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ORIGINAL ARTICLE

Comparing direct, network scale-up, and proxy respondent methods in estimating risky behaviors among collegians

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Abstract

Background and aim: Various methods of estimating the size of hidden populations are prone to different degrees of information biases. This study aimed to assess such biases.
Methods: We estimated the prevalence of risky behaviors using direct, modified network scale-up (NSU) and proxy respondent method (PRM) among college students.
Results: The network sizes of the male and female students were 25.8 and 29.5. We found alcohol use was the most prevalent risky behaviors among males (PRM: 18.12%, NSU: 8.68%, direct: 13.4%) and the extra-marital sex was the most prevalent one among females (PRM: 3.47%, NSU: 0.95%, direct: 1.4%). Based on PRM, intravenous drug use (IDU) was the least prevalent behavior among college students.
Conclusion: We concluded that direct and NSU methods might underestimate the results.

Keywords

Risky behaviors, network scale-up, proxy respondent

History

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Introduction

Risky behaviors such as drug abuse, alcohol use, and extra-marital sex (EMS) are activities which may disrupt development or lead to morbidity or mortality (de Guzman & Bosch, 2007) and are responsible for 8, 5, and 2% of the global DALYs (Disability Adjusted Life Years), respectively, among the 15–24 age groups (Gore et al., 2011).

The overall community health depends on controlling risky behaviors among the young population (WHO, 2013). Therefore, the size estimation of such subgroups is key information to planning, monitoring, and evaluation of the prevention programs and could be a priority for health policy-makers across the globe. This is more highlighted in Muslim countries due to the social and cultural stigma attached to such risky behaviors.

Several studies have been conducted to estimate the size of risky behaviors among different populations. Some of these studies reported different estimates of risky behaviors among university students (Akvardar et al., 2003; Golbasi & Kelleci, 2011; Hanson et al., 2008). In studies conducted in some Iranian universities, the reported prevalence ranged from 5.8% to 17.4% for alcohol users (Ahmadi et al., 2004; Homa et al., 2009; Jodati et al., 2007), and 8.5% to 21% for opium users (Ahmadi et al., 2004; Ghanizadeh, 2001). In addition, the EMS prevalence in 15–18 years age group was reported as of 28% in Tehran (Mohammad et al., 2007).

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It seems that the direct methods of size estimation may lead to underestimation of the sizes of populations with risky behaviors, due to under-reporting of some stigmatized behaviors (Bernard et al., 2010; Hickman et al., 2002; UNAIDS/IMPACT/FHI, 2003). As mentioned earlier, the social stigma of risky behaviors is more prominent in Islamic countries compare to other places. Because of such information biases, the direct methods is expected to underestimate the frequency of these risky behaviors (Hasnain, 2005).

Because of the direct methods limitations, researchers have focused on indirect methods to estimate the population size of the high-risk groups. Network scale-up (NSU) and proxy respondent method (PRM) are two such indirect techniques (Hickman et al., 2002; UN Office on Drugs and Crime, 2003), which we used in our study to cross-validate their findings.

NSU is a relatively new indirect method that does not need to access population with risky behaviors; also, it can estimate the size of different groups within a study and generalize the results to the target population (Shokoohi et al., 2012). The assumption is that the social network participants from a random sample (respondents) can represent the studied population (McCarty et al., 2001; Rwanda Biomedical Center, 2012).

PRM is another indirect method for estimating the size of the high-risk groups without the need to estimate the size of the social network. In this method, a random sample of respondents (proxy respondents) are asked about the behaviors of a selected group of persons (alters) they know. The assumption is that the random sample of the selected respondents and alters will form a representative sample of the community (McCarty et al., 2001).

All methods particularly the direct and the NSU methods are seemed to be prone to some information biases due to stigma. The results of the direct method, may be underestimated because of the response (prestige) bias (respondents may fail or reluctant to report accurately about their own or their acquaintances). The NSU method, has both prestige bias and information transmission bias (respondent might not be aware of such behaviors among his/her acquaintances in the network) leading to underestimation. In PRM, on the other hand, each respondent reports the behavior of his/her near acquaintance; therefore, such biases are expected to have less influence on the results.

We have found few studies that compared the results of these three methods within a group to cross-validate their findings. Therefore, we conducted a study among college students in order to evaluate the comparability of the results obtained by these methods.

