



RESEARCH ARTICLE

REVISED Programmatic mapping and estimating the population size of female sex workers, men who have sex with men, people who inject drugs and transgender populations in Kenya

[version 4; peer review: 2 approved, 3 approved with reservations]

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Abstract

Introduction

Effective coverage of Human Immunodeficiency Virus prevention services for Key Populations (KPs) including female sex workers (FSWs), men who have sex with men (MSM), people who inject drugs (PWID) and transgender (TG) people necessitates periodic validation of physical venues and size estimates. Kenya conducted a robust size estimation of KPs in 2012 and a repeat mapping and size estimation exercise was conducted in 2018 to update KP Size Estimates and sub-typologies within each County for calculation of realistic program indicators.

Methods

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A prospective mixed methods programmatic mapping approach adopted comprised two steps. The first step involved consolidating and documenting all known venues where KPs congregate while the second step included visiting and validating these venues confirming their active status. Data were collected in 34 out of 47 Counties in Kenya between January and March 2018. Data collected included estimated number of KPs (range), venue typology and timing of operation of each venue.

Results

We estimated a total number of 167,940 (129,271 to 206,609) FSWs; 32,580 (24,704 to 40,455) MSM; 16,063 (12,426 to 19,691) PWIDs and 4,305 (2,826 to 5,783) transgender people congregating at 10,250, 1,729, 401 and 1,218 venues respectively. Majority of the venues for FSW (81%), MSM (64%) and transgender people (67%) were bars with and without lodging, PWIDs were mostly found on streets and injecting dens (70%). Around 9% of FSW and MSM and 11% of PWIDs were below the age of 18 years.

Conclusion

This study provided information on young KPs, female PWIDs, MSWs and for the first time, TG people in Kenya. The exercise updated size estimates of KPs by typology and provided new evidence for resource allocation, planning of interventions and targets. Programmatic mapping continues to be a useful approach supporting programs to achieve high levels of coverage and prioritize resources.

Keywords

Key Populations, programmatic mapping, population size estimates

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REVISED Amendments from Version 3

The updated article has changes in the abstract where the data for PWUDs has been deleted to focus only on PWIDs. An explanation on the use of FGDs and how participants were selected has been elaborated.

Any further responses from the reviewers can be found at the end of the article

Introduction

Key populations (KPs) are disproportionately affected by human immunodeficiency virus (HIV) compared to the general population^{1,2}. In 2018, 54% of all new adult HIV infections globally were among KPs (including sex workers, people who inject drugs, prisoners, transgender people, and men who have sex with men) and their sexual partners indicating their elevated risk of HIV infection³. This elevated risk of HIV among KPs and their sexual partners is attributed to risky sexual behaviors such as multiple sexual partners, unprotected sex and sharing contaminated needles but also in part to stigma and discrimination, high violence and barriers to HIV prevention, care, treatment, and other services among these populations⁴. To scale up HIV prevention interventions tailored to local needs, it is important to understand the epidemic and its drivers as well as its geographic localization, then develop a public health response using these local updated data^{5,6}. Programmatic mapping and size estimation serves as a critical step to develop and scale-up HIV prevention programs for KPs. It helps to estimate population size, understand where these populations are located and how to reach them for an effective program response, provides evidence to decision makers on numbers within the counties and therefore supports in resource mobilization for interventions for KPs. It also provides denominators which can be used to track the progress of a program and interventions^{7,8}. A review conducted in Africa showed that less than half of the 54 countries in Africa had estimated the size of KPs and published these data⁹. Within Eastern Africa, Tanzania, Uganda and Kenya were the only countries that have conducted and published KP size estimations¹⁰⁻¹².

Kenya exhibits a mixed HIV epidemic; generalized among the adult population and concentrated within KPs. It is among the ten countries in southern and eastern Africa that account for 80% of all people living with HIV (PLHIV) globally¹³. HIV prevalence among KPs is high with 18.9% among people who inject drugs (PWID)¹⁴, 29.5% among female sex workers (FSW) and 18.2% in men who have sex with men (MSM)¹⁵. Recognizing the importance of KPs in the HIV response, the 2014/15-2018/19 Kenya AIDS Strategic Frameworks (KASF) prioritized FSW, MSM, transgender people (TG) and PWIDs in the HIV response to reduce new HIV infections by 75% nationally¹⁶⁻¹⁸. To comprehend the scope of the HIV prevention response, Kenya first conducted programmatic mapping and size estimation of KPs in 2012 where a total of 10,670 FSW hotspots with an estimated number of 103,298 FSWs; 1,585 MSM hotspots with an estimated number of 10,033 MSM

and 919 PWID hotspots with an estimated number of 7,850 PWIDs were done. Similarly another size estimation was done in Nairobi where 11,042 MSM, 29,494 FSW and 10,937 PWIDs were estimated^{19,20}. The results supported the scale up KP interventions in 34 out of 47 counties in the country for example counties that only had programs for the FSW sub-population, scaled up services to include services for MSM. Since the monitoring and evaluation framework for the KASF 2014/15–2018/19 recommends updating KP size estimates every five years, the Kenya national KP program under the National AIDS and STIs Control Programme (NAS COP) decided to re-map and re-estimate the sizes of KPs in all counties where KP programs were implemented¹⁷. Programmatic mapping isn't designed to identify the total size of KPs, but rather to identify populations that are actively seeking partners at venues (FSW/MSM and TG) and/or congregating for injecting (PWIDs). Kenya for the first time estimated the number of TG people through existing partners who were implementing FSW and MSM programs as there were no programs specifically implementing for this sub-population. The focus of the study was on transwomen and data shared is based on this population due to their higher risk to HIV. This study aimed to update KP size estimates within each County where a KP program was being implemented for the calculation of realistic program targets and indicators, as well as comprehend the changes in KP dynamics over time.

