



Estimation of The Prevalence of Cigarette, Hookah, and Alcohol Consumption in Iran: Network Scale-up Method

Karim Hamid¹, Moluk Hadi Alijanvand², Rohollah Farsi³, Arezoo Tavakoli⁴, Masoumeh Sadat Mousavi^{5,*}

¹ School of Public Health, Shahrekord University of Medical Sciences, Shahrekord, Iran

² Department of Epidemiology and Biostatistics, School of Health, Shahrekord University of Medical Sciences, Shahrekord, Iran

³ Department of Surgery, Vali Asr Hospital, Shiraz University of Medical Sciences, Iran

⁴ Department of Nursing, Faculty of Science, Eghlid Branch, Islamic Azad University, Eghlid, Iran

⁵ Department of Public Health, Faculty of Science, Eghlid Branch, Islamic Azad University, Eghlid, Iran

*Corresponding Author: Department of Public Health, Faculty of Science, Eghlid Branch, Islamic Azad University, Eghlid, Iran. Email: mousavi68.ma@yahoo.com

Received: 17 May, 2025; Revised: 4 August, 2025; Accepted: 5 August, 2025

Abstract

Background: Risky behaviors such as smoking, alcohol consumption, and substance use are increasingly observed among Iranian youth. These behaviors pose serious health and social risks. Understanding their prevalence is crucial for effective prevention and intervention strategies.

Objectives: This study aimed to estimate the prevalence of cigarette, hookah, and alcohol consumption among individuals aged 18 - 40 years in Shahrekord, Iran, using the indirect network scale-up method (NSUM).

Methods: A cross-sectional analytical study was conducted in 2023 on 700 individuals (350 males and 350 females) aged 18 - 40 years, selected via two-stage random sampling from the SIB system of Shahrekord Health Center. The NSUM was used to estimate high-risk behaviors, and social network size was estimated using both ratio and regression-based approaches.

Results: The participants were 700, including 350 (50%) men and 350 (50%) women, with an age range of 18 - 40 years and a mean and standard deviation of 30.14 ± 6.32 . The social network size was estimated to be 117 (111.39 - 123.99). Using NSUM, the estimated prevalence (95% CI) of hookah, cigarette, and alcohol consumption among the target population was 22% (21.67 - 22.35), 18.87% (18.56 - 20.20), and 9.52% (9.28 - 9.76), respectively.

Conclusions: Findings indicate that the active social network size of individuals aged 18 - 40 in Shahrekord is somewhat lower than the national average. Moreover, the prevalence of hookah, cigarette, and alcohol use is notably high, underscoring the need for targeted health interventions to prevent substance abuse in this age group.

Keywords: Network Scale-up, High-Risk Behaviors, Cigarette, Alcohol, Hookah, Population Size Estimation

1. Background

Risk behavior is behavior that can endanger health and life and have harmful consequences (1) and includes alcohol consumption, smoking, and hookah smoking (2). The prevalence of risky behaviors, especially among young people, is a serious health threat that has been considered by health officials, law enforcement, and social policy makers as one of the most important problems in society in recent years due to rapid social changes (3). The scope of these behaviors is wide and

includes a series of behaviors that not only harm the individuals involved, but also cause serious harm to other members of society. These behaviors can be connected in a chain and reinforce each other, each risky behavior leading to another risky behavior, and there is a deep connection between these behaviors (4). This behaviors can jeopardize life expectancy at birth, the demographic window, and the resulting literacy, and consequently the sustainable development process in Iran (5).

Tobacco use is considered one of the most important risk factors and increases the overall burden of disease in the world, especially in relation to chronic and non-communicable diseases such as cardiovascular, respiratory, cancer and stroke (6, 7). According to the World Health Organization, one billion people worldwide smoke (8) and 4% of disability-adjusted life years in developed countries and 13% of disability-adjusted life years in developing countries are due to smoking (9). Studies conducted in 30 European countries showed that 50% of students aged 18-26 have experienced alcohol and addictive substances (10). The latest national study conducted in the country on the prevalence of tobacco use showed that 25.4% of the Iranian population aged 18 - 65 years are smokers (11). According to the 2011 Survey of Non-communicable Disease Risk Factors (STEPS) study, the prevalence (95% confidence interval) of hookah and pipe tobacco use in the country (18.19 - 93.97) is 19.44%, alcoholic beverages 6.86%, and cigarettes 9.33% (8.95 - 9.72) (12). Also, based on the results of the 2011 Survey of Non-communicable Disease Risk Factors, the prevalence of tobacco, cigarettes, and alcoholic beverages in Chaharmahal and Bakhtiari province was reported to be 19.48%, 10.24%, and 78.7%, respectively, which was higher than the national prevalence reported in this study (12).