Methods

This study was conducted in Kerman University of Medical Sciences (KUMS), one of the large medical universities in south-east of Iran, training students in almost all medical fields, with more than 4000 students.

We recruited students who had studied at least 1 year in KUMS. A random sample of 500 students was selected from different faculties proportional to their sizes using a stratified sampling scheme.

Most of the samples were approached in the classes, with the permission of each faculty's department of education. A trained person explained the objectives of the study, and encouraged students to answer the questions with the highest accuracy. He particularly explained the concept of ''to know'' based on the guideline that, ''any student who studies at KUMS, you know his/her by name and face; and who also knows you by name and face; and you spend at least 2 h/week together inside or outside of the campus''. The students were asked to answer the questions separately.

The questionnaire had four parts: demographic questions, questions attributed to the NSU method, questions attributed to the PRM and direct questions about their behaviors. Because of the complexity of questions and methods, these four parts were distributed separately.

The frequencies of four risky behaviors were investigated: alcohol use (since consuming alcohol is prohibited in Iran, therefore, use of alcohol is categorized as a risky behavior), opium abuse, EMS and drug abuse (hashish[1], heroin, and intravenous drug use [IDU[2]]).

Modified NSU method

We asked students to count the number of members of the same sex in their personal networks (c_i) (Although boys and girls are mixed in classes, their interactions are limited because of the cultural and religious norms. Therefore, their social networks are basically from their own sex). We then asked them to find out, how many people in their networks had one of the four risky behaviors (m_i) at least once in last year. The size of each sub-population(e_j) was estimated based on the number of known subjects in the network of each respondents using the following formula:

$$e_j = t \times m_j / C$$

where t is the total students of KUMS, m_j is the average of m_{ij}, i stands for a respondent, j stands for a high-risk sub-population, and c is the average of c_i.

PRM

We selected 30 girl's names and 30 boy's names with unique spelling and a frequency of at least 0.5% in the general population of Iran. Names were distributed on six cards for boys and six cards for girls. Male respondents were asked to select one of the cards with male names and similarly females were asked to select a card with female names. They were then asked to identify one person in their college networks who has the same name written on their selected cards. After that, the respondents were asked to write if the identified individuals had any of our defined risky behaviors. In this process, respondents were asked to identify the closest person with one of the selected names in his or her social network.

In PRM, the frequency of risky behaviors among alters were used as an estimate for the frequency of those behaviors among college students.

At the end, we asked participants direct questions about their own risky behaviors. Answer to all parts of the questionnaires was optional and participants had a choice to quit the task at any time.

Statistical analysis

In the final step, we cross-validated the results of these three methods. Since, PRM may has the minimum information bias; we used its estimations as the most accurate figures, to compare them with the results of the direct and NSU methods, classified by gender. We would consider the ratio of these estimations (direct and NSU versus PRM) as correction factors that might help us to calibrate the results of direct questioning and NSU method.

All statistical analyses were performed using Microsoft Office Excel 2007.

Results

Excluding the responses of those with many missing or un-expected values, we were able to analyze the data obtained from 420 students (final response rate 84%). The mean (standard deviation) age of these respondents was 21.9 (2.7) years; 62.7% were females. About 86.9% of the students were single, and 69.3% were accommodated in dormitories. Most of them (88.4%) had studied at least 3 years in KUMS.

The estimated C for the male and female students was 25.8 and 29.5, respectively.

Estimating the prevalence of the risky behaviors

Females

The prevalence of risky behaviors varied from 0 for Hashish, Heroin consumption and IDU, to 0.95% for EMS based on the NSU method.

[1]A cannabis product.
[2]Intravenous Drug Use.

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Table 1. Estimated prevalence for risky behaviors of KUMS students using different methods.