Methods**Study design**

The study employed a programmatic mapping approach where quantitative data was collected. Programmatic mapping approach maps the sites and spots where key populations engage in risky behavior. It is the systematic identification of locations where KPs congregate and could be reached with services. The term “programmatic” is used to indicate that the mapping is done as part of routine service delivery activities to improve the engagement of KPs with the program and monitor program coverage. It also provides an estimate of the KPs at the venue level and also accounts for the overlap of KPs between different venues. We reviewed and updated the existing hotspots, conducted a physical validation of these spots in addition to identifying new ones. The exercise was led by KP communities, involving existing implementing partners (IPs) and service providers who can also identify existing program and service gaps^{21,22}. Characteristics and locations of hotspots change, either due to closure or the creation of new hotspots and it is important to validate the existing hotspots and to identify new hotspots. This study revalidated the size estimates of the existing spots and characterized sex work or injecting sites in terms of operational typologies. It also helped identify new hotspots not previously covered by the programme. Virtual hotspots for MSM were not included in the exercise. After consultations with stakeholders and the community it was agreed that the estimates would include 25% of MSM who do not visit physical hotspots and seek partners in the virtual spaces based on a study that mapped the virtual platforms to estimate the population of MSM who use the internet to find sexual partners²³.

Sampling

The size estimates exercise took place in 34 out of the 47 counties in Kenya. We only included counties where HIV prevention programs and services were implemented. Based on this criteria, 34 counties were selected for mapping FSW, 30 counties were selected for mapping MSM, 15 for PWID and 30 counties were selected to map transgender people.

Data collection

Data were collected between January 2018 to March 2018 by existing IPs in 34 counties (Bomet, Bungoma, Busia, Embu, Homabay, Kajiado, Kakamega, Kericho, Kiambu, Kilifi, Kirinyaga, Kisii, Kisumu, Kitui, Kwale, Laikipia, Nakuru, Machakos, Makueni, Meru, Migori, Mombasa, Muranga, Nairobi, Narok, Nyamira, Nyeri, Siaya, Taita Taveta, Tharaka Nithi, Trans Nzoia, Turkana, Uasin Gishu and Vihiga). This was not a stand alone research study, and was conducted as part of the key population program of the Kenya's National government initiative. We focused on the counties where HIV prevention programs were already providing services to key populations which were 34 out of the 47 counties. There was a consultative process during the national technical working groups for key populations and it was agreed to conduct the KPSE exercise as part of the programs and to update size estimates of key populations in these 34 counties. At the time of the size estimations only 34 counties had FSW partners implementing for the FSW, 15 counties had PWID implementing partners and 30 counties had MSM implementing partners. These are the counties that were then the focus of the size estimations.

Level one. Data collection was done in two sequential steps: "level one" and "level two". Level one involved making a comprehensive list of venues and hotspots for different KPs types within each county. This activity was done in collaboration with the peer educators (PEs), outreach workers (ORWs) and program staff from the implementing partners. The exercise involved listing down the known hotspots where KPs congregate and profiling the sites using a form known as level one form (L1 form). The L1 form listed all existing hotspots within a specific sub-location and also the existing hotspot-level information such as hotspot name, location, typology of KPs, overall number of KPs and the details of nearest health facility. This list included those venues and hotspots that were previously mapped by the IPs. The process further involved identifying new venues and hotspots by consulting KP members, peer educators, outreach workers and program staff from IPs.

Level two. Once a complete venue list was developed for each county, the next step known as "level two" involved validating and profiling all known venues or hotspots. In this step, field teams visited each venue or hotspot, identified and interviewed three to five KP members who belong to or operate through that specific venue or hotspot through focus group discussions (FGDs). FGDs helped peers to share their knowledge on the hotspots and reach consensus especially on the estimated number of KPs. The FGDs were conducted through structured questions that were part of the form that collected data at level 2 known as Form B. Form B can be found under Extended data²⁴. The

interviews took place at the hotspot and were conducted by the PE with support from the ORW and it took about 15 minutes. At the hotspot, a gatekeeper was identified and informed on the process and what information was being collected for informed consent to carry out the exercise. The peer educator for the hotspot then identified either FSWs, MSMs or PWIDs present at the hotspot at the time of the mapping exercise and they were approached and requested to take part in the group discussion. The KP members were identified randomly from the hotspots at the time of the size estimation hence they were found physically at the hotspot during the exercise and were homogeneous in the sense that they belonged to the same KP group. They were all interviewed at the same time and provided the estimate for low, mid and high KPs after discussing among themselves building consensus. Data were collected using "level two form" (Form B) which captured hotspot characteristics such as peak day(s), peak time(s), and the approximate numbers of KPs at each site on non-peak days and peak days. In addition, the form captured the numbers of transgender population, number of MSWs, number of PWUD, the numbers of KPs in various age groups, and the numbers of male and female PWID. For this mapping exercise we used the broader term of transgender, as used in other similar studies although the focus was on transwomen. It should be noted that no specific information about individuals was collected, and the methodology did not physically count individuals. Rather, the methodology captured the KPs' estimates of how many KPs are at each hotspot at various days/times.

Data quality assurance

A team of master trainer's including County AIDS and STI Coordinators (CASCOs), Sub County AIDS and STI Coordinators (SCASCOs), IPs and KP community leaders were trained on programmatic mapping in a three-day national level training workshop conducted by National AIDS and STI Control Programme (NAS COP), University of Manitoba (UoM), Partners for Health and Development in Africa (PHDA) and University of California, San Francisco (UCSF). At the county level, the CASCOs organized trainings of IPs including peer educators and outreach workers and led the process of field data collection. The national KP program was responsible for overall coordination, data management, analysis, monitoring of fieldwork and assuring data quality. Field supervision and data quality assurance were achieved through a multilayered monitoring mechanism. At the national level, NAS COP, UoM and UCSF monitored all field activities and conducted random supervisory visits in the field. At the county level, the CASCOs and SCASCOs along with the NAS COP site supervisors led the supervision of the mapping process.

