Population Size Estimation of Female Sex Workers In Tbilisi and Batumi, Georgia 2014

Study Report

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Prepared by:

Curatio International Foundation

Center for Information and Counseling on Reproductive Health - Tanadgoma

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Acronyms

AIDS	Acquired Immune Deficiency Syndrome
BBS	Behavioral Surveillance Survey
CI	Confidence Interval
CIF	Curatio International Foundation
FSW	Female Sex Worker
GEL	Georgian Lari (exchange rate of 1.74 GEL/1 USD on April 4, 2014; 1.77 GEL/1 USD on May 25, 2014)
GFATM	The Global Fund to Fight AIDS, Tuberculosis and Malaria
HH	Household
HIV	Human Immunodeficiency Virus
NSU	Network Scale-Up
PSE	Population Size Estimation
PSU	Primary Sampling Unit
PWID	People Who Inject Drugs
SPSS	Statistical Package for the Social Sciences
STIs	Sexually Transmitted Infections
TLS	Time-Location Sampling
UNAIDS	Joint United Nations Programme on HIV/AIDS
USD	United States Dollar
USAID	United States Agency for International Development
VCT	Voluntary Counseling and Testing
WHO	World Health Organization

Executive Summary

Background and objectives

Georgia is among the countries with low HIV/AIDS prevalence, but with a high potential for the development of a widespread epidemic. From the early years of epidemic injecting drug use was the main route of HIV transmission, however, for the last two years heterosexual transmission is prevailing. During the last two years heterosexual transmission was found among newly registered cases in 44.8% in 2012 and 49% in 2013. However, we cannot judge about change in the transmission route unless more detailed analysis of new infections is done.

In this report, we present findings of population size estimation (PSE) study. The PSE among FSW is the first of its kind in Georgia. The primary objectives of the study is to estimate FSW population size in Tbilisi and Batumi by applying multiple methods and triangulating the findings to provide the most plausible estimates of this key population. The PSE findings will inform preventive program design and will be used to track coverage of preventive interventions.

The study was implemented within the GFATM-funded project "Generate evidence base on progress in behavior change among MARPs and effectiveness of preventive interventions" by Curatio International Foundation (CIF), Center for Information and Counseling on Reproductive Health – Tanadgoma.

Methods

Multiple methods were used for FSW population size estimation in Tbilisi and Batumi; including the "network scale-up method", "census", "capture-recapture", "service Multiplier method". Last two methods were conducted in conjunction with the BBS.

To correct for NSU biases international estimates were used, as local factors are not known. Data were triangulated together with service administrative data as well the multiple methods' findings to provide the most plausible estimates for the population size of FSW in Georgia. Some methods were dropped from the analyses (e.g. census in Tbilisi and Capture in Batumi) as administrative data provided higher numbers. Prevalence of FSW according to the NSU method is 1.03% in Tbilisi and 2.42% in Batumi. Comparisons of Georgia estimates (from the NSU method) with the regional estimates indicate Georgia FSW prevalence is within the range of regional recommendations of UNAIDS. NSU figures represent estimates for all types of FSWs, while other methods count mainly street and facility based FSW and those who benefit from free HIV testing offered by the preventive programs. Following triangulation some methods were excluded. The final mean estimates of FSWs

(street- and facility based) is 617 and 408 in Tbilisi and Batumi, respectively. Estimates were calculated for other major cities in Georgia as well.

It is recommended that in future available NSU estimates are corrected by applying local factors derived from a random sample of FSW. It is also recommended that other methods, especially those which are cost-effective (e.g. multiplier) are repeated in conjunction with the next rounds of BBS studies.

Introduction

Georgia is among the countries with low HIV/AIDS prevalence, but high potential for developing a widespread epidemic. The estimated prevalence of HIV among the adult population is 0.3%[1]. As of December 31, 2013 in total 4,131 HIV cases have been registered by the national HIV surveillance system. The annual number of new cases grew from around a hundred during early 2000s to about 490 in 2013. In the early years of the HIV epidemic in Georgia, as in most Eastern European countries, injecting drug use was the major transmission mode. Since 2010, transmission has shifted toward the heterosexual mode, which became dominant by 2011. The percentage of drug use, as a transmission mode among newly registered HIV cases has decreased from 43.2 % in 2012 to 35% in 2013 while heterosexual transmission has increased from 44.8% in 2012 to 49% in 2013[2].

Preventive interventions targeting this high-risk group are currently being implemented in Georgia. However, to determine the coverage of such services, and so better planning and scaling-up of preventive interventions, it is vital to have an acceptable estimate of the size of FSWs population, even if it is a challenge to measure accurately the exact population size.

The lack of a gold standard for the size estimation of hidden populations, including FSWs, make it difficult to assess which among these methods is most accurate. There are a number of methods available to estimate the size of hidden populations. Selection of a method depends on factors such as networking patterns, the visibility of the population, data accuracy of service providers, cultural factors, budgetary issues, etc.[3] Each method has its own strengths and weakness, therefore use of multiple methods along with the triangulation of estimations allows for validation of findings when arriving to the most acceptable size estimation.