Estimating the size of these high-risk groups in the national surveillance system has been somewhat neglected, and very few published statistics are available to estimate the population size of these groups using valid methodologies (13). Due to the lack of direct contact with members of the target community and hidden populations, the network expansion method is considered an indirect method in the true sense and is used as one of the new methods for estimating such populations (14). In this method, there is no need to contact directly with members of the subpopulations under study, in other words, in this method, there is no need to be directly in contact with people who are sick or have that health problem, but rather selecting a random sample of the community is sufficient (the most important advantage), estimating many groups or diseases is possible with a single study, and the results obtained from this method are comparable at different times (15).

2. Objectives

This present study was conducted with the aim of estimating the prevalence of cigarette, hookah, and alcoholic beverage consumption in the 18 - 40 year old population of Shahrekord city through the network expansion method.

3. Methods

3.1. Objective and Population

This cross-sectional study was conducted to investigate high-risk behaviors (smoking, hookah, alcoholic beverages, etc.) in the population aged 18 to 40 years in Shahrekord in 1402. The population included 56,720 people registered in the SIB system who had lived in Shahrekord for at least 2 years.

3.2. Sampling Method and Sample Size

Sampling was carried out using a two-stage random method and proportional to gender and age group from the bases of 11 health centers. Considering an approximate prevalence of 45% for tobacco and alcohol consumption in the province (based on the 1400 Survey of Non-communicable Disease Risk Factors), a 95% confidence interval, and $d = 0.045$, a sample size of 700 people (adjusted for the limited population) was determined.

3.3. Inclusion and Exclusion Criteria

Inclusion criteria: Individuals aged 18 to 40 registered in the SIB system, residing in Shahrekord for at least 2 years, ability to hear and speak Persian. Exclusion criteria: Unwillingness to cooperate and failure to respond to phone calls (after 3 attempts)

3.4. Data Collection Tools and Methods

Information was collected through a questionnaire and telephone interview by 4 trained interviewers (2 men and 2 women). The questionnaire consisted of three sections.

3.4.1. Indirect Estimation of High-Risk Behaviors (Network Expansion)

Asking about the number of people with high-risk behaviors in the individual's social network.

3.4.2. Indirect Estimation of Social Network Size

Using 16 reference groups (such as the number of people with a specific name or job that the individual knows), demographic information, and a precise definition of "knowing" to estimate network size.

3.4.3. Definition of Knowing

Mutual recognition by name, meeting in person in the past year, and the possibility of establishing contact (email, phone, in person).

3.5. Validity and Reliability of the Instrument

A researcher-made questionnaire was used. Face and content validity were not examined, but reliability was assessed after data collection: Internal consistency (Cronbach's alpha): Overall alpha 0.646, for the questionnaire sections between 0.662 and 0.693.

3.5.1. Reliability (Test-Retest)

The questionnaire was completed by 20 people and repeated after 5 weeks. Intraclass correlation coefficients (ICC) for the sections were between 0.869 and 0.973.

3.6. Methods for Estimating Social Network Size

3.6.1. Direct Method

Directly asking people about the number of people they know in their active network (with problems such as difficulty in counting and the possibility of duplicate individuals).

3.6.2. Indirect Method (Used in This Study)

Using the formula ($m/c = e/t$) to estimate social network size; including e indicating size of the group of interest (reference group of a certain size), t indicating total population studies, m indicating number of people in the reference group that the individual knows, and c indicating size of the individual's social network.

3.7. Rationale for the Network Expansion Method

Based on the idea that the prevalence of a characteristic in an individual's social network is an estimate of the prevalence of that characteristic in the community. In this method, the focus is on the active network of individuals (people with whom the individual has the ability to communicate).

3.8. Data Analysis Method

Estimation of high-risk behaviors by direct method: Using chi-square and Fisher tests to examine the distribution of behaviors based on demographic variables and t -test to compare the mean age.

3.9. Indirect Estimation of High-Risk Behaviors

Calculating the frequency of the target group population using the maximum likelihood function of the network generalization estimator ($m/C = e/t$). Correcting the raw estimate with a transparency factor

(50% in this study). Using correction factors to adjust for the effect of biases.