Data analysis

A database was designed using [Open DataKit](#) (ODK) Collect application by UCSF with both logic flows and logic checks enforced for enhanced data consistency. Data were either collected using the installed ODK collect application on Android smartphone-based or on a paper form if the interviewed subject or data collector was not comfortable with the use of an android device. Paper-based data was later captured

using the ODK Collect application. Both onsite and offsite data verification was conducted by site supervisors for every 10% of data collected per day. Data managers also reviewed the data collected for consistency and completeness before data were cleaned and analyzed. If 10% or more of the data collected showed inconsistencies, the validation process was redone in those venues or hotspots. Additionally, data for MSM were revalidated based on the recommendation by the MSM community, the research and program team. They felt that the numbers of MSM need to be revalidated as some of the numbers were different from what the program generated estimates were. Thus 5%–10% of the hotspots were randomly picked within 10 randomly selected counties and were revalidated to check for under-reporting or over-reporting in those counties.

Venue or hotspot analysis and size estimates of KP at each venue or hotspot were conducted using information collected at level two. Since this information was directly obtained from KPs at the venue or hotspot level, the information had high reliability specifically regarding the numbers of KPs, their characteristics, typology and mobility. The size estimation process included finalizing the number of KPs for each venue or hotspot within an intervention site and geographic area, and aggregating it subsequently at the Ward, Sub-county, County and finally at the national level. These estimates were adjusted for the overlap as most KPs visit more than one spot, and also for the average number of spots visited by each KP. The adjustment were made independent of overlapping group participation. We agree that there are some overlapping behaviors, but we included the KP member in the group where he/she was originally counted. The following mathematical function was used i.e., $E_i = \sum S_i(1-P_i) + (S_i * P_i / M_i)$, where S_i = spot estimate, P_i = proportion of KPs visiting multiple spots, M_i = average no of spots visited. Analysis of the data was done using SPSS version 24.0.

Ethics and consent

The study followed all ethical principles of conducting research with human subjects including use of informed consent and maintaining confidentiality of information through strict measures. Ethical approval for this research was obtained from Kenyatta National Hospital, University of Nairobi Ethical Review Committee (ERC) of (P647/11/2017) for secondary analysis of the study data. International ethical guidance was followed to maintain confidentiality of participants i.e., no recording of participant identity or personal identification information, use of unique identifying codes and limiting access to the data files to authorized individuals only. Informed verbal consent was then obtained from the participants before the discussions started. All interviews were conducted in a safe and secure place. All participating KPs were compensated for their time and travel in Kenyan Shillings equivalent to \$5 USD. Debriefing sessions were conducted after the interviews and all participating KPs were referred to HIV prevention, treatment and care facilities.

Results

Table 1 presents the estimated KP size estimates (KPSEs) (range) of FSWs, MSMs, PWIDs and TG people in 34 counties mapped in Kenya. A total of 167,940 (129,271 to 206,609) FSWs were estimated in 10,987 geographical venues or hotspots with 9% of them being under the age of 18 years. FSWs were the largest KP in Kenya followed by an estimated number of approximately 32,580 (24,704 to 40,455) MSM, operating from 2,153 geographical venues or hotspots. Nearly 9% of these were less than 18 years old. 36% of the MSM, that is, 11,807 (8,760 to 14,854) informed that they sell sex to other men in these venues or hotspots. Approximately 16,063 (12,426 to 19,691) PWIDs were estimated at 402 venues with 11% of them being under the age of 18 years. In terms of gender, 13,658 (85%) PWIDs were male while 2,405 (15%) PWIDs were female. We also estimated 4,305 TG women from 1,218 venues. **Table 1** also shows the number of KPs per 1,000 adult men or women above 18 years. We estimated 11.6 FSW per 1,000 women, 1.1 male PWIDs per 1,000 males, 0.18 female PWIDs per 1,000 females, 2.4 MSM per adult men and 0.34 transgender women per 1,000 males. This study did not include transmen, and only focused on transwomen, hence the denominator is 1000 adult men. The full dataset can be found under *Underlying data*²⁴.

Table 2 shows information on various venues used by FSW, MSM, PWID and TG women in Kenya as well as their estimated numbers by typology of venues. A total number of 14,760 geographical venues or hotspots and locations were identified for all different KPs typologies with FSWs having the highest number of 10,987 venues or hotspots in all 34 counties. The typology of venues ranged from bars with lodging, bars without lodging, guest houses, streets, sex dens and uninhabited buildings. Bars without lodging accounted for 5,099 (46.4%) of the total FSW venues or hotspots followed by bars with lodging at 3,769 (34.3%). All the other typologies accounted for below 4% of the total FSW venues or hotspots. For MSM, a total of 2,152 venues or hotspots were mapped in 30 counties with similar typologies as FSW venues. Bars without lodging accounted for 762 (35.4%) of the total MSM venues or hotspots followed by bars with lodging (28.4%) and 192 (8.9%) street venues. All other typologies accounted for 27% of the total MSM venues or hotspots. A total of 402 venues for PWID were found in 15 counties only. These mostly included streets/highways/alleys/backstreets, injecting dens, uninhabited buildings, parks/beaches/toilets and homes. Streets/highways/alleys/backstreets accounted for 151 (37.6%) of the total PWID venues or hotspots followed by injecting dens at 130 (32.4%). All the other typologies accounted for 30% of the total PWID venues or hotspots. It was noted that people who use drugs and not necessarily injecting drugs used the same venues as those who injected drugs. Transgender women were found to use the same venues used by FSWs and MSM. A total of 1,218 such FSW and MSM venues were identified that the transgender women were also using. Nearly 3/4 of these venues included both bars with and without lodging facilities

Table 1. Size estimates of various key populations in Kenya.