		Prevalence (%) correction factors					
Behavior	Gender	PRM[a]	NSU[b]	Direct	PRM: m versus f[c]	NSU versus PRM	Direct versus prm
Alcohol	Female	2.32	0.44	2.23	7.82	0.19	0.96
	Male	18.12	8.68	13.4		0.48	0.74
Opium	Female	1.16	0.07	1.64	8.11	0.06	1.41
	Male	9.39	3.02	5.13		0.32	0.54
Hashish	Female	0.77	0		2.61	0	
	Male	2.01	0.17			0.09	
Heroin	Female	0.38	0		5.21	0	
	Male	2.01	0.17			0.09	
IDU[d]	Female	0.39	0		1.74	0	
	Male	0.67	0.23			0.35	
EMS	Female	3.47	0.95	1.4	3.86	0.27	0.40
	Male	13.42	7.48	10.32		0.56	0.77

[a]Proxy Respondent Method.
[b]Network scale-up.
[c]Male versus female ratio of the PRM estimates.
[d]Intravenous drug use.

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In PRM, the percentages were 0.4% and 3.5% for Heroin use and EMS, respectively.

Direct method showed various estimates from 1.4% for EMS to 2.2% for alcohol use (Table 1).

The lowest and the highest ratios of NSU versus PRM estimates were 0 and 0.3 for drugs and EMS, respectively. Corresponding figures for the ratio of direct versus PRM estimates were 0.4 and 1.4 for EMS and opium consumption, respectively (Table 1).

Males

Using NSU method, the prevalence of risky behaviors was estimated between 0.2% for Hashish and Heroin and 8.7% for alcohol use. The PRM and the direct methods showed these prevalence as of, 0.7% (IDU), 18.1% (alcohol use), and also 5.1% (opium) and 13.4% (alcohol use), respectively. The NSU versus PRM estimates ratios ranged from 0.1 for drug consumption to 0.6 for EMS. On the other hand, the direct versus PRM estimates ratios varied between 0.5 and 0.8 in opium consumption and EMS, respectively (Table 1).

Male versus female estimates ratio

The ratio of alcohol users among males versus females was 19.7, 7.8, and 6.0 based on the estimates (results) of NSU, PRM, and the direct methods, respectively. The corresponding figures for opium consumption were 44.6, 8.1, and 3.1, respectively. These ratios were also 7.9, 3.9, and 7.4 for EMS, respectively.

Discussion

We found that the frequency of alcohol use and EMS were higher than the other risky behaviors, using these methods. Moreover, we found lower estimations by the NSU and the direct methods compare to the PRM; these differences were more prominent particularly among females, and when the NSU method is used.

The estimated *C* for males and females were 25.8 and 29.5, respectively. This indicates that every male and female student in KUMS on the average has about 26 and 29 KUMS students in his or her social network from the same sex implying that on the average, each female student knew 3.8 more females compare to the number of males that a male student knew in the collage. As we might have expected, it was much lower than the estimated *C* for the whole community in Iranian population which was 303 (Shokoohi et al., 2010). This could be because of different definitions used for ''to know'' in these two studies. In our study, we explored only the network size of students on the campus and of their own sex.

We have shown that the alcohol use and EMS were the most common risky behaviors among students. Similar to our results, Shokoohi et al. (2012), in one of the first size estimation studies among the Iranian population using NSU method, reported that the alcohol use (6.8%), EMS (4.7%), and also opium consumption (3%) had the highest frequencies among Kermanian males. It should be mentioned that previous studies had been designed for general population and may not be compared with our college-based study.

We had maximum estimations in the PRM when compared with the other two methods. The ratios of NSU versus PRM estimations in all behaviors, and in both genders were less than one. These findings may show that PRM is less prone to information bias; because in this method, the respondents were asked to recall the behaviors of only the known alters whose names were shown on their selected cards without disclosing the alters' identities. However, in NSU method, they have to look for, recall and count the exact number of individuals with risky behaviors within their networks. Therefore, the phenomenon of under-reporting in NSU due to the transmission error might be more prominent. Another information bias might occur due to prestige bias, but with lower degree. The lowest NSU versus PRM estimate ratios in both genders were for the consumption of opium and its derivatives, indicating more underestimation of the size of subpopulations with the least common behaviors by the NSU technique. Conversely, we observed the highest ratios in the most common behaviors such as alcohol use and EMS. This further indicates that the NSU method poorly underestimates the size of hidden populations with common behaviors.

These behaviors might have more social visibility in both genders; and may be less affected by recall bias and transmission error.

For such a bias in NSU estimations, it is recommended that the results of these studies to be adjusted. We considered the NSU versus PRM estimates ratio as a correction factor indicating the visibility of the behaviors and hence, the degree of transmission error and prestige bias.

