Estimation of the size of the female sex worker population in Rwanda using three different methods

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Summary

HIV prevalence is disproportionately high among female sex workers compared to the general population. Many African countries lack useful data on the size of female sex worker populations to inform national HIV programmes. A female sex worker size estimation exercise using three different venue-based methodologies was conducted among female sex workers in all provinces of Rwanda in August 2010. The female sex worker national population size was estimated using capture–recapture and enumeration methods, and the multiplier method was used to estimate the size of the female sex worker population in Kigali. A structured questionnaire was also used to supplement the data. The estimated number of female sex workers by the capture–recapture method was 3205 (95% confidence interval: 2998–3412). The female sex worker size was estimated at 3348 using the enumeration method. In Kigali, the female sex worker size was estimated at 2253 (95% confidence interval: 1916–2524) using the multiplier method. Nearly 80% of all female sex workers in Rwanda were found to be based in the capital, Kigali. This study provided a first-time estimate of the female sex worker population size in Rwanda using capture–recapture, enumeration, and multiplier methods. The capture–recapture and enumeration methods provided similar estimates of female sex worker in Rwanda. Combination of such size estimation methods is feasible and productive in low-resource settings and should be considered vital to inform national HIV programmes.

Introduction

In many countries, the HIV epidemic is concentrated in subgroups of the population whose behaviour exposes them to a high risk of acquiring HIV infection, including injection drug users, men who have sex with men, and commercial sex workers.[1] The prevalence of HIV infection has been well established to be higher among female sex workers (FSWs) compared to the general population[2–5] and this group remains a key point of transmission for HIV and other sexually transmitted infections (STIs). In Rwanda, where the HIV prevalence amongst FSW is reported to be as high as 51%,[6] this key population is known to be an important mode of transmission of HIV and other STIs.[5] In order to decrease HIV incidence and transmission, it is vital for HIV national prevention and treatment programmes to focus investment and resources on preventing new HIV infections among FSWs;[7] however, in many sub-Saharan African countries, the scope and size of this population remain unknown.

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Many challenges exist to obtaining population-based data on sex workers, which include, but are not limited to, legal restrictions on solicitation of sex work, stigma and discrimination associated with sex work, the mobile nature of sex work, the clandestine nature of the activity, geographic heterogeneity among sex workers (e.g. street-based, venue-based, home-based, etc.), and varying definitions of professional sex work as opposed to other forms of non-monetary transactional sex.[8] In Rwanda, size estimation of FSWs is challenging due to the illegality and criminalization of the occupation. Anecdotally, the most common types of FSWs in Rwanda include those who are street-based, home-based, lodge-based, road (truck stop)-based, venue-based, and associated with escort services; however, no estimates have been made regarding the overall number or relative proportion of these distinct groups of FSWs. Due to the lack of accurate size estimations of FSW populations the proportion of HIV infections associated with this key population is unclear, which complicates evidence-based decision-making regarding resource allocation for policy and programming. Additionally, the absence of size estimation for this population prevents accurate estimation of coverage and utilization of HIV programming related to prevention, case detection, and treatment.

Various methods have been suggested to estimate FSW population sizes, each with strengths and weaknesses. Some of these methods are venue-based methods, leveraging the fact that sex workers tend to congregate in certain areas. However, this assumption has its limitations when estimating population size. For example, among sex workers who typically have long-term repeat clients, client encounters may often occur in a private residence, reducing the likelihood of these FSWs being included in venue-based estimation methods. Estimation of the size of FSW populations using classic census methods is useful when organizing prevention programmes in the absence of previous size estimation data. In this method, detailed mapping of all likely venues is developed with key stakeholder groups and ideally with the participation of FSWs. Based on this detailed mapping, all sites are visited within a given timeframe and all eligible individuals are counted at each site. Because of variability in times for data collection, sites often need to be visited on several occasions by the research team. However, given the resource-intensive nature of classic census methods, they have had limited practicality in developing countries.

The capture–recapture method (CRM) has been employed to estimate the size of hidden or difficult-to-reach human populations such as sex workers, homeless persons, and intravenous drug users, and it is currently recommended by the World Health Organization/Joint United Nations Programme on HIV/AIDS.[7,9,10] This method begins with a 'capture' stage in a defined geographical area where a sample of subjects are initially identified and 'tagged' by providing an identifying object and then 'released' back into the population. At a subsequent time, a second sample is then recaptured independently, some number of which will have been tagged previously. The proportion of marked individuals 'recaptured' provides an estimate of the proportion of the whole population.[11] This method is relatively easy to use but an accurate estimate must be based on critical assumptions: (1) the two samples should be independent and (2) there is no in- or out-migration of individuals among the population.