3.10. Indirect Estimation of the Size of the Social Network

Using information related to the frequency of reference groups and inserting it into the relevant formula.

3.11. Software Used

Data analysis was performed using SPSS software.

4. Results

4.1. Description of Demographic Characteristics of Participants

The participants were 700, including 350 (50%) men and 350 (50%) women, with an age range of 18 - 40 years and a mean and standard deviation of 30.14 ± 6.32 . The mean and standard deviation of age for men and women were 29.68 ± 6.64 and 30.61 ± 5.96 , respectively. 467 (66.7%) were married and 362 (51.7%) had a university education (Table 1).

The social network size was estimated to be 117 (111.39 - 123.99). The results obtained in the present study using the raw social network size in the age group of 18 - 40 years ($c = 117$) and the correction factors (transparency coefficient and popularity factor) were calculated, and among the subgroups with high-risk behaviors, the highest prevalence (95% confidence interval) was reported for hookah (17.62 - 17.17) 30.17, cigarettes (14.55 - 14.15) 85.14, alcoholic beverages (7.70 - 7.27) 48.7 percent (Table 2).

The results obtained in the present study were calculated using the social network size calculated in previous studies in the age group 25 - 40 years ($c = 306$) and the corresponding correction factors (transparency coefficient and popularity factor), among the subgroups with high-risk behaviors, the highest prevalence (95th percentile confidence interval) was estimated for hookah with (6.6 - 41.82) 61.6 percent, followed by cigarettes and alcoholic beverages, electronic cigarettes and pipes with (5.67 - 49.5), (2.86 - 73.3), (0.21 - 18.26) and (0.13 - 20) 0.16 percent, respectively (Table 2). Total of 700 people, 6 people were excluded from the analysis stages due to having c equal to zero, and the size of the social network after removing these samples was estimated to be 105 (100.53 - 110.97), the results obtained in the present study were calculated using the size of the social network after removing people with zero social networks in the age group of 18 - 40 years and the relevant correction coefficients (transparency

Table 1. Demographic Characteristics of the Participants^a

Demographic Feature	Values
Gender	
Male	350 (50)
Female	350 (50)
Marital status	
Single	205 (29.3)
Married	467 (66.7)
Divorced/widowed	28 (4)
Educational level	
Elementary school	52 (7.4)
High school diploma	286 (40.9)
Associate degree	114 (16.3)
Bachelor's and higher	248 (35.4)
Age group	
18 - 23	100 (14.3)
23 - 28	161 (23)
28 - 33	164 (23.4)
33 - 38	157 (22.4)
38 - 40	118 (16.9)

^a Values are expressed as No. (%).**Table 2.** Adjusted Estimates of Risky Behaviors and Correction Factor

Risky Behavior	Raw Estimate	Popularity Factor	Transparency Coefficient	Adjusted Estimate	Prevalence RD (%)	Prevalence OS; c = 306 (%)	Prevalence RRG; c = 105 (%)	Prevalence R (%)
Alcohol consumption	1,634	0.77	0.5	4,245	7.48 (7.27 - 7.70)	9.52 (9.28 - 9.76)	8.34 (8.11 - 8.57)	7.24 (7.02 - 7.45)
Cigarette smoking	3,242	0.77	0.5	8,420	14.85 (14.55 - 15.14)	18.87 (18.56 - 19.20)	16.54 (16.24 - 16.85)	14.35 (14.07 - 14.64)
Hookah use	3,779	0.77	0.5	9,816	17.30 (17.00 - 17.62)	22.22 (21.67 - 22.35)	19.28 (18.96 - 19.61)	16.73 (16.43 - 17.04)
Pipe smoking	92	0.77	0.5	239	0.42 (0.37 - 0.48)	0.53 (0.48 - 0.60)	0.72 (0.65 - 0.79)	0.41 (0.36 - 0.46)
Electronic cigarettes	123	0.77	0.5	321	0.57 (0.32 - 0.42)	0.72 (0.65 - 0.79)	0.53 (0.48 - 0.60)	0.55 (0.49 - 0.61)

Abbreviations: RD, raw data; OS, using social network size from other studies; RRG, removing reference groups; R, regression method.

coefficient and popularity factor), which among the subgroups with high-risk behavior, the highest prevalence (95th percentile confidence interval) was reported for hookah (18.61 - 96.18) 28.19, cigarettes (16.24 - 85) 54.16 and alcoholic beverages (8.57 - 11.8) 34.8 percent (Table 2).

