking and at-risk cannabis use in both French- and German-speaking individuals and for cannabis use in French-speaking individuals. In German-speaking individuals, the lowest prevalence of cannabis use was among early respondents, followed by non-consenters. For drinking status, a different pattern emerged: In the French-speaking region, the lowest prevalence of drinkers was among non-consenters followed by early respondents, whereas in German-speaking region, it was found in non-consenters and silent refusers.

The highest prevalence of substance use was among silent refusers, followed by non-consenters for at-risk RSOD, smoking status and at-risk cannabis use in both linguistic regions, and for cannabis use status (French-speaking only) and at-risk smoking (German-speaking only). The highest prevalence of at-risk drinking volume of alcohol and at-risk smoking (French-speaking only) was found in non-consenters, followed by silent refusers. For drinking status, the highest proportion of alcohol users was found in both French- and German-speaking late respondents.

Prevalence rates among late respondents only were commonly closer to rates in the total sample than they were for early respondents only, silent refusers only and non-consenters only. This was true for at-risk volume drinking and cannabis use status in the French-speaking region, and for at-risk RSOD, smoking status and at-risk smoking, and at-risk cannabis use in both linguistic regions.

Insert Table 1 about here.

Results of logistic regressions are presented in Tables 2 and 3. Early respondents were less often users or at-risk for substance use than late respondents in both linguistic regions (although not significant for at-risk volume drinking and at-risk cannabis use among German-speaking individuals). In contrast, compared to late respondents silent refusers (exception for drinking status) and non-consenters (exception for drinking status in both linguistic region and for cannabis use status in German-speaking region) were generally more often substance users than were late respondents, though not all of these comparisons were significant. There were significant differences in drinking status among German-speaking silent refusers, and among non-consenters in both linguistic regions (due to fewer abstainers than there were among late respondents). For smoking status in both linguistic regions, cannabis use status and at-risk cannabis use (in the

French-speaking region only), silent refusers were significantly less often non-smokers, cannabis non-users and more often at-risk for cannabis use than were late respondents. In the French-speaking region, non-consenters were significantly more often at-risk for smoking than late respondents. Adjusting for covariates did not substantively change these results. Comparing non-consenters to silent refusers, there were significant differences in smoking and cannabis use status, with a higher proportion of non-users among non-consenters than among silent refusers. There were no significant differences for the remaining substance use outcomes.

Insert Tables 2 and 3 about here.

In Table 4, the prevalence of substance use outcomes and corresponding relative non-response bias within each linguistic region are presented separately for the total population (early respondents, late respondents, silent refusers, and non-consenters), as well as for early respondents only, for early and late respondents only, and for consenters (early and late respondents and silent refusers) only.

Insert Table 4 about here.

With the exception of drinking status, the relative non-response bias decreases as the participation rate increases, with the smallest bias found when the participation rate is highest (i.e. when early, late, and silent refuser respondents are combined). Looking at early and late respondents only, there are important relative non-response biases above 10% for drinking status (German-speaking only), at-risk volume drinking, smoking status and at-risk cannabis use (both linguistic regions). When prevalence was based on early and late respondents and silent refusers, relative non-response bias fell below 10% for all substance outcomes (excluding at-risk volume drinking) in the French-

speaking sample, where the participation rate was high. In contrast, within the German-speaking sample where the participation rate was lower, relative biases remained important (>10%) for drinking status, at-risk volume drinking and at-risk cannabis use.

4. Discussion

The aim of the present study was to examine whether late respondents (i.e. non-respondents subsequently converted to respondents) in a cohort study differ significantly from early respondents, silent refusers or initial non-respondents on substance use outcomes. Many researchers in substance use consider late respondents (or follow-ups of non-respondents) to be proxies for non-respondents; however, they consistently fail to obtain data on persistent non-respondents. One unique advantage of the present study is that 94% of the informed subject pool completed a short substance use questionnaire regardless of any subsequent participation in the larger cohort study. This approach allowed us to compare the substance use outcomes of late respondents to nearly all persistent non-respondents (silent refusers and non-consenters), and to compare outcomes between our early and late respondents to those found in the existing literature.