As expected, the visibility coefficients were smaller for hidden behaviors among females. Our findings showed that the visibility of EMS in males and females were 0.56 and 0.27. While, these coefficients for alcohol use, opium consumption, and IDU were 0.48, 0.19, 0.32 among males; 0.06, 0.35, and 0 among females. This could be explained by more bias in recalling the female behaviors due to their more hidden networks and more degree of prestige bias caused by stigma in the females behaviors compared to males. Therefore, it seems that without corrections, the results of NSU underestimate the frequency of risky behaviors even in college students who are a well-educated group to understand the concepts of this methodology better than the general population.

Direct versus PRM might be an indicator of prestige bias, means people may deny their behaviors even if they know their personal information is masked. The lowest ratio of the direct versus PRM estimates was observed in opium consumption in males and EMS behavior in females. The latter is expected in the Islamic countries because of more prestige bias against such behaviors. On the other hand, we found the lowest bias in males and females estimates for EMS and alcohol use, respectively. In females, the prevalence of alcohol use behavior were the same using both methods indicating lower prestige bias for this behavior compared to the other risky actions in female students.

The results of our study showed that the level of bias in NSU was more than the one in direct method. The most probable explanation is that the direct method is only prone to prestige bias, while the NSU method is affected by both prestige and transmission biases, although the former is very low. The exception was in opium consumption behavior among females, that the highest prevalence had been estimated by direct technique. It should be noted that this behavior was the least prevalent action among all behaviors that their prevalence was estimated by means of this technique. Hence, the respondents might have failed to recall and detect such behaviors among their acquaintances when using indirect methods. However, considering the low degree of knowledge about different kinds of opiates, we could not rely on the estimates of these behaviors.

Based on our literature review, the study of Rwanda (2012) was the only one which used both indirect methods. The results of this study showed lower prevalence for female sex workers and their clients estimated by the NSU compared to the PRM. This is in agreement with our results that showed lower prevalence for EMS behaviors using NSU. Although, in Rwanda study, similar sizes of MSMs and IDUs were reported using both methods, we did not estimate MSM behavior separately in the current study; but we found higher estimates of IDU when using PRM compared to the NSU method especially in females.

In all methods, the prevalence of all risky behaviors in males was more than those in females. That might be because of more restrictions for females particularly in traditional cultures which are still dominant in Iran. Because of such views, females have usually more shame to report stigmatized behaviors (prestige bias) even through indirect techniques. Therefore, even if females have such behaviors, they would try to hide them because the society does not tolerate that. Thus, the lower visibility of the risky behaviors in females might be due to such restrictions.

The male versus female ratios obtained by NSU method were much more than those of the other two techniques. This might be due to the fact that the stigmatized behaviors are more hidden in female populations of these countries. Therefore, the recall and the visibility of such actions in social networks of participants could be more difficult, leading to underestimation of the risky behaviors in females when compared to males using the NSU method. The highest male versus female ratios in NSU and PRM belonged to opium consumption, while the direct method showed the highest gender ratio for the EMS contact. This might be because of higher underestimation of female EMS by the direct method.

Unfortunately, there is no reliable comparative method, as a gold standard, to compare the results of these methods with. Therefore, we used the PRM as a proxy standard, although we knew that the limitations of these methods might reduce our comparative study precision.

We faced another obstacle while conducting this study; it was not an easy task to distribute questionnaires among students in a systematic way. Some lecturers did not give us such permission and some students also did not co-operate as we expected. Meanwhile, we discovered that many students found the PRM questionnaire more interesting when compared to the other ones.

Conclusion

Having cross-validated the estimates of different methods about the frequency of risky behaviors among the college students, it seems that the NSU and the direct methods are prone to some degrees of biases leading to size underestimation of the hidden populations. We also found that some behaviors such as alcohol use and EMS were relatively common, particularly among male students that could be taken into consideration by policy makers.

Contributors

Mahdi Afshari and Khodadad Sheikhzadeh participated in the study by writing the protocol and Analysis of the results and also data collection. Ali Akbar Haghdoost and Mohammad Reza Baneshi monitored the steps of the study and contributed to writing the first draft and final manuscript.

Declaration of interest

The authors declare no conflicts of interests. The authors alone are responsible for the content and writing of this article.

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writing the manuscript, or the decision to submit the paper for publication.

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