The enumeration methods for size estimation may use different methodologies. For example, rather than counting every individual, they may use a sample frame or list, or they may choose clusters (for instance hot spots, brothels, or cabarets), and then count the individuals within those designed clusters. The number counted is then scaled up according to the size and structure of the sample frame.[12] Enumeration methods have the advantage of being easy to calculate and understand, although they may not perform well for hidden populations.[12]

Size estimation using the 'multiplier' method generally relies on having information from two separate data sources that overlap in a known way;[13] the first could be an institution or service in which the population is supposed to be in contact offering the particular object or service, or participating in a memorable event as the count of the first population, and the second is the target population defined in the same way in the same area in a survey after a given time.[14] The population size is then estimated by multiplying the number who received the service by the proportion reporting receiving the service.[8] This method is often preferred when the population is hard to reach, but it is highly dependent on the quality of the data being used.[14]

The purpose of the present study is to use different methods to estimate the population size of the relatively inaccessible FSW population in Rwanda in order to better inform national HIV planning. Specifically, the objective of this study is to estimate the FSW population size across Rwanda using the CRM and enumeration methods and estimate the FSW population size in Kigali, the capital, by the multiplier method.

Methods

Survey design

From 15 August to 22 August 2010, we conducted a cross-sectional national survey of FSWs in Rwanda.

We used venue day-time (VDT) sampling methods, a technique which involves specific place of availability of FSWs waiting for their client, days and time to reach them, and has previously described as optimal for hard-to-reach populations.[15] For example, a hot spot that is open from Friday to Sunday from 10 p.m. until 2 a.m. is considered as three VDTs (Friday: 10 p.m.–2 a.m.; Saturday 10 p.m.–2 a.m. and Sunday: 10 p.m.). The VDTs were selected according to hot spots previously identified during a FSW mapping exercise conducted in Rwanda in 2008 by Rwanda Biomedical Center.[16] A total of 694 VDTs were identified, which were chosen independently of the 2010 Behavior surveillance survey (BSS), which collected data on a total number of 1338 FSWs.[6] Of those, 150 VDTs were randomly selected for data collection, including 30 VDTs from each of the five provinces in order to ensure geographic diversity. In order to minimize double counting of individual subjects, a screening question was asked of all participants: 'in the last 2 weeks has anyone approached you asking to participate in a size estimation exercise?'

Study population and sampling

Data collection occurred when FSWs were present at the hot spot, typically between 4 p.m. and 5 a.m. FSW was defined as a female self-reporting as receiving money for sex. Male sex workers and FSWs under the age of 15 were excluded. Ten participants were randomly selected at each hot spot by assignment of study numbers and random number selection using an Excel sheet where there were more than 10 FSWs at the arrival of data collectors. A questionnaire was administered to each selected subject, which asked whether or not they participated in the BSS in February 2010. The tag for subjects to recall participation in the BSS was the compensation fees granted to participants, the type of questionnaire administered, and the HIV testing conducted. Subjects were also asked whether they had attended the Gikondo transit camp in Kigali during the specific time period of January 1–March 31, 2010, during a time when vocational trainings for FSWs were being held.

The CRM and enumeration method of size estimation were used for the same population and in the same time. The multiplier method was applied specifically to FSWs reporting attendance to the Gikondo transit camp vocational trainings, where specific numbers of FSWs in February 2010 are recorded and available. The actual number of participants attending this camp was considered as a first count. The second count consisted of participants captured in Kigali in the size estimation exercise.

CRM[7,13]

The formula[7] used to estimate the population size was

$$N = M * C/R \qquad (1)$$

where N = Estimate of total FSW size, M = Total number of FSWs 'captured' and 'marked' on the previous FSW BSS, C = Total number of FSWs 'captured' and 'marked' on the size estimation exercise, R = Number of FSWs captured on the previous FSW BSS that were then recaptured on the FSW size estimation exercise (i.e. included in both samples). The confidence interval for the estimate of total FSW size was calculated using the following formula[7]

$$95\% \text{ confidence interval (CI)} = N \pm 1.96 \text{ Var(N)} \qquad (2)$$

where Var(N) was calculated as

$$\text{Var(N)} = M * C(M - R) * (C - R)/R3 \qquad (3)$$

Enumeration method[7]

For the enumeration method of FSW size estimation, a second data collector enumerated all FSWs at the site including those participated in the interview. The average number of FSWs in all spots in the sampling frame was applied to each stratum (bars, brothels, streets), and the sum of all strata was calculated to produce the whole population.

Multiplier method[7,13]

The multiplier method was used to estimate the size of FSWs in Kigali only. FSWs that were selected in the size estimation survey were asked questions about whether they received specific services or had contact with specific institutions. These proportions were used as multipliers along with the service/institution population data. In this case the proportion or count of FSWs seen at Gikondo transit camp in February 2010 was multiplied by the number or proportion of FSWs captured in Kigali during the FSW size estimation exercise. In Gikondo transit camp occupations of attendees were recorded in registers.

The formula[7,13] utilised for the multiplier method was

$$S = N/P \qquad (4)$$

where S = size of FSW, N = number of FSWs at Gikondo transit camp in Kigali in February 2010, P = proportion in the FSW size estimation survey.