We stated two competing hypotheses: 1) late respondents would be more similar to non-respondents than to early respondents; therefore, efforts to increase response rates would decrease non-response bias; and 2) late respondents would be more similar to early than to non-respondents, because only those non-respondents perceiving the topic as most salient or least sensitive would be converted to late respondents. Strategies to increase response rates would thus have little or no effect on non-response bias.

Our results show that early respondents generally were more often abstainers and used lesser amounts of substances than did late respondents. Similar findings have been obtained in prior studies that compared early to late respondents (e.g., Korkeila et al., 2001; Zhao et al., 2009) or respondents to follow-ups of non-respondents (e.g., Boström et al., 1993; Smith and Nutbeam, 1990). Consistent with the propositions of several authors (e.g., Alreck and Settle, 1995; Babbie, 2007; Singleton and Straits, 2005) who point out the importance of achieving high response rates to deal with the issue of non-response in survey research, our findings offer partial support for our first hypothesis and suggest that setting up strategies such as ETC to increase participation rates is an efficient way of reducing survey non-response bias.

Although they differed from early respondents, late respondents were not similar to non-respondents. They were generally less likely to be substance users or heavy users, than were non-respondents. There is one exception as regards alcohol use, where late respondents were less often abstainers although they were also more often heavy drinker. Thus, late respondents do not appear to be representative of the pool of non-respondents. This finding do not provide strong support for our first hypothesis but rather lends partial support to our second hypothesis pointing out that sensitivity or lack of saliency (in the case of alcohol abstainers) of substance use questions (Bradburn and Sudman, 1979; Singer, 1978) may lead to non-responding (see Groves, 2006). On the one hand, heavy users may perceive substance use questions as more intrusive or embarrassing than do moderate or non-users, therefore making them more likely to decline participating. In this sense, even when great efforts are made to increase response rates, the heaviest users would still be less likely to participate. On the other hand, the finding that late respondents were more often drinkers indicates that encouraging telephone calls may not be sufficient to raise saliency among abstainers, but only convince individuals for whom the topic is already salient enough.

In sum, our results neither fully support nor reject our hypotheses, because late respondents are not similar to early or to non-respondents. Instead, these results support the idea that late respondents recruited with much effort lie somewhere between the two. This suggests that using late respondents as proxies of non-respondents is a valuable method for evaluating the potential for non-response bias, but may underestimate the magnitude of actual non-response bias, because non-respondents are heavier substance users compared to late respondents.

Regarding relative non-response bias, findings demonstrate that the addition of late respondents to the pool of respondents greatly reduced the magnitude of the bias. Nevertheless, this is not sufficient to free survey estimates from the risk of non-response bias, because for several of our substance use outcomes, relative non-response bias remained above 10%. Adding silent refusers to the pool of respondents causes relative bias to fall below 10% for nearly all outcomes in the French-speaking sample (with the exception of at-risk volume drinking). Reductions in non-response bias were also found in the German-speaking sample, where overall response rates were lower, even though important bias (i.e. for drinking status, at-risk volume drinking and at-risk cannabis use) remained above 10%. A side note to the present study is that non-consenters could be compared with consenters that did not eventually participate (silent refusers). Although there were no consistent patterns of differences between non-consenters and silent refusers, both of these groups clearly increased non-response bias. The impact of silent refusers might be mitigated if study participation could begin immediately upon gaining consent. Due to organizational reasons within the army recruitment centres of the present study, consent could be obtained in the centres, but baseline assessments had to be done at a later date. This allowed time for conscripts to avoid participating, even though originally consenting.

One limitation of the present study is that not many variables were available in addition to substance use to explain differences between early and late respondents and non-respondents, because a very short questionnaire was used to maximize response rates of all later cohort participants and non-participants. This study was also restricted to young male conscripts only; therefore, results cannot be generalized to both sexes or to older age groups. Moreover, the response rate to the short questionnaire was high (approximately 94%), but was not perfect. If the remaining six per cent were the heaviest substance users (as thought), the true magnitude of differences between non-respondents and respondents may still have been underestimated.