[1] UNAIDS, AIDSinfo, 2012. http://www.unaids.org/en/regionscountries/countries/georgia/
[2] "Global AIDS Response Progress Report. Georgia" http://www.unaids.org/en/dataanalysis/knowyourresponse/countryprogressreports/2014countries/GEO_narrative_report_2014.pdf
[3] WHO, Regional Knowledge Hub for HIV/AIDS Surveillance. Network Scale-up Method Workshop Manual, 2013

Study Objectives

The proposed study objectives were to estimate the FSWs population size in 2014 in Georgia by using different estimation methods and triangulating the findings to provide the most acceptable estimates.

Ethical Issues

The survey investigators were cognizant of the fact that the individuals participating in this study were at some risk for social harm should they be identified as part of the target group. These surveys were designed to provide maximum protection for the participants, yet at the same time provide individual and community benefits.

The ethical issues that have been taken into consideration are:

- Participation in these surveys was voluntary. Participants were free to withdraw at any time and were informed that a refusal or withdrawal would not affect services they would normally receive.
- No names were recorded. All documentation is anonymous, linked only by a study number.
- Staff conducting the survey was trained in discussing sensitive issues and protecting participants' confidentiality and human rights.
- Protocols and instruments of the surveys were submitted to and approved by the Ethical Committee of the Infectious Disease, AIDS and Clinical Immunology Research Center (certificate N 14-002, of 03.11.2014).

Methods

In the absence of a gold standard for estimating the population size of a hidden and hard to reach population, estimates are empirically imprecise and prone to potential biases. The present PSE among FSW applied the following methods: Network Scale-Up, Census, Capture-Recapture and Service Multiplier. The estimates were later presented to a group of experts and stakeholders to triangulate and synthesize the most rigorous estimate of the FSW population size in Georgia. The use of multiple methods strengthened confidence in estimates, provided upper and lower acceptability bounds, and reduced the likelihood that biases of any single method would have substantially alter results. The following describes the methods used in this study.

Method 1: Network Scale-Up

One of the most promising approaches among size estimation methods is network scale-up (NSU) that has its roots in anthropology and social network analysis. The general concept behind network scale-up method is that an individual's social network is representative of the whole population. That is, one person's group of friends somehow reflects the characteristics of the whole community. Therefore, we can ask members of the general population, whether their acquaintances, or alters, have high risk behaviors (such as buying and/or selling sex, having anal sex between men or injecting drugs). By asking questions about an acquaintance – a person other than the respondent – the interview takes on some anonymity allowing the responses to be honest without fear of stigma or other negative consequences for the respondent or his/her friends.

For example, if a respondent knows 100 women, and he knows that 2 of those acquaintances provide sexual services for payment then we can estimate that 2 out of 100 people in the general population are FSWs. If we multiply that proportion by the total population of the country, say 5 million, we could estimate that there are 100,000 FSWs in the country. The more respondents we have, the better the estimate becomes.

Estimating the hidden population size requires:

1. Estimating the number of people in the respondent's personal network (how many people does s/he know?)
2. Asking how many people they know in the hidden population
3. Dividing the number in the hidden population by the total network size
4. Multiplying that proportion by the total population
5. Adjusting the results for known and measurable biases.

Averaging these calculations over many respondents would create the following maximum-likelihood estimator:

$$\hat{N}_t = \frac{\sum_i y_i}{\sum_i \hat{d}_i} N$$

Where,

$\hat{N}_t$ is the estimated size of the hidden population

d is the estimated personal network size of respondent i

y is the number of people in the hidden population known by respondent i

N is the total population of the country

To estimate the number of acquaintances a respondent has, the active network size, we applied "known size populations"approach.Known population means that size of this sub-population is known e.g. number of women who gave birth.

The concept is simple; reconfiguring the above formula suggests we can estimate the personal network size (d), by asking how many people the respondent knows among populations with known sizes and comparing that to the proportion of that population in the total population. For example, we have statistics on the number of women that gave birth in a year or the number of doctors. Using these "known populations" we will back-estimate a respondent's network size. To improve the estimate, we asked this question for a 19 known population groups such as:

Ten groups with specific "first names":

- How many people do you know with the "first name of **Luka**"?
- How many people do you know with the "first name of **Mamuka**"?
- How many people do you know with the "first name of **Zurab**"?
- How many people do you know with the "first name of **Vazha**"?
- How many people do you know with the "first name of **Sofio**"?
- How many people do you know with the "first name of **Manana**"?
- How many people do you know with the "first name of **Shorena**"?
- How many people do you know with the "first name of **Nino**"?
- How many people do you know with the "first name of **Maya**"?
- How many people do you know with the "first name of **David**"?

Nine additional groups of subpopulations:

- How many people do you know, who got **married** in 2013 year?
- How many **teacher**s do you know?
- How many people do you know, who **gave birth** in 2013 year?
- How many people do you know, who **died** in 2013 year?
- How many people do you know, who **died due to cancer** in 2013 year?
- How many people do you know, who were **injured or died** in road accidents in 2013?

- How many higher educational **students** do you know?
- How many **lecturers** in higher education institutions do you know?
- How many people do you know, who are currently **imprisoned**?