Female sex workers (FSWs)	Estimated Numbers
<i>Estimated FSWs (range)</i>	167,940 (129,271 to 206,609)
<i>No. of venues</i>	10,987
<i>Estimated FSW below 18 years (range)</i>	14,809 (10,432 to 19,185)
<i>No. of FSWs per 1,000 adult females**</i>	11.6
<i>Average No. of FSWs per venue</i>	15
People who Inject Drugs (PWID)	
<i>Estimated PWIDs (range)</i>	16,063 (12,426 to 19,691)
<i>Estimated PWIDs below 18 years (range)</i>	1,831 (1,229 to 2,433)
<i>No. of venues</i>	402
<i>Estimated Male PWIDs</i>	13,658
<i>No. of PWID per 1000 adult men**</i>	1.09
<i>Estimated Female PWIDs</i>	2,405 (15%)
<i>No. of PWID per 1000 adult women**</i>	0.18
<i>Average No. of PWID per venue</i>	40
Men who have sex with men (MSM)	
<i>Estimated MSM (range)</i>	32,580 (24,704 to 40,455)
<i>No. of venue</i>	2,153
<i>Estimated MSM below 18 years (range)</i>	2,949 (2,039 to 3,858)
<i>Estimated MSM who sell sex (Male sex workers) (range)</i>	11,807 (8,760 to 14,854)
<i>No. of MSM per 1000 adult men**</i>	2.37
<i>Average No. of MSM per venue</i>	15
Transgender People	
<i>Estimated transgender people (range)</i>	4,305 (2,826 to 5,783)
<i>No. of venue</i>	1,218
<i>No. of transgender people per 1000 adult men**</i>	0.34
<i>Average No. of transgender people per venue</i>	3

*Total estimated number (minimum estimate – maximum estimate)

** Number of adult females and males (18–49) in Kenya was taken from the 2019 Kenya Population Housing Census Volume III (Available at: <https://www.knbs.or.ke/?wpdmpo=2019-kenya-population-and-housing-census-volume-iii-distribution-of-population-by-age-sex-and-administrative-units>. Accessed April 20, 2021).

which accounted for nearly 70% of the transgender women in Kenya.

Findings indicated that KPs usually are available on the venues during the entire week and most times of the day. However, there are days specific to each KP when their numbers increase than the usual referred to as peak days and peak times. Sunday was the peak day of operation for FSWs, reported by 85% of the respondents followed by Saturday (74%). Most FSW reported

being available at their specific venues on these days, especially between 6pm–10pm. Sunday and Saturday were also reported to be the peak days of operation for MSM reported by 86% of the respondents, with evenings (6pm–10pm) being the peak time of operation. Data gathered from PWIDs showed that they are present at the venues during most days of the week, with more activity seen on Fridays and Sundays mostly early mornings and evenings when PWID usually come to venues to inject drugs (Table 2).

Table 2. Venue information for key populations in Kenya.

Variable	FSWs		MSM		PWID		Transgender women	
	No. of venues	Estimate	No. of venues	Estimate	No. of venues	Estimate	No. of venues	Estimate
Venues Typology								
Street	424	9132	192	2820	151	4913	105	397
Parks/beach/toilet	105	1945	90	1373	29	663	38	143
Residential	324	10342	114	2449	17	511	69	274
Sex den/brothel	118	2538	15	147	1	17	16	59
Strip club/ massage parlor/ salon	242	2592	29	448	2	41	15	59
Bar with lodging	3769	55839	613	8076	3	48	412	1455
Bar without lodging	5099	71012	762	12775	25	537	429	1409
Guest house	435	6912	42	430	0		36	115
Uninhabited building	44	757	12	193	39	1108	7	32
Drug dens	2	28	3	29	130	8166	2	4
Casino/club	244	4802	144	2530	5	60	63	300
Others	181	2043	137	1311	0		26	60
Hours of operation								
Morning (till 12 pm)	12%		5%		80%		NA	
Afternoon (12 – 5 pm)	26%		17%		27%		NA	
Evening (5 – to 9 pm)	74%		71%		41%		NA	
Night (9 pm onwards)	62%		72%		38%		NA	
Days of operation								
Monday	18%		12%		19%		NA	
Tuesday	10%		6%		28%		NA	
Wednesday	11%		8%		34%		NA	
Thursday	22%		13%		26%		NA	
Friday	53%		37%		56%		NA	
Saturday	76%		85%		36%		NA	
Sunday	85%		86%		48%		NA	

Table 3 shows an average along with minimum and maximum estimated numbers of FSWs, MSMs and PWIDs in 34 counties mapped in Kenya. Of the 167,940 FSWs estimated in all 34 counties, nearly one fourth were found in Nairobi (24%), followed by Nakuru (11%) and Mombasa (5%). More than 90% of the FSWs were found to concentrate in 24 counties. Overall, 32,580 MSM were estimated in 30 counties, of which 91% concentrated in 14 counties, with Nairobi County accounting for 31% of the total estimate. Both Kilifi and Mombasa comprised of 9% each of the total estimated MSM in Kenya. PWIDs were found in 15 counties with an estimated number of 16,063. Nearly 85% of the total

PWIDs were from 4 counties, with Nairobi having the largest proportion (31%) followed by Kilifi and Mombasa, which had 27% and 16% of the estimated PWID respectively. Transgender women were the smallest number of KP with an estimated number of 4,305 transgender women found in 30 counties, they share the venues with FSW and MSM, with Nairobi County having the largest share (25%) followed by Bungoma (12%), Mombasa (10%) and Kilifi (8%) counties.