It is still possible to draw some conclusions from our findings. Late respondents converted to respondents by the use of special efforts (such as ETC) differ from both early and non-respondents. The use of strategies to increase response rates substantively decreases the risk of non-response bias.

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Table 1. Descriptive statistics of substance use outcomes and covariates as a function of type of respondent/non-respondent

| | French-speaking | | | | | | German-speaking | | | | | |
	Total n(%)	Early respondents	Late respondents	Silent refusers	Non-consenters	P-value	Total n(%)	Early respondents	Late respondents	Silent refusesr	Non-consenters	P-value
n	6099	2196	1123	1110	1670		5720	1528	610	460	3122	
Education												
primary	2976(48.8)	47.8%	49.8%	48.9%	49.3%	<.001	4252(74.3)	75.5%	77.4%	73.0%	73.4%	<.001
secondary	1551(25.4)	21.1%	26.1%	31.3%	26.8%		973(17.0)	12.8%	14.6%	20.7%	19.0%	
tertiary and higher	1572(25.8)	31.1%	24.1%	19.8%	23.8%		495(8.7)	11.7%	8.0%	6.3%	7.6%	
Urbanicity												
> 10000	3063(50.2)	48.7%	48.0%	54.7%	50.7%	.004	1799(31.5)	31.7%	28.4%	36.7%	31.2%	.032
< 10000	3036(49.8)	51.3%	52.0%	45.3%	49.3%		3921(68.5)	68.3%	71.6%	63.3%	68.8%	
Drinking status												
no	691(11.3)	12.2%	9.2%	10.2%	12.5%	.016	422(7.4)	7.0%	4.6%	8.0%	8.0%	.025
yes	5408(88.7)	87.8%	90.8%	89.8%	87.5%		5298(92.6)	93.0%	95.4%	92.0%	92.0%	
Not at risk volume drinking[a]	5010(92.6)	95.0%	92.7%	91.0%	90.6%	<.001	4957(93.6)	95.7%	94.5%	94.1%	92.2%	<.001
At risk volume drinking[a]	398(7.4)	5.0%	7.3%	9.0%	9.4%		341(6.4)	4.3%	5.5%	5.9%	7.8%	
Not at risk RSOD[a]	2763(51.1)	55.1%	49.8%	46.7%	49.7%	<.001	2866(54.1)	59.0%	53.3%	48.7%	52.6%	<.001
At risk RSOD[a]	2645(48.9)	44.9%	50.2%	53.3%	50.3%		2432(45.9)	41.0%	46.7%	51.3%	47.4%	
Smoking status						<.001						
No	3487(57.2)	67.3%	55.7%	45.0%	52.9%		3078(53.8)	66.1%	52.6%	38.5%	50.3%	<.001
Yes	2612(42.8)	32.7%	44.3%	55.0%	47.1%		2642(46.2)	33.9%	47.4%	61.5%	49.7%	
Not at risk smoking[b]	702(26.9)	35.0%	27.6%	23.2%	21.9%	<.001	872(33.0)	41.9%	32.9%	25.8%	31.4%	<.001
At risk smoking[b]	1910(73.1)	65.0%	72.4%	76.8%	78.1%		1770(67.0)	58.1%	67.1%	74.2%	68.6%	
Cannabis use status						<.001						<.001
No	3765(61.7)	66.2%	62.1%	55.2%	59.9%		3759(65.7)	69.4%	62.6%	58.5%	65.6%	
Yes	2334(38.3)	33.8%	37.9%	44.8%	40.1%		1961(34.3)	30.6%	37.4%	41.5%	34.4%	
Not at risk cannabis use[c]	1488(63.8)	73.5%	64.1%	55.9%	58.6%	<.001	1361(69.4)	77.6%	71.9%	65.4%	66.0%	<.001
At risk cannabis use[c]	846(36.2)	26.5%	35.9%	44.1%	41.4%		600(30.6)	22.4%	28.1%	34.6%	34.0%	

Note. [a]Among drinkers. [b]Among smokers. [c]Among cannabis users.