"Known population" subgroups were selected on the WHO's recommendation, which yields that the proportion of every reference group in the general population should be 0.1% to 4%, not to lead to bias estimation of respondent's network size, affecting as usual very rare or prevalent groups. Statistical information on "known populations" was obtained from the National Statistics Office of Georgia[4] and Public Service Hall of the Ministry of Justice.[5]

To estimate personal average network size, a random sample of the general population from households in Tbilisi and Batumi was surveyed. The sample size was comprised of 1015 and 150 participants in Tbilisi and Batumi, respectively. A two-stage stratified sampling was used. The National Statistics Department election list for 2010 year was used as a sampling frame. According to the list, Tbilisi and Batumi are divided by municipalities (strata) and election areas. Election areas were selected as primary sampling units (PSU) and households as the second. Number of households in each PSU were defined as five. Within each municipality number of PSUs were selected based on the probability proportion to size method. PSUs were selected from the list by system random method. Within each PSU the random walk method was used to select households. Within each selected household one person (aged 18-49 years) was selected to be interviewed (based on last birthday). If there were no response at the household after 3 visits (on different days and different time) the next household was selected.

The study participants were from the adult population ranging 18-49 years of age, who provided verbal informed consent to participate in the study. Final sample comprise of 1012 Tbilisi and 149 Batumi residents.

A structured questionnaire was developed to collect information on demographic characteristics, on personal network size and on the number of acquaintances representing high risk groups. The questionnaire and method of survey administration (self-administered, interviewer administered or mixed administration method) was pilot tested separately in 20 households and 20 barber shops. Piloting showed that the interviewer administered questionnaire was the most appropriate method. Data collectors were trained prior to the field work.

[4] www.geostat.ge
[5] http://www.justice.gov.ge/

The data were collected through anonymous interviewer-administered face-to-face interviews. See Appendix 1 for NSU questionnaire. In the study, we used the below internationally accepted definition of "know" to provide a comparable personal network size to other studies/settings:

- [People that you know them by sight and name, and who also know you by sight and name]

  AND

- [People that you had some contact with either in-person, over the phone or the internet (e.g.: e-mail, Skype, chat through social networks) in the last 2 years]

  AND

- [People of all ages who lives in Georgia].

In addition to questions about the number of people they know among a certain group of people (known size populations), we also asked if they know any (and then how many) people in their network who are female sex workers, clients of female sex workers, MSM, or injecting drug users:

- How many people do you know who inject drugs?
- How many men do you know who are clients of female sex workers?
- How many men do you know who have sex with other men?
- How many female sex workers (women who exchange sex for money) do you know?
- Questions about high risk-group populations were asked with caution. The sequence of questions was as follows: IDUs, clients of FSW, MSM and FSW and each question included definitions of these groups. Clients of sex workers were defined as "those men who pay for having sex with female sex workers", FSW were defined as - "Women who exchange sex for money". Here we present only FSW findings.
- The household survey fieldwork took place from April 10th to May 05th and for the barbershop fieldwork took place during June 5th to 12th 2014. See Figure 1 for a timeline of all methods applied.
- We used below the population size of Tbilisi, Batumi and Georgia in 2014[6] (**Table 1**)

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[6] Source National Statistics Office of Georgia, www.geostat.ge

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We used below population size of Tbilisi, Batumi and Georgia in 2014[7] (**Table 1**)

Table 1-Population size Tbilisi, Batumi and Georgia, 2014

	Male		Female		Total	
Area	**Total**	**18-59y**	**Total**	**18-59y**	**Total**	**18-59y**
Tbilisi	508,862	359,611	666,338	379,590	1,175,200	739,201
Batumi	57,472	39,168	70,528	41,344	128,000	80,512
Whole Country	2,198,300	1,307,580	2,401,500	1,382,360	4,490,500	2,689,940

Even with a high response rate in NSU this method has the following biases:[8]

- "Information Transmission effect or Transparency Bias"– A respondent may know someone, but not be aware of all of their behaviors (e.g. commercial sex).
- "Relative Network size" or "Popularity Ratio "–Members of the key populations may have a personal network size that is different from the general population.
- "Barrier effect" - The position of a respondent (e.g. physical barriers such as geographical or social barriers) may cause him/her to know fewer members of the population than would be expected. In addition, there could be barriers between the key populations and the respondents that affect the likelihood that a respondent knows someone in the key populations.
- "Reporting bias" - People may fail to accurately report the populations in question or may be reluctant to do so because of the stigma surrounding the behavior of the population.

Transmission Bias and Popularity ratio could be corrected by directly contacting members of the high-risk populations through random sampling and asking them questions about their acquaintances and how many of them know about the respondents sexual behaviors. The barrier effect is minimized when known populations satisfy "scaled-down" condition. In our case, for known population groups, those names were selected that have minimal variations, whenever available all

[7] Source National Statistics Office of Georgia, www.geostat.ge

[8] Report from the consultation on network scale-up & other size estimation methods from general population surveys 28-30 March 2012, New York City

variations of the name were provided. Reporting bias (which might be a case in our study due to social desirability bias during face-to face interview) was not possible to correct.