Figure 1, Figure 2, Figure 3 and Figure 4 shows the distribution of FSWs, MSMs PWIDs and Transgender People in the different counties in Kenya. As shown FSWs were present in

Table 3. Estimated number of FSWs, MSMs, PWIDs and TGs in all Counties mapped in Kenya.

County	FSW	MSM	PWID	Transgender women
Total	167,940 (129,271–206,609)	32,580 (24,704–40,455)	16,063 (12,426–19,691)	4,305 (2,826–5,783)
Bomet	3,309 (2,585–4,032)	120 (100–140)	NA	9 (4–14)
Bungoma	3900 (2,699–5,100)	1,562 (1,162–1,961)	NA	518 (336–699)
Busia	2,968 (2,408–3,527)	572 (440–704)	NA	NA
Embu	1,851 (1,332–2,369)	132 (93–171)	NA	NA
Homa bay	3,783 (2,594–4,971)	252 (176–327)	91 (55–127)	87 (56–118)
Kajiado	7,642 (6,359–8,924)	474 (311–636)	63 (43–83)	113 (71–155)
Kakamega	1,751 (1,352–2,150)	637 (487–787)	NA	91 (65–117)
Kericho	2,333 (1,937–2,728)	NA	NA	10 (8–12)
Kiambu	5,810 (4,780–6,839)	1,664 (1,264–2,064)	1,230 (1,045–1,415)	93 (61–124)
Kilifi	6,696 (4,963–8,428)	2,868 (2,064–3,671)	4,308 (3,168–5,447)	341 (218–463)
Kirinyaga	2,497 (1,858–3,135)	15 (10–19)	NA	2 (1–3)
Kisii	6,538 (4,908–8,168)	462 (328–595)	36 (29–43)	62 (39–85)
Kisumu	5,151 (3,894–6,407)	2,492 (1,764–3,220)	491 (390–592)	228 (140–316)
Kitui	2,856 (2,164–3,547)	44 (34–54)	NA	37 (21–53)
Kwale	2,833 (2,051–3,615)	681 (540–821)	1,736 (1,127–2,336)	68 (45–91)
Laikipia	1,154 (818–1,489)	138 (91–185)	NA	185 (128–241)
Machakos	4,916 (4,050–5,782)	2,234 (1,546–2,921)	57 (47–67)	275 (193–357)
Makueni	2,743 (2,218–3,268)	338 (227–448)	NA	NA
Meru	2,515 (2,098–2,932)	55 (37–72)	75 (60–89)	8 (5–11)
Migori	4,709 (3,548–5,869)	559 (372–745)	202 (153–250)	183 (86–279)
Mombasa	8,187 (6,016–10,357)	2,855 (2,291–3,418)	2,591 (1,992–3,189)	435 (300–569)
Muranga	2,533 (2,142–2,142)	NA	NA	2 (2–2)
Nairobi	39,643 (31,146–48,139)	10,209 (8,200–12,217)	5,024 (4,198–5,849)	1,064 (688–1,439)
Nakuru	17,708 (13,278–22,138)	2,072 (1,438–2,706)	23 (9–36)	82 (59–105)
Narok	3,064 (2,383–3,745)	59 (44–73)	NA	11 (9–12)
Nyamira	1,999 (1,432–2,566)	107 (80–133)	NA	3 (2–3)
Nyeri	1,299 (1,060–1,537)	123 (108–137)	NA	10 (7–12)
Siaya	4,027 (3,087–4,967)	663 (485–841)	110 (87–132)	95 (69–120)
Taita taveta	1,611 (1,163–2,059)	NA	NA	15 (9–20)
Tharaka nithi	2,594 (1,972–3,215)	141 (107–175)	NA	15 (7–23)
Trans nzoia	2,522 (1,724–3,320)	NA	NA	1 (1)
Turkana	3,722 (2,890–4,553)	450 (383–517)	NA	183 (138–228)
Uasin gishu	2,886 (2,202–3,570)	83 (68–97)	30 (23–36)	46 (34–57)
Vihiga	200 (160–240)	527 (454–600)	NA	40 (25–54)

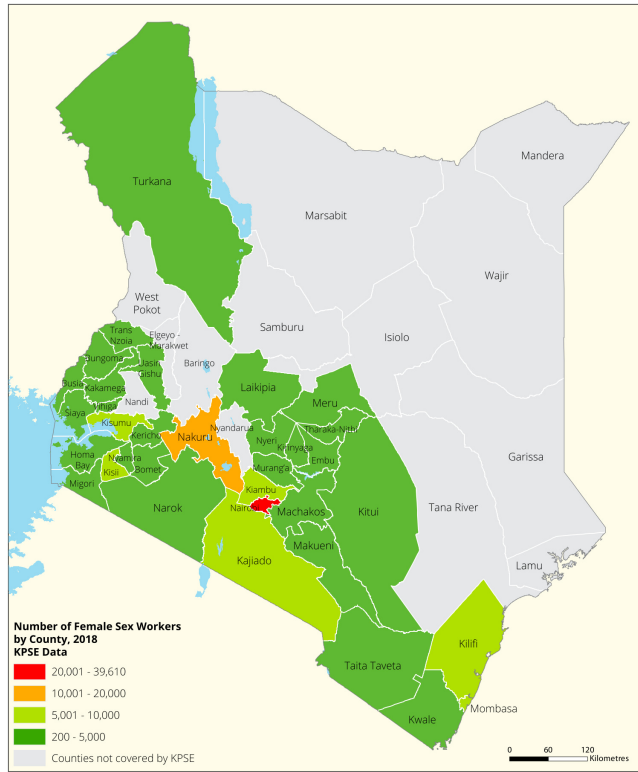


Figure 1. Distribution of FSWs mapped in different counties in Kenya.