Table 2. Unadjusted and adjusted logistic regression models for alcohol use outcomes on type of respondent/non-respondent

	Unadjusted			Adjusted[b]		
	OR	95% CI	p	OR	95% CI	p
Drinking status (abstainers = 1)						
French-speaking						
Early respondents	1.37	1.07-1.74	.010	1.40	1.10-1.78	.006
Late respondents	1.00			1.00		
Silent refusers	1.12	0.84-1.48	.420	1.06	0.79-1.40	.688
Non-consenters	1.41	1.09-1.80	.007	1.39	1.07-1.78	.011
German-speaking						
Early respondents	1.57	1.02-2.39	.040	1.57	1.02-2.41	.037
Late respondents	1.00			1.00		
Silent refusers	1.82	1.09-3.01	.021	1.76	1.05-2.91	.029
Non-consenters	1.81	1.21-2.70	.004	1.78	1.19-2.65	.005
At risk RSOD[a]						
French-speaking						
Early respondents	0.81	0.69-0.94	.007	0.81	0.69-0.94	.008
Late respondents	1.00			1.00		
Silent refusers	1.13	0.94-1.34	.169	1.15	0.96-1.37	.121
Non-consenters	1.00	0.85-1.17	.970	1.01	0.85-1.18	.912
German-speaking						
Early respondents	0.79	0.65-0.96	.018	0.79	0.65-0.96	.018
Late respondents	1.00			1.00		
Silent refusers	1.20	0.93-1.54	.153	1.21	0.93-1.55	.142
Non-consenters	1.03	0.85-1.22	.773	1.03	0.86-1.23	.749
At risk volume drinking[a]						
French-speaking						
Early respondents	0.67	0.48-0.91	.012	0.69	0.50-0.94	.023
Late respondents	1.00			1.00		
Silent refusers	1.27	0.92-1.74	.146	1.26	0.90-1.73	.166
Non-consenters	1.33	0.99-1.78	.056	1.34	0.99-1.79	.053
German-speaking						
Early respondents	0.77	0.49-1.19	.246	0.78	0.49-1.20	.257
Late respondents	1.00			1.00		
Silent refusers	1.08	0.62-1.85	.781	1.06	0.62-1.82	.819
Non-consenters	1.45	0.98-2.11	.058	1.44	0.97-2.10	.064

Note. None of the silent refusers (reference) vs. non-consenters comparisons reached significance.
[a]Among drinkers. [b]Adjusted for urbanicity and education.

Table 3. Unadjusted and adjusted logistic regression models for smoking and cannabis use outcomes on type of respondent/non-respondent

	Unadjusted			Adjusted[g]		
	OR	95% CI	p	OR	95% CI	p
Smoking status (nonsmoker = 1)						
French-speaking						
Early respondents	1.63	1.40-1.89	.000	1.60	1.37-1.85	.000
Late respondents	1.00			1.00		
Silent refusers	0.65[a]	0.54-0.76	.000	0.66	0.56-0.78	.000
Non-consenters	0.89[a]	0.76-1.03	.144	0.90	0.76-1.04	.159
German-speaking						
Early respondents	1.76	1.45-2.12	.000	1.74	1.43-2.10	.000
Late respondents	1.00			1.00		
Silent refusers	0.56[b]	0.44-0.72	.000	0.57	0.44-0.73	.000
Non-consenters	0.91[b]	0.76-1.08	.292	0.91	0.76-1.08	.313
At risk smoking[e]						
French-speaking						
Early respondents	0.71	0.55-0.90	.007	0.73	0.56-0.93	.014
Late respondents	1.00			1.00		
Silent refusers	1.26	0.95-1.64	.099	1.21	0.92-1.59	.168
Non-consenters	1.36	1.04-1.76	.021	1.36	1.04-1.76	.023
German-speaking						
Early respondents	0.68	0.50-0.91	.012	0.69	0.50-0.92	.014
Late respondents	1.00			1.00		
Silent refusers	1.41	0.98-2.02	.064	1.36	0.94-1.95	.096
Non-consenters	1.07	0.81-1.39	.616	1.05	0.80-1.37	.705
Cannabis use status (nonusers = 1)						
French-speaking						
Early respondents	1.20	1.03-1.39	.018	1.22	1.04-1.41	.010
Late respondents	1.00			1.00		
Silent refusers	0.75[c]	0.63-0.89	.001	0.75	0.63-0.89	.001
Non-consenters	0.91[c]	0.78-1.06	.259	0.92	0.78-1.07	.273
German-speaking						
Early respondents	1.35	1.11-1.64	.003	1.38	1.13-1.68	.001
Late respondents	1.00			1.00		
Silent refusers	0.84[d]	0.65-1.07	.169	0.84	0.65-1.08	.184
Non-consenters	1.14[d]	0.95-1.36	.159	1.13	0.94-1.35	.178
At risk cannabis use[f]						
French-speaking						
Early respondents	0.64	0.49-0.83	.001	0.67	0.51-0.86	.003
Late respondents	1.00			1.00		
Silent refusers	1.41	1.07-1.83	.012	1.38	1.05-1.79	.019
Non-consenters	1.26	0.98-1.62	.070	1.28	0.99-1.64	.058
German-speaking						
Early respondents	0.74	0.51-1.06	.104	0.75	0.52-1.07	.119
Late respondents	1.00			1.00		
Silent refusers	1.35	0.89-2.04	.154	1.30	0.85-1.97	.212
Non-consenters	1.32	0.96-1.80	.085	1.30	0.95-1.78	.100