The calibration survey to correct transmission bias and popularity ratio was not conducted among FSWs population. So we applied international measurements for these biases. [11]

Method 2: Census

Mapping and census exercises were combined and done during the same days and time periods. Mapping was conducted in order to determine the working places, working hours and the number of female sex workers present at each place through observation. Detailed information on the mapping is given in the FSW Bio-BBS study report.[9] The census method counted every individual from an at-risk population that usually worked at these designated places. Detailed maps of the city streets of Tbilisi and Batumi were used for the mapping exercise. Tbilisi was conventionally divided into 28 parts (sections, zones), while Batumi was divided into 8 parts. The size of each section was dependent on the number of the streets within the specified area. Each zone was observed and visited during the day and night at predetermined times.

Daytime – In both cities: 14:00 - 17:00 – for observation and counting. The working groups consisted of two members who were moving around the study areas by cars.

Nighttime – In both cities: 20:00-24:00.

As per the WHO guidelines, the census should take place in a very short period of time.[10] Otherwise, sex workers moving between sites may lead to double counting. To avoid this, mapping/census lasted 5 and 4 days in Tbilisi and Batumi cities, respectively.

First, social workers counted female sex workers on the streets in both cities and then inside cafes/bars in Batumi. Afterwards, social workers approached FSWs by introducing themselves while explaining the study objective. During this time the social workers also asked how many of them were out with clients or not working for health reasons.

In the facilities such as cafes/bars, social workers counted the visible sex workers and approached them directly, or an informed person/manager. The social workers then asked about the total number of FSW in the facility.

[9] Bio-BBS study report among FSW in Tbilisi and Batumi, Georgia, 2014. Curatio International Foundation, Association Tanadgoma

[10] UNAIDS/WHO Working Group on global HIV/AIDS and STI Survailance, Guidelines on Estimating the Size of Populations Most at Risk to HIV, 2010

Nighttime census was combined with the capture method as described in more detail in its respective section.

Method 3: Capture-Recapture

Capture-recapture requires the following steps: map the sites where the study population congregates, go to the sites and mark all of the members of the population at the site, keep a count of marked persons, return to the sites some weeks later and remark all of the persons being at the same place, and then count all members present at “hotspots” and persons who were counted in the first sample.

The first phase, or the capture was carried out simultaneously with the night-time census. Staff members distributed unique objects directly to each FSW and asked them to keep the object during a one-month period. Mirrors were used as unique objects, which were given out to each FSW individually. To turn objects into unique ones, the Tanadgoma logo was attached to the bottom of the mirror. The number of FSWs to whom these unique objects were given was separately counted.

The second phase, or the recapture, was carried out three weeks after the capture. Social workers visited the same sites during the night at the exact same time that the capture phase was conducted.

First, the total number of the FSWs was counted. Afterwards, they were asked whether they had received Tanadgoma mirrors and the number of such FSW was recorded:

- First the FSW was asked if she had been given the object by a social worker and was asked to show the object;
- If she was not able to show the object, then she was asked to describe the object;
- If the description was close to the real object, then the object was shown for confirmation.
- Such FSWs were counted as recaptures.
- Calculation of population size by the capture – recapture method: multiply the number of FSWs captured in the first phase sample by the number in the second phase sample and divide by the number of recaptures.

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Calculation of population size by the capture – recapture method: multiply the number of FSWs captured in the first phase sample by the number in the second phase sample and divide by the number of recaptures.

The formula is as follows:

$$N = \frac{C1 * C2}{R}$$

Where,

N - is total size of study population;

C1 - number of persons in first capture;

C2 - number of persons in second capture;

R - number of recaptures.

To give a range of error 95% confidence interval is calculated using the following formula:

95%CI=N±1.96√Var (N),

Where Var (N) is calculated as follows:

Var (N) = [(C1*C2) (C1-R) (C2-R)] / [R^3]

Method 4: Service Multiplier

In the BBS survey, we used the opportunity to integrate a related method to estimate the size of the FSWs population -the "multiplier method". In this method two sources of data are needed. That's why it is highly dependent on the quality of the existing data. It is necessary to review how the existing data were collected before you use the data to produce estimates.

- The first source - a count or listing of program data including only the population whose size is being estimated (number of FSWs who attended an STI clinic in the last six months)
- The second source - a representative survey of the populations whose size is being estimated.

A health center in Tbilisi known as the "Healthy Cabinet" maintains records of FSWs users by using a unique code during times of service. The number of beneficiaries who used the "Healthy Cabinet" services during the last six months was obtained from the center. The study participants were asked whether they received services at this health center during last six months. The question was formulated as follows:

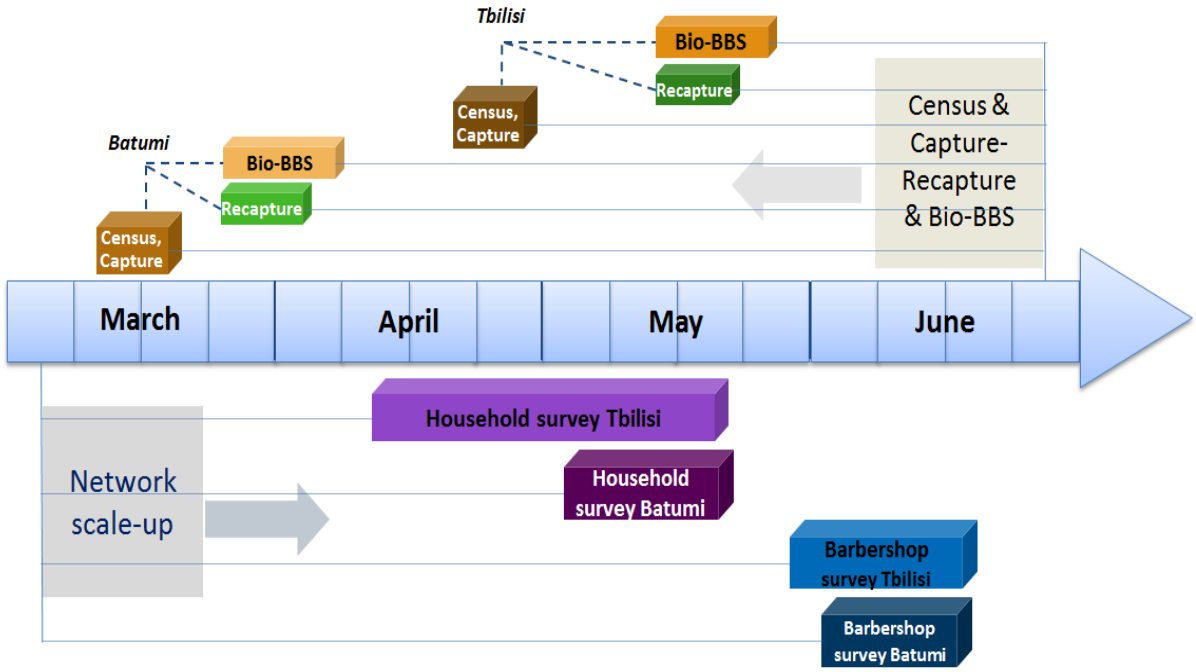
Did you receive service in "Healthy Cabinet "during last six months? (Specify: "Healthy Cabinet" located at … st Tbilisi or at … st Batumi).

Using these two data sources, the multiplier method provides a population size estimate by the formula:

$$N = \frac{n}{p}$$

Where N is the FSWs population size, given by n as the number of FSWs who were using the "Healthy Cabinet" service during the specified time period and p as the adjusted proportion of FSWs reporting using the "Healthy Cabinet" service during the time period collected in the BBS survey.

Figure 1 - Study timeline



Results

Network Scale-Up Estimates

Active Social Network Size

Although we recruited participants from both houses and barbershops, we only report the results from household survey. This was decided based on the unacceptable bias ratio between the real and estimated size of "known size" populations we observed in the barbershop survey. Out of the 24 "known size" population groups used to estimate the social network size, only 4 remained eligible. This means that participants in the barbershop survey did not provide accurate responses to the questions. Field workers also noted that participants answered to the questions without enough attention and concentration. Due to all of the above limitations, the barbershop survey data was excluded from the analysis.

Transparency and Popularity Bias

Since we did not estimate the transparency bias for FSW in Georgia, we used international estimates: Transparency bias for FSWs = 44% and popularity ratio for FSWs = 0.7 [11]

NSU Population Size Estimates of Key Populations at Risk for HIV

The population size estimate of FSWs at risk for HIV is presented in Table 2.

The total number of adult FSW (aged 18-59 years old) in Tbilisi was estimated as 2,879 (95%CI, 2,805-3,009). This means 0.76% [0.74-0.79%] of adult women in Tbilisi were FSW. In Batumi, the prevalence of FSW among adult women (18-59 years old) was considerably higher and estimated as 2.42% (95%CI, 2.36-2.53%)

Table 2 - Population estimate size of FSW using network scale-up method, Georgia 2014

	Age Group	Frequency	%
Tbilisi	Total	2,961 [2,861 - 3,068]	0.44% [0.43-0.46%]
	18-59y	2,879 [2,805 - 3,009]	0.76% [0.74-0.79%]
Batumi	Total	1,018 [988-1,061]	1.44% [1.4-1.5%]
	18-59y	1,002 [977-1,048]	2.42% [2.36-2.53%]
Georgia	Total	14,469 [14,026-15,022]	0.6% [0.58-0.63%]
	18-59y	14,218 [13,715-14,759]	1.03% [0.99-1.07%]

Numbers in [ ] are plausible intervals.

Census data

Social workers visited every “hotspot” in both cities and collected information on the number of sex workers based on each hotspot.

The Census estimates for Tbilisi and Batumi are as follows:

Tbilisi: 242 (street-based FSW)
Batumi: 354 (street-based and facility based FSW)

Capture-recapture

For the capture phase 80 and 100 unique objects were distributed in Tbilisi and Batumi, respectively.

[11] Rastegari A., et al, 2013. The estimation of active social network size of the Iranian population.

In the recapture phase 88 FSWs were found at “hotspots,” and among them 17 were recaptured. While in Batumi 102 FSWs were counted and among the 66 recaptured (see Table 3).

Table 3 – FSWs found at hotspots capture-recapture

	I Capture	II capture	Recapture
Tbilisi	80	88	17
Batumi	100	102	66

Capture-Recapture results are as follows:

Tbilisi: 414, 95% CI 427 - 4010.08% of adult (18-59 years) female population in Tbilisi
Batumi: 155, 95% CI 198 - 1120.27% of adult (18-59 years) female population in Batumi

Unique-Object Multiplier

The BBS was conducted using a TLS method with a sample of 120 FSW for Batumi and 160 in Tbilisi. In Batumi the sample was reached during 4 days, while in Tbilisi it required 7 days. Data analysis showed that 25% and 25.8% of study participants had received the service provided by the “Healthy Cabinet” during the last six months in Tbilisi and Batumi, respectively.