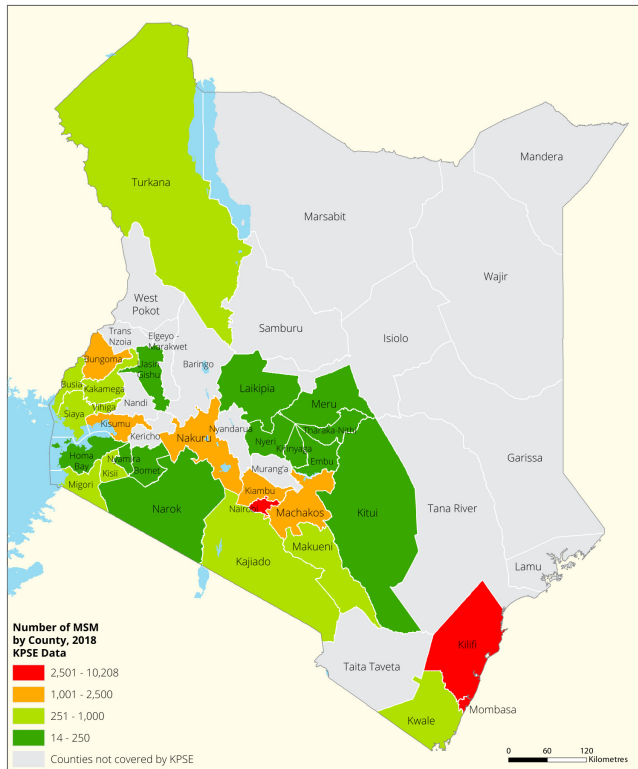


Figure 2. Distribution of MSMs mapped in different counties in Kenya.

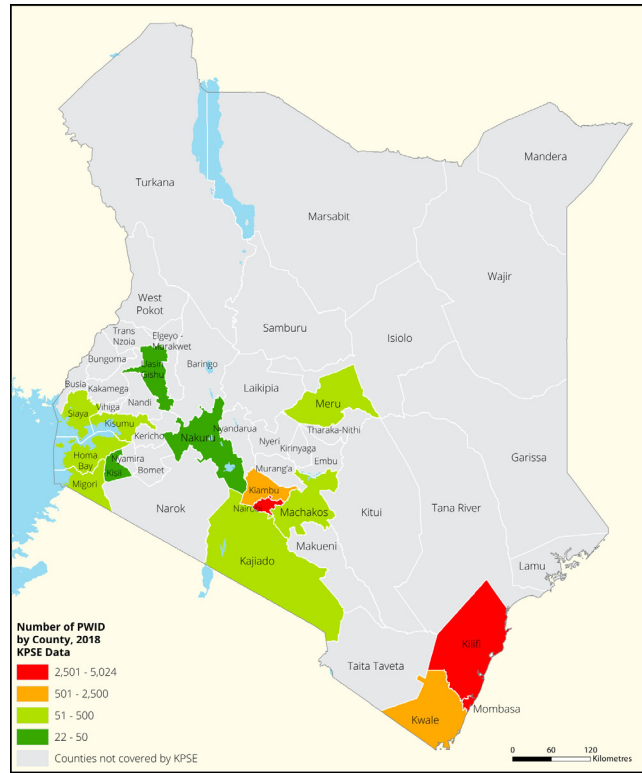


Figure 3. Distribution of PWIDs mapped in different counties in Kenya.

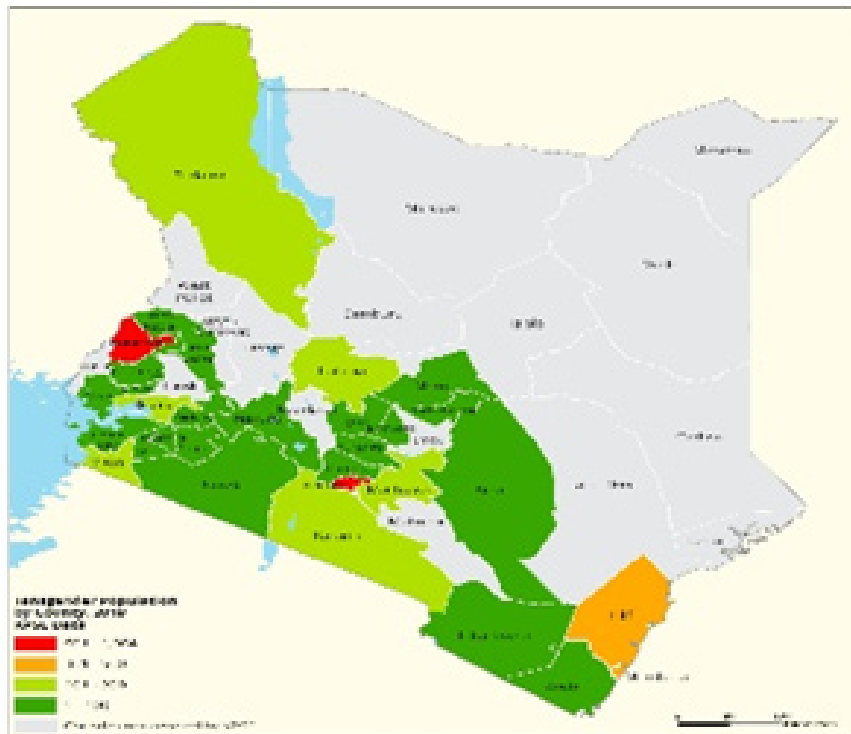


Figure 4. Distribution of TG women mapped in different counties in Kenya.

all 34 counties, MSM in 30 counties PWIDs in 15 counties and TG women were only found in 30 out of the 34 covered by the exercise.