5. Discussion

In this study, the network expansion method was used to estimate high-risk behaviors among the age groups of 18 to 40 years in Shahrekord city. The results show a high prevalence of high-risk behaviors including

smoking 18.87%, hookah 22%, and alcoholic beverages 52.9% indirectly.

In the present study, the highest prevalence of indirect consumption was related to hookah with 22%, which was higher than the study by Lotfi et al. in Shahre-Rey in 2016, which reported a prevalence of 82.8% (14), while it is consistent with the results of the study by Rastegari et al. in Larestan, which was 22.66% (16). In the present study, the prevalence of cigarette smoking was 18.87%, which is close to the results of Rastegari et al. in 2014 with a prevalence of 16.44% (16), but higher than the results of Lotfi et al. in 2016 with a prevalence of 10.3% (14). In a study conducted by Maghsoudi et al. in 2014,

the number of smokers was significantly higher (17). The prevalence of alcohol consumption in the present study was reported to be 52.9%. In a study conducted by Peykani et al. in 2017 among medical students in Rafsanjan using an indirect method, the prevalence of alcohol consumption was reported to be 57.26% (18). Findings from the study by Sajjadi et al. in 2015 among medical students in Tehran reported a prevalence of alcohol consumption of 92.4%, which was lower than the results of our study (1). A study by Maghsoudi et al. in 2020 in Myanmar reported the prevalence of alcohol consumption as 20.3% (17). Considering that the present study was conducted on the general population and the prevalence of alcohol consumption using the network expansion method in the general population in the whole country was reported as 2.7%, the estimated prevalence of alcohol consumption in the present study seems reasonable (18, 19).

Using different methods, the size of the social network can be estimated, and each method can estimate different sizes. As in a study in the United States, six different methods estimated six different sizes from 97 to 399 (399, 117, 113, 105, 105, 97) (19). In another study in Kerman, Iran, four methods produced four different estimates ranging from 100 to 350 (20). Also, in a similar study conducted in Tabriz using the network expansion method and purposive sampling, the size of the social network of individuals was 113.8 (21). In the present study, we used the known population method using the maximum likelihood method. The main reason is the higher accuracy of this method compared to other methods, which has led researchers to welcome this method in previous studies. Because this method involves an active search of the respondents' memories, and active memory search usually leads to more accurate responses (21). Considering the size of social networks estimated in other studies, the number 23.91 for the active network size in this study based on the definition of "cognition" seems to be a reasonable estimate and close to the estimates of the active network size in other studies (21). In a study conducted by McCarthy et al. in the United States, the average number of social networks was 291 (19). The difference between this number and the number of social networks estimated in our study could be due to regional differences in estimation, as in the aforementioned study, the social network of individuals was estimated for the entire country, while we estimated this number for only one city. Another reason is that the level of communication in this city is low compared to other geographical areas. Another reason is the definition of acquaintance, part of the definition in

McCarthy's study is: "At least one contact in the past two years", while this part of the definition in our study is at least one contact in the past year. This inconsistency in the definition causes differences in the number of people known by respondents and consequently variations in the number of social networks. Shokoohi et al. in Kerman estimated several numbers using different methods for c , but using the same method that we used in our study, they produced an estimated c of 303, which is very different from our estimate (21). The reason behind it could also be differences in target groups, cultural differences, and the level of communication of the people of Shahrekord.

In the Kerman study, the target group was Kerman men aged 18 to 45 years old and was asked how many men aged 18 to 45 they knew, and the knowledge was not limited to the city of Kerman. Then, respondents reported all men in the target group they knew throughout Iran. Whereas in the present study, respondents were asked to report the number of people they knew in the city of Shahrekord (19). The aforementioned drawbacks may have caused an overestimation of c in the Kerman study. Some other factors that explain the difference between c numbers in different studies are cultural differences in different domains, variation in respondent characteristics, and the size of the region in which the study was conducted (22). In our study, the size of the social network of women and men was almost equal, indicating that in recent years, the role of men and women in social activities has increased to the same extent. The size of the social network of married couples was larger than that of single individuals. The reason for this difference is not easy. On the one hand, it seems that a married person may have more connections in his or her own network and his or her spouse's network, but on the other hand, married people tend to limit their connections in their friendship networks. The size of the network was larger in people with a bachelor's degree or higher, which is consistent with Banshee's results. Education was positively associated with the size of the social network. The positive relationship observed between the social network and the level of education has also been observed in other parts of the world (23). The reasons for this could be that education usually provides people with new opportunities to participate more in social affairs and obtain higher-ranking jobs. Educated people can also communicate with others via the Internet. All of these factors may increase the size of the educated people's network.