Data derived from the “Healthy Cabinet” showed that 205 FSWs had received the service during the last six months in Tbilisi and as for Batumi only 119 FSWs were registered at the “Health Cabinet” within the time period of focus.

FSW service multiplier results are as follows:

Tbilisi: 461
Batumi: 820

Discussion

As it has already been mentioned above, while choosing the study methodology, our overall approach was to implement multiple methods simultaneously to minimize potential bias resulting from a single method. The goal was to produce the most well supported estimate of population sizes using available survey data and service statistics. As presented below, four different methods were used for FSW size estimation.

One of the main advantages of the Network scale-up method is that it gives us an opportunity to estimate the size of multiple hidden groups from a single survey. So this method was used for FSWs size estimation and questions about FSWs were incorporated into the study instrument.

As noticed above, correction of biases should be done using the results from a random sample of the target population, as such; these estimates were not available for Georgia. Therefore, we used transparency bias and barrier effect indexes from the Iranian study: Transparency bias - 44% and Barrier effect – 0.7[11].

Batumi estimates are three times higher compared to Tbilisi. It is hard to test, but this difference could reflect the actual picture or could be the effects of biases. There are contextual differences between Batumi and Tbilisi, e.g. Batumi residents' average social network size is higher compared to Tbilisi (460 vs. 345). In addition Batumi results could be overestimated due to several limitations. The Batumi HH sample size (150 respondents) could have affected the FSW estimates. Also, if representatives of this risk group are highly visible, they might "stick the mind" of respondents very well and are more likely to be mentioned as acquaintances. Another possible reason of overestimation could be "behavior inflation," or respondents counting people who are not actual sex workers.

One of the limitations of this method is that it uses other country estimates that might affect the final results (high transparency rate leads to lower estimates).

The main limitation of the Census method was that in Tbilisi, social workers could not reach female sex workers in the facilities (bars, disco clubs and night clubs) because of entry charges. That's why the final results do not include FSWs working in closed facilities.

An external factor that may have negatively affected the capture-recapture results is unusually bad weather for the capture phase in both cities. As social workers were counting mainly street –based FSWs, it is likely that part of FSW were absent due to rainy and windy weather, therefore, capture size was reduced and the result is a high overlap between capture and recapture ultimately leading to underestimation.

One of the limitations of the FSW Multiplier method is non-independence of the two data sources that is common for Multiplier methods. It is plausible that the subgroups of this high-risk group, relatively lower-class FSWs, are more likely to use the free HIV/STI testing service and are also more likely to participate in health surveys (Bio-BBS). This positive correlation will result in an underestimation of the total population size (i.e., the overlap between service use and BBS survey participation is exaggerated).

Triangulation

For triangulation we present finding from all methods and preventive program data for the first six months in 2014.

Table 4 - FSW size estimations from all methods

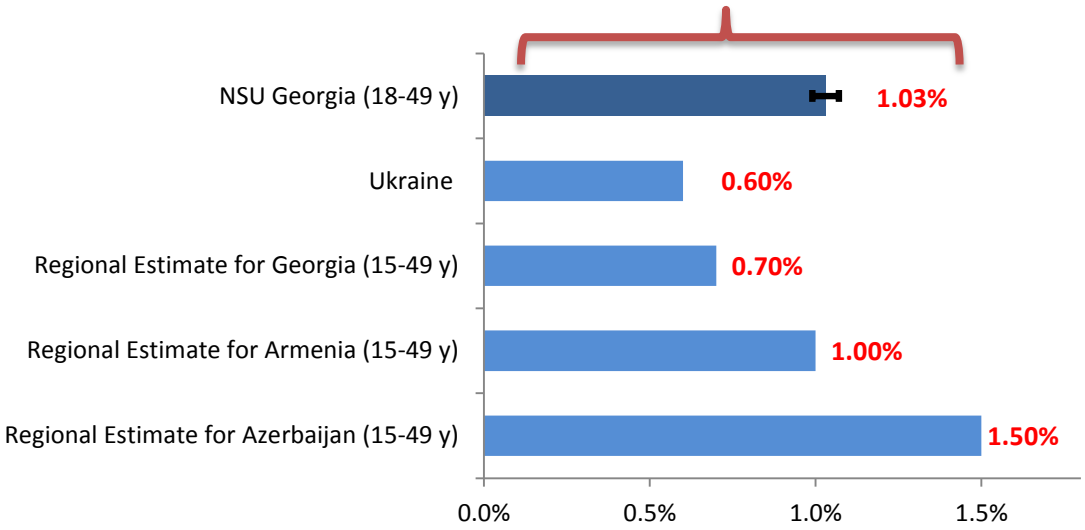
	NSU	Census	Capture-Recapture	Multiplier	Preventive Programs Database
Tbilisi	2,891 (2,805-3,009)	242	414 ± 12.5	820	449
Batumi	1,002 (977-1,048)	354	155 ± 43.4	461	241

NSU figures represent estimates for all types of FSWs, while other methods count mainly street and facility based FSW and those who benefit from free HIV testing offered by the preventive programs. Consequently, to estimate this sub-group of FSW for programmatic purposes, we will use: census, capture-recapture and multiplier methods. Tbilisi census estimates are lower than the programmatic data. A possible explanation could be that the Tbilisi FSW census represents street-based workers only; while the program also serves those who are facility-based. The capture-recapture estimates in Batumi is lower than the number of FSW who were serviced by preventive programs possibly due to the factors described above. Consequently, these sources will be excluded from triangulation.