Discussion

Programmatic mapping and KP size estimates were first conducted in Kenya in 2012²⁵. Data generated from mapping have been used effectively by NASCOP to develop HIV prevention strategies and service delivery for KPs since 2012²¹. This study not only contributed to updating the KP national size estimates, it generated evidence of young KPs and also provided county wise estimates in 34 out of the 47 counties in Kenya to revise program indicators. Furthermore, this was the first time that Kenya has estimated the number of transgender people and provided evidence for their inclusion as a KP in the Kenya AIDS Strategic Framework II 2020/21-2024/25¹⁸.

Comparing the size estimates of KPs from 2012²⁵, we have noticed a 26% increase in the overall estimated number of FSW (133,675 to 167,940) and a 76% increase in MSM (18,460 to 32,580), while the number of PWID has decreased from 18,327 to 16,063. This reduction in the number of PWIDs could be due to the scale-up of the medically assisted therapy (MAT) program in the country in the last three years²⁶. The higher number of FSWs and MSM reported could be due to an improved mapping methodology and size estimation technique as well as using the KPs to report on additional hotspots that they knew and were eventually also mapped. The number of KPs estimated through this exercise were calculated using information obtained from KPs frequenting venues and might be an underestimate of the total population of KPs in the country. This is because we would have missed those KPs who only frequent virtual sites or do not visit venues to find sex partners. A virtual mapping conducted in three counties for MSM showed that 75% of the MSM who mostly use virtual sites to find partners also visit physical venues²³. Thus the overall estimated number of MSM in Kenya might be 20% to 25% higher than the numbers presented in this study. It is also important to note that a high proportion of MSM work as male sex workers and should be the focus of HIV prevention activities in Kenya.

It is worth mentioning that while literature consistently documents limited success in estimating and reaching young KPs²⁷, this study was able to document a substantially higher proportion of young KPs among all groups mapped. An estimated 14,809 FSWs (9%), 2,949 MSM (9%) and an estimated 1,831 PWID (11%) were younger than 18 years of age which shows that Kenya needs to strategize tailored care and service delivery programs to increase young KP engagement in HIV services. We also found a significant mixing of key populations in multiple venues. For example, we saw transgender people using the same venues used by FSWs and MSM. In addition, we saw that PWID venues were also used by people who use drugs without injecting. We also found a significant number of females who inject drugs in venues used by males who inject drugs. The PWID program had challenges in getting female PWIDs to come in for services and based on the data, they do

share the same hotspots, it is imperative then to design our programs to ensure our services appeal to the female PWID such as having female PWID only days/times for services and inclusion of care packages.

From a program perspective, this study has also provided valuable information to the HIV prevention program for key populations in Kenya, about counties which need to be prioritized to reach KPs and appropriate use of limited resources for the most effective coverage. Eighteen counties out of all the counties mapped in Kenya, collectively contained 80% of all FSWs mapped. That is 79,876 out of 167,940 FSWs. For MSM, eight out of all counties mapped collectively accounted for 80% (25,956 of the 32,580) of the total estimated number of MSM. Likewise, for PWID, 15 counties collectively accounted for 85% of the estimated PWID and, for transgender people, 10 counties out of all the counties mapped accounted for 82% of the estimated population. With limited resources, these data can help the country prioritize KPs in these counties for optimal coverage and effective utilization of resources.

The approach presented in this paper has several strengths. One of the key strengths is the leadership role played by the national and county governments and ownership of data collected. The rapidity and simplicity of the process and strong involvement of the KP in the development and implementation of the approach also need mentioning. Data were collected by KP members including peer educators and outreach workers who knew about the venues where KP congregate, and later used this information to provide services.

The exercise also had some limitations. The estimates generated are not based on any physical counting of individuals, rather they are dependent on the reporting of the respondents. Thus, there could be an under-estimation of some KP sub-populations at the venue level. Moreover, KPs that find partners online and do not usually come to these physical locations were likely to be missed and not counted. KPs that frequented multiple venues were likely to be enumerated more than once. Although in the final analysis, this duplication was adjusted for, there still is a possibility of double counting some individuals especially if they use different typology of venues. To overcome these calculation issues, we propose that the country must triangulate data from multiple sources e.g., program data and finalize the size estimates of these KPs mapped. Another limitation was the inability of mapping studies to identify overlap among the typologies for the KPs such as identification of one as a sex worker as well as an injecting drug user. We also did not interview transgender people but collected their data through FSW and MSM. This means that data collected maybe not applicable for transgender people as the information provided by key informants was biased towards transgender women. Finally, we are also cognizant of the fact that social gatherings for KPs are not just to find sexual partners, but as a way of networking and socializing. This programmatic mapping however, was conducted to identify populations that are actively seeking partners at venues

(FSW/MSM and TG women) and/or congregating for injecting (PWIDs).

Despite limitations, this study was able to provide robust information on the size, locations and operational dynamics of KPs with a good indication of where HIV services could be provided for effective control of HIV. These revised estimates will be able to provide new targets and resources for the KP program in Kenya and will also help the government, donors and implementers monitor the effective coverage of existing key population programs in various geographies and populations.

Finally, to conclude, this study not only provides updated estimates of various KP mapped but also brings context-specific epidemiological evidence which is highly beneficial to guide HIV prevention program development and implementation²⁶. The country must set up systems and interventions to reach out to those more difficult to reach and use this information to develop high impact interventions for effective control of HIV in Kenya.

Data availability

Data on the Number of adult females and males (18–49) in Kenya was taken from 2019 Kenya Population Housing Census Volume III (Available at: <https://www.knbs.or.ke/?wpdmpromo=2019-kenya-population-and-housing-census-volume-iii-distribution-of-population-by-age-sex-and-administrative-units>. Accessed April 20, 2021).

Underlying data

This data is confidential considering the fact that KPs are a criminalized population in Kenya and sharing names of sites may put their life in danger. The raw data from the interviews is in SPSS format. Aggregate level de-identified data tables are available on Harvard Dataverse (see below). The corresponding author (jmusimbi@gmail.com) will be able to facilitate access to the full underlying data. A formal request needs to be made and a data sharing agreement will have to be made before sharing the data.