Data management and analysis

All completed questionnaires were managed by the survey team leader and data were double entered into an EPI-Info database [Epi Info is public domain statistical software for epidemiology developed by Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia (USA)] at Rwanda Biomedical Center (RBC) and analysed using STATA 11 (StataCorp LP, College Station, Texas, USA).

Ethical considerations

This study was reviewed and approved by the Rwanda National Ethics Committee. Verbal consent was obtained from all study subjects prior to enrolment.

Results

CRM

Overall, 920 FSWs participated in the FSW size estimation, of which 384 were recaptured from the previous FSW BSS. A total of 384 (29%) participants in February 2010 BSS were recaptured and 954 were not recaptured. Forty-six people came twice in the same survey and were excluded in data analysis. Therefore, according to the CRM, the population size of FSWs was 3205 (95% CI: 2998–3412).

Enumeration method

FSWs were counted at each hot spot, and the average number of FSWs per venue type were 24.7 in street-based venues, 17.5 in club-based venues, and 50 in cabaret-based venues. The total number of estimated FSWs by the enumeration method was 3348.

Multiplier method

Seven-hundred fifty-one FSWs were recorded as attending the Gikondo transit camp in February 2010. Two-hundred fifty-three FSWs in the city of Kigali participating in the FSW size estimation survey reported being in the Gikondo transit camp between 1 January and 31 March 2010. The proportion of FSWs registered in the Gikondo transit camp in February 2010 that were included in the size estimation survey was 33.3% (95% CI: 27.5–39.2%). The FSW size estimate for Kigali based on these data is 2253 (95% CI: 1916–2524).

Discussion

This study estimated the size of the FSW population in Rwanda using the CRM and enumeration method in the national population and the multiplier method in the capital city of Kigali. Estimating the size of key populations in general and for FSWs in particular in Rwanda is important for HIV prevention programmes. The size of FSW populations change over time, and simple methods for size estimation are needed.

The overall objective of this survey was to estimate population sizes of FSWs in Rwanda using three different methods of estimation combined with existing research activities through a previously planned BSS. In CRMs, 71% of FSW attendees in previous BSS were not recaptured in size estimation exercise. The reason could be the big population and the mobility of FSWs. Our results showed a high degree of concordance between CRM and enumeration methods, as the estimate of the enumeration method is included in 95% CI of capture–recapture size estimate.

Previous studies in other settings used the same methodology as recommended by the UNAIDS. For example, the CRM has been used in Ivory Coast, Kenya, and El Salvador for estimating the number of FSWs.[15,17,18] The enumeration method was used in a single province in Mozambique to estimate the size of FSW and truck driver populations.[19] The multiplier method was also used in Nairobi, Kenya, to estimate the size of hard-to-reach populations.[20] However, few other comparative analyses have been reported.[21]

The multiplier method was used in the survey, demonstrated a population estimate of 2253 FSWs in the city of Kigali. This finding is similar to a recent mapping exercise conducted in 2012 where the population size of FSWs in Kigali was found to be 2395.[22] Assuming the various estimates are approximately correct, the data suggest that nearly 80% of FSWs in Rwanda are based in the capital. A previous demographic health survey has also shown that higher concentrations of FSWs are living in Kigali, and these results correspond to an increased rate of HIV in Kigali compared to the rural areas outside of the capital (7.1% versus 2.3%, respectively).[23] In the nearby African capital of Nairobi, Kenya, a similarly small number of hot spots (18%) contain the majority of the area's sex workers (65%).[20]

We recognise several limitations of this study. A large number (71%) of FSW attendees from the 2010 BSS were not recaptured in this size estimation study. These may have included FSWs working in home-based, phone-based, or hotel-based settings, or those with unsteady participation in commercial sex work, and may not have been present at the time of data collection. Additionally, FSWs in rural areas may be more likely to avoid identification as FSWs due to stigma and criminalisation. We believe, however, that overall population migration during this time period was low, thereby limiting bias. Whereas sampling frames for the first and second captures is ideally independent, the first survey (BSS) covered virtually all viable hot spots of FSWs in Rwanda, and therefore

many of the same locations were sampled in the second survey, leading to possible underestimation of the true population size. A limitation in the analysis utilising the multiplier method was the incomplete match of the time period of registration of the original group of FSWs (February 2010) and the period recalled by FSWs during the survey (1 January–31 March 2010), which could have led to an inaccurate number of FSWs in Kigali. However, given that most occupants of the Gikondo transit camp stayed in the camp for several weeks, we believe that the vast majority of FSWs reporting being in the camp at some point during the 3-month period were very likely to be present for the vocational training in February 2010.

Despite these limitations, our results provide first-time estimates of the FSW population in Rwanda. Estimating the size of key populations in general, and for FSWs in particular in Rwanda, is vitally important for HIV policy and programming. Additionally, our results add to the body of literature suggesting that triangulating different methods to calculate population size estimations in hard-to-reach key populations is feasible and necessary[7,21] in a resource-poor setting.

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