The final mean estimates of FSWs (street- and facility based) in these cities will be **617** and **408** in Tbilisi and Batumi, respectively.

Comparisons of Georgia estimates (derived from the NSU method) with the regional estimates indicate Georgia FSW prevalence is within the range of regional recommendations of UNAIDS, although higher compared to Ukraine estimate (0.6%). Limitations of the NSU estimates were described earlier, therefore this figure should be treated with caution.

Figure 2 - FSW population size estimates in different countries[12,13]



With the aim to define programmatic targets, we estimated FSW sizes in other cities based on NSU coefficient (1.03%). The Tbilisi estimate was also recalculated. In cities other than capital, preventive program activities could reach FSW population easier than in Tbilisi, where high-level FSWs represent a major portion of all FSW.

Table 5 - FSW size estimations in different cities

City	All female 18-59	Prevalence	95% CI		FSW size		
		Point - estimate	Lower bound	Upper bound	Point - estimate	Lower bound	Upper bound
Tbilisi (capital)	379,590	1.03%	0.99%	1.07%	3,910	3,758	4,062
Batumi	41,344	2.42%	2.36%	2.53%	1,001	976	1,046
Kutaisi	59,851	1.03%	0.99%	1.07%	616	593	640
Telavi	7,125	1.03%	0.99%	1.07%	73	71	76
Poti	14,713	1.03%	0.99%	1.07%	152	146	157
Zugdidi	22,364	1.03%	0.99%	1.07%	230	221	239
Rustavi	36,567	1.03%	0.99%	1.07%	377	362	391
Gori	16,138	1.03%	0.99%	1.07%	166	160	173
Total other cities w/t	198,103				2,615	2,528	2,723
Total all cities	577,693				6,525	6,286	6,785

[12] Ukraine: Analytical Report, "Estimation of the Size of Populations Most-at-Risk for HIV Infection in Ukraine" as of 2012

[13] Regional estimates: J Vandepitte at al. Estimates of the number of female sex workers in different regions of the world. *Sex Transm Infect* 2006;82

Limitations

The study is subject to several limitations. Firstly NSU estimates are vulnerable to number of biases described above and to correct some of these biases we used the factors (transmission error and popularity ratio) derived from the study of other country that could have significant affected our estimates. Secondly, methods that rely on visual count such as census is likely to miss most hidden sub-groups of population. In our case census was mostly restricted to FSW working on streets in Tbilisi and street and facility based (where entry charges are not required) FSW in Batumi. Capture method was influenced by weather conditions in both cities which was beyond of our control. Multiplier method is subject to non-independence of the two data sources that was also difficult to control. And finally the size estimates from only two cities Tbilisi and Batumi are available. The FSW population size in other large urban areas of Georgia were estimated based on data from these two cities only, therefore the other cities estimates come with additional assumptions and therefore greater uncertainty.

Recommendations

It is well known that FSWs are a highly vulnerable group in the scope of the HIV epidemic so the estimates of the population size are important to inform preventive programs. Similar to MSM population FSWs have sub-populations that makes it difficult to reach the most hidden groups. The FSWs standing in the streets or working in the low/middle class facilities belong to the most vulnerable groups for HIV spread. So the major concern of programmatic service delivery should be expanding the coverage of these FSWs. According to the results of different size estimation methods the proportion of street- and facility based sex workers does not exceed approximately 21% and 40% correspondingly of all FSWs in Tbilisi and Batumi cities.

The other sub-groups of FSWs (belonging to higher socioeconomic layer) are not reachable by current standardized preventive package (condom, lubricant, informational material and counselling on HIV/AIDS) due to their very hidden behavior. These sub-groups never come to the service delivery facilities to receive free service. In conclusion, from multiple methods used in different cities some were successfully applied and some not. In future available NSU estimates could be corrected by local factors derived from a random sample of FSW. It is also recommended that other methods, especially those that are cost-effective (e.g. multiplier) are repeated in conjunction with the next rounds of BBS studies. Multiple methods would allow more rigorous estimates and accurate coverage of preventive interventions.

Appendix 1 - NSU survey questionnaire

Section A. For interviewers
Interviewers code: _____ City: _____ Date of interview: ____/____/_____ (dd/mm/yy) The interview started:_____(hr:m)interview finished:_____(hr:mm)

Section B. Demographic Data

1. **How old are you?** …… (year)
2. **Sex** male- 1 female - 2
3. **Ethnicity** Georgian – 1 Armenian – 2 Azeri- 3 other-4 no response- 99
4. **What is the highest level of education you attended?**

Never attended school.....1 →**go to6**

Uncompleted primary education…….2 →**go to6**

Completed primary education……3 →**go to6**

Uncompleted secondary education….4 →**go to6**

Completed secondary education.....5

Initial vocational program.....6

Secondary vocational program.....7

Bachelor or equivalent 8

Master or equivalent 9

Doctor or equivalent 10

5. **Are you a student**?