5.1. Conclusions

Our results show that the size of the active social networks of the 18 - 40 year old groups in Shahrekord city is about 91 people, and the size of the social network in this age group in Shahrekord city is somewhat lower than the size of the social network in the whole country. Also, the use of hookah, alcoholic beverages, and cigarettes is highly prevalent, and the prevalence of these behaviors was estimated to be higher in the indirect method than in the direct method. Therefore, planning and implementing preventive measures against substance abuse in this age group seems necessary.

5.2. Limitations

One of the most important limitations of the study is the collection of information on high-risk behaviors, which has cultural and social restrictions and may lead to an underestimation of these behaviors. Another limitation of this study is the lack of access to age groups under 18 years to estimate high-risk behaviors due to ethical issues. Study limitations include selection bias, reporting bias, and cohort bias, which may have affected the study results.

Footnotes

Authors' Contribution: Study concept and design: M. S. M. and K. H.; Acquisition of data: R. F. and A. T.; Analysis and interpretation of data: M. H. A.; Drafting of the manuscript: K. H.; Critical revision of the manuscript for important intellectual content: M. S. M.; Statistical analysis: M. S. M.; Administrative, technical, and material support: K. H.; Study supervision: M. S. M.

Conflict of Interests Statement: The authors declare no conflict of interest.

Data Availability: Upon request from the journal editor, data will be provided by the corresponding author.

Ethical Approval: This study was supported in part by grant (IR.SKUMS.REC.1402.050) from the Shahrekord University of Medical Sciences.

Funding/Support: This study was supported by Shahrekord University of Medical Sciences.

Informed Consent: Informed consent was obtained from individuals prior to the interviews.

References

1. Sajjadi H, Jorjoran Shushtari Z, Shati M, Salimi Y, Dejman M, Vameghi M, et al. An indirect estimation of the population size of students with high-risk behaviors in select universities of medical sciences: A network scale-up study. *PLoS One*. 2018;**13**(5): e0195364. [PubMed ID: 29738560]. [PubMed Central ID: PMC5940232]. <https://doi.org/10.1371/journal.pone.0195364>.
2. Panahi R. The Factors Associated to High Risk Behaviors in Sanandaj City Students Based on Health Belief Model. *Iran J Health Edu Health Promot*. 2018;**39**:393-402. <https://doi.org/10.30699/acadpub.ijhehp.6.4.393>.
3. Assanangkornchai S, Mukthong A, Intanont T. Prevalence and patterns of alcohol consumption and health-risk behaviors among high school students in Thailand. *Alcohol Clin Exp Res*. 2009;**33**(12):2037-46. [PubMed ID: 19740137]. <https://doi.org/10.1111/j.1530-0277.2009.01043.x>.
4. Pasharavesh L, Khoshbo S, Rezaei M, Saiedi MR. Frequency and related factors of smoking in high school girls in Kermanshah (2004). *J Kermanshah Univ Med Sci*. 2010;**13**(4).
5. Karimy M, Niknami S, Heidarnia AR, Hajizadeh I. Measuring constructs of theory of planned behavior (TPB) regarding cigarette use among adolescents. *J Kermanshah Univ Med Sci*. 2013;**16**(8).
6. Khojandi GA, Banashi MR, Sharifi H, MOHSENI SHOKROLLAH. [High-risk behaviors prevalence among Islamic Azad and Payame Noor University students in Roudan, 2016]. *J Prevent Med*. 2019;**5**(2):44-52. FA.
7. Rahimzadeh M, Rastegar H, Fazel Kalkhoran J. [Prevalence and causes of tendency to cigarette and water pipe smoking among male and female physical education students in University of Kurdistan]. *J Health*. 2016;**7**(5):680-6. FA.
8. Zarei A, Bagherzadeh R, Gharibi T, Ravanipour M. Tendency to High-Risk Behaviors in Adolescents and its Related Factors in Bushehr, 2019. *Iran South Med J*. 2020;**23**(6):554-68. <https://doi.org/10.52547/ismj.23.6.554>.
9. Tavousi M, Panahi R, Haerimehrizi A, Anbari M, Mozaffari Kermani R, Rostami R. [Tobacco use prevention interventions among Iranian adolescents: A review study]. *J Health Field*. 2018;**6**(3):36-49. FA.
10. Rahimi MA, Sahimi IE. [Drug use condition among school students in Iran]. *J Social Welfare*. 2006;**5**(19):9-29. FA.
11. Moosazadeh M, Ziaaddini H, Mirzazadeh A, Ashrafi-Asgarabad A, Haghdoost AA. Meta-analysis of Smoking Prevalence in Iran. *Addict Health*. 2013;**5**(3-4):140-53. [PubMed ID: 24494171]. [PubMed Central ID: PMC3905476].
12. Abbasi-Kangevari M, Ghanbari A, Fattahi N, Malekpour MR, Masinaei M, Ahmadi N, et al. Tobacco consumption patterns among Iranian adults: a national and sub-national update from the STEPS survey 2021. *Sci Rep*. 2023;**13**(1):10272. [PubMed ID: 37355699]. [PubMed Central ID: PMC10290637]. <https://doi.org/10.1038/s41598-023-37299-3>.
13. Hemayatkhah M, Rahmanian V, Rahmanian K, Haghdoost A. [Population size estimation of groups at high risk of HIV/AIDS in men, using network scale up in south of Iran, 2017]. *J Isfahan Med School*. 2019;**36**(512):1662-9. FA. <https://doi.org/10.22122/jims.v36i512.11086>.
14. Lotfi Z, Gheirati E, Tajik F, Tavakoli Z, Mahmoodi M, Naieni KH. [Estimation of the population of drug abusers using the network expansion method for assessment of the community in the Golhesar village, Tehran]. *J School Public Health Institute of Public Health Res*. 2016;**14**(3):29-42. FA.
15. Shokoobi M, Mohebbi ES, Rastegari A, Hajimaghsoudi S, Haghdoost AA, Baneshi MR. [The introduction of network scale-up method: an indirect method to estimate the hard-to-reach populations]. *Iranian J Epidemiol*. 2014;**10**(1):81-92. FA.
16. Rastegari A, Haji-Maghsoudi S, Haghdoost A, Shatti M, Tarjoman T, Baneshi MR. The estimation of active social network size of the