Note. Significant differences for unadjusted models between silent refusers (reference) and non-consenters: [a]OR = 1.37, 95% CI [1.18-1.60], p < .001; [b]OR = 1.61, 95% CI [1.32-1.97], p < .001; [c]OR = 1.21, 95% CI [1.04-1.41], p = .014; [d]OR = 1.35, 95% CI [1.10-1.65], p = .003. [e]Among smokers. [f]Among cannabis users. [g]Adjusted for urbanicity and education.

Table 4. Prevalence of substance use outcomes and corresponding non-response bias based on total sample, early respondents, early and late respondents, respondents and silent refusers, for French- and German speaking individuals

	French-speaking				German-speaking			
	Total	Early respondents	Early and late respondents	Early, late respondents and silent refusers	Total	Early respondents	Early and late respondents	Early, late respondents and silent refusers
Participation rate		34.41%	52.00%	69.39%		24.74%	34.64%	42.13%
Drinking status (%abstainer)								
Prevalence	11.33%	12.16%	11.15%	10.91%	7.38%	7.00%	6.31%	6.62%
Relative bias		-7.31%	1.60%	3.75%		5.08%	14.41%	10.26%
At risk volume drinking[a]								
Prevalence	7.36%	4.98%	5.76%	6.59%	6.44%	4.29%	4.64%	4.86%
Relative bias		32.38%	21.67%	10.47%		33.30%	27.86%	24.43%
At risk RSOD[a]								
Prevalence	48.91%	44.95%	46.76%	48.40%	45.90%	40.96%	42.64%	44.15%
Relative bias		8.10%	4.39%	1.03%		10.78%	7.12%	3.83%
Smoking status (%non-user)								
Prevalence	57.17%	67.30%	63.39%	58.77%	53.81%	66.10%	62.25%	58.04%
Relative bias		-17.72%	-10.88%	-2.80%		-22.84%	-15.69%	-7.87%
At risk smoking[b]								
Prevalence	73.12%	65.04%	68.07%	70.97%	66.99%	58.11%	61.34%	64.68%
Relative bias		11.05%	6.92%	2.94%		13.26%	8.44%	3.46%
Cannabis use status (%non-user)								
Prevalence	61.73%	66.21%	64.81%	62.41%	65.72%	69.37%	67.45%	65.86%
Relative bias		-7.26%	-4.98%	-1.09%		-5.56%	-2.63%	-0.22%
At risk cannabis use[c]								
Prevalence	36.25%	26.55%	29.97%	34.17%	30.60%	22.44%	24.28%	26.49%
Relative bias		26.75%	17.33%	5.72%		26.67%	20.64%	13.41%

Note. [a]Among drinkers. [b]Among smokers. [c]Among cannabis users.