Student of secondary professional program 1

Student of the higher professional program 2

Undergraduate student.....3

Masters student 4

Doctoral student..... 5

6. What is your current marital status?

Single .....1 Divorced 3

Married .....2 Widowed 4

no response 99

7. What is your current occupation?

Occupied ..... 1 if yes: Employed..... 1.1 Self employed.....1.2

Unemployed..... 2 if yes: housewife..... 2.1

No response..... 99

8. Do you use the barbershop service?

Yes..... 1 if yes: How many times per year _____

No..... 2 →**go to Section C**

No response ..... 99 →**go to Section C**

9. In which district do you use the barbershop services mostly?

Vake ..... 1 Samgori 6

Saburtalo ..... 2 Gldani 7

Mtatsminda .....3 Didube 8

Nadzaladevi ..... 4 Isani 9

Chughureti .....5 Krtsanisi 10

Section C. Number of people you know with specific name

Now, I want you to recall and write down the number of people with specific namethat you know.These people should be

- [People that you know them by sight and name, and who also know you by sight and name]
  AND
- [People that you had some contact with either in-person, over the phone or internet(e.g.: e-mail, Skype, chat through social networks) in the last 2 years]
  AND
- [People of all ages who lives in Georgia].

Example: Suppose we are asking you to recall the number of people you know with the "first name of Elena" in last 2 years? Take your time and try to recall the overall number of people you know, having "Elena" as a first name. Let's say you recall/count 11 people with the first name of Elana. Perfect! First, you should exclude famous people that you know about, but who do not know about you. So, you should not consider Elena Satine, as she doesn't know about you! ☺. Then, exclude those who are not living in Georgia. Here, as all Elena that you know are living here in Georgia, you should not exclude anyone. And last, of those 10 people with the fist name of Elena, exclude anyone

(let's say 3) whom you did not contact with over the last 24months either in-person, phone or internet. So, the number of people you may write down is 7 (11 – 1 – 3 = 7).

Important notes:

- We know it is not an easy task. Please do your best to recall as much as you can.
- If at the end, you could not recall anyone from the mentioned group, write 0.

Groups	description	answer
1.	How many people do you know with the "first name of Mamuka"?	_____ person(s)
2.	How many people do you know with the "first name of Luka"?	_____ person(s)
3.	How many people do you know with the "first name of Zurab"?	_____ person(s)
4.	How many people do you know with the "first name of Vazha" ?	_____ person(s)
5.	How many people do you know with the "first name of Sophiko, or Sophio or Sopho"?	_____ person(s)
6.	How many people do you know with the "first name of Manana"?	_____ person(s)
7.	How many people do you know with the "first name of Shorena"?	_____ person(s)
8.	How many people do you know with the "first name of Nino"?	_____ person(s)
9.	How many people do you know with the "first name of Maya"?	_____ person(s)
10.	How many people do you know with the "first name of Davit"?	_____ person(s)

Section D. Number of people you know by groups

Now I will ask you the number of people you know.

Again, I am asking about

- [People that you know them by sight and name, and who also know you by sight and name]
  AND
- [People that you had some contact with either in-person, over the phone or the internet (e.g. e-mail, Skype, chat through social networks) in the last 2 years]
  AND
- [People of all ages who lives in Georgia].

Groups	Question	answer	
		overall	Only male
1.	How many people do you know, who **were married in2013 year?**	_____ persons	
2.	How many **teachers** do you know?	_____ persons	_____ male
3.	How many people do you know, who**gave birth in 2013 year?**	_____ female	
4.	How many people do you know, who **died in 2013 year?**	_____ persons	_____ male
5.	How many people do you know, who**died due to cancer in 2013 year?**	_____ persons	_____ male
6.	How many people do you know, who **were injured or died in road accidents in 2013?**	_____ persons	_____ male
7.	How many **higher educational students**do you know?	_____ persons	_____ male
8.	How many **lecturers in higher education institutions** do you know?	_____ persons	_____ male
9.	How many people do you know, who **are currently imprisoned?**	_____ persons	_____ male

Section E. Number of people you know who are at high-risk of HIV, by groups

- [People that you know them by sight and name, and who also know you by sight and name]
  AND
- [People that you had some contact with either in-person, over the phone or the internet (e.g: e-mail, Skype, chat through social networks) in the last 2 years]
  AND
- [People of all ages who lives in Georgia].

Groups	Description	Answer (Write the number of people you know)					
		Overall	Sex		Age group (year)		
			Male	Female	<18y	18-30y	>30y
1	Some people use drugs, some of them use drugs by injection. How many people do you know who inject drugs? **(Injecting drug user is a person who injects drugs without medical indication)**	____	_____	_____	_____	_____	_____
2	How many men do you know who are clients of female sex workers? **(Those men who pay for having sex with female sex workers)**		_____		_____	_____	_____
3	In general, men have sex with women, but there are some men who have sex with men. How many men do you know who have sex with other men? **(They may also have sex with women)**		_____		_____	_____	_____
4	How many female sex workers do you know? **(Women who exchange sex for money)**			_____	_____	_____	_____