- Iranian population. *Glob J Health Sci.* 2013;5(4):217-27. [PubMed ID: 23777738]. [PubMed Central ID: PMC4776847]. <https://doi.org/10.5539/gjhs.v5n4p217>.
17. Maghsoudi A, Jalali M, Neydavoodi M, Rastad H, Hatami I, Dehghan A. Estimating the prevalence of high-risk behaviors using network scale-up method in university students of Larestan in 2014. *J Substance Use.* 2016;22(2):145-8. <https://doi.org/10.3109/14659891.2016.1150528>.
 18. Peykani S, Gheirati E, Rezaeian M, Vazirinejad R, Ahmadiania H. Population Size Estimation of Students with High-Risk Behaviors Using the Network Scale-up Method in Rafsanjan University of Medical Sciences, Iran (2017). *J Occupational Health Epidemiol.* 2021;10(4):239-48. <https://doi.org/10.52547/johe.10.4.239>.
 19. McCarthy OT, Caulfield B, O'Mahony M. Technology engagement and privacy: A cluster analysis of reported social network use among transport survey respondents. *Transportation Research Part C. Emerg Technolo.* 2016;1(63):195-206. [PubMed ID: 36243944]. [PubMed Central ID: PMC10125066]. <https://doi.org/10.34172/ijhpm.2022.6578>.
 20. Killworth PD, Johnsen EC, McCarty C, Shelley GA, Bernard H. A social network approach to estimating seroprevalence in the United States. *Social Networks.* 1998;20(1):23-50. [https://doi.org/10.1016/s0378-8733\(96\)00305-x](https://doi.org/10.1016/s0378-8733(96)00305-x).
 21. Shokoohi M, Baneshi MR, Haghdoost AA. Estimation of the active network size of Kermanian males. *Addiction & Health.* 2010;2(3-4):81.
 22. Jafari A. Size Estimation of Most-at-Risk Groups of HIV/AIDS Using Network Scale-up in Tabriz, Iran. *J Clin Res Gov.* 2014;3:6-21. <https://doi.org/10.13183/jcrg.v3i1.80>.
 23. Bao S, Wu G, Zhang W, Zhou C, Guo W, Zhou X, et al. Application on size estimation through the network scale-up method on men who have sex with men in Chongqing municipality. *Zhonghua liu xing bing xue za zhi= Zhonghua liuxingbingxue zazhi.* 2012;33(10):1036-9.