Harvard Dataverse: Data of Programmatic mapping and estimating the size of Female sex workers, Men who have sex with men and People who inject drugs, in Kenya: <https://doi.org/10.7910/DVN/ZO5T7Z>²⁴.

This project contains the following underlying data:

- Data Dictionary.xlsx
- KPSEdata.tab

Extended data

Harvard Dataverse: Data of Programmatic mapping and estimating the size of Female sex workers, Men who have sex with men and People who inject drugs, in Kenya: <https://doi.org/10.7910/DVN/ZO5T7Z>

This project contains the following extended data:

- Form Validation form.docx (Form B)

Data are available under the terms of the [Creative Commons Zero “No rights reserved” data waiver](#) (CC0 1.0 Public domain dedication).

Authors’ contributions

JM, HM, MM, SK, JK, DA, WW, RP, SI, PB, participated in the design of the study as well as the data collection tools. SK, JK, RP, SI and FE analyzed the data. JM and FE drafted the first draft of the manuscript. All other authors reviewed and approved the final manuscript.

Acknowledgements

The authors would like to thank the counties and all implementing partners including KP-led organisations who supported the KP Programmatic mapping in the 34 Counties. We also thank all the peer educators and outreach workers from KP communities who provide support during the data collection process. Special thank you to Dr. Peter Young and Paul Musungila for their technical input to this paper. Acknowledgements are also due to the Key Populations program in NASCOP and the Technical Support Unit (TSU) housed within NASCOP, Ministry of Health, which supports implementation of KP-related national strategies.

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[PubMed Abstract](#) | [Publisher Full Text](#) | [Free Full Text](#)

Open Peer Review

Current Peer Review Status: ? ✓ ✓ ? ?

Version 4

Reviewer Report 23 January 2025

<https://doi.org/10.21956/gatesopenres.17681.r39208>

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Daniel McCartney

London School of Hygiene & Tropical Medicine, London, UK

This article provides an in-depth summary of a programmatic mapping and size estimation exercise for key populations (KPs) in Kenya conducted in 2018. The research focuses on female sex workers (FSWs), men who have sex with men (MSM), people who inject drugs (PWIDs), and transgender women. The article, though based on data from several years ago, is relevant for Kenya's future efforts in KP size estimation and are useful for other countries planning similar exercises.

Importantly, this study is notable for its inclusion of transgender women in the mapping and estimating process and its age differentiations for KPs (including those under 18 years of age) and gender differentiation for PWIDs and sex workers. This differentiation enhances the specificity and usability of the data for policymaking and programmatic interventions. This version is mostly complete but would benefit from further editing to ensure consistency and improved readability, and considering the following overall and section-specific comments:

Overall comments:

This version demonstrates efforts to specifically and accurately detail the inclusion of transgender women in the size estimation and mapping. To ensure consistency and clarity, I recommend revising the title to explicitly mention transgender women and ensuring uniform use in text and tables and text (e.g., replace "transgender people" with "transgender women" in Table 1, as done for Table 2 & 3). Although correct in the few instances used, I would also suggest replacing "transwomen" with "transgender women" for consistency and clarity.

Section-specific comments:

Introduction:

- Suggest to indicate the year of HIV prevalence estimates for the listed KPs (although note reference is from 2015), and the year when the additional size estimate was completed in Nairobi.
- For clarity, suggest to review statement that this study represents the first time size estimates for transgender women were conducted in Kenya. Suggest to define transgender women explicitly (e.g., "those assigned male sex at birth who identify as female") to avoid ambiguity.

- Suggest to state that this is the first KP size estimation to provide age differentiation for all populations, and gender distinctions for PWIDs and sex workers in Kenya.
- Suggest to conclude the introduction with a clearer statement of the study's aims.

Methods:

- Suggest to clarify whether the size estimation of transgender women was a distinct process or integrated into the MSM and FSW exercises. Similarly, ensure to clearly specify that male sex workers (MSWs) were estimated solely through the MSM exercise. This is mentioned in the limitations, but would be useful in the methodology.
- As noted by other reviewer, clarify whether the 25% of MSM not visiting physical locations were included or excluded in the estimates.

Results:

- Suggest to review and correct numerical expressions (e.g., "2.4 MSM per adult men" should read "2.4 MSM per 1,000 adult men"). Ensure that all values are presented comprehensively with minimum and maximum ranges.
- Suggest to revise terminology in the results section for greater accuracy and to minimize potential stigmatization. For example, when describing when present at specific venues, suggest to replace "peak days of operation" for MSM with "peak days of activity" or similar (as done for PWIDs). Also, as providing size estimate specifically for transgender women, possibly state as "per 1,000 adults assigned male sex at birth" rather than "per 1,000 adult men".
- Ensure to maintain similar clarity in Figures 1-4 visualizing the distribution of KPs (Fig 4 is not clear).

Discussion:

- Suggest to expand on the positive outcomes of the study, such as the inclusion of transgender people in the updated Kenya AIDS Strategic Framework (KASF). Are there additional applications or benefits resulting from this work?
- Suggest to discuss whether Kenya has plans to update the KP size estimations, given the previous KASF recommendation to revise these every five years.

Minor comment:

I suggest to refer to the 2024 UNAIDS terminology guidelines (https://www.unaids.org/en/resources/documents/2024/terminology_guidelines) to ensure inclusive and appropriate terminology to avoid use of potentially stigmatizing language. For example, "use of unsterile injecting equipment" rather than "sharing contaminated needles".

References

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Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Clinical epidemiology of HIV and other STIs among key populations

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 07 January 2025

<https://doi.org/10.21956/gatesopenres.17681.r39129>

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Rebecca Anderson 

Imperial College London, London, England, UK

This article summarises the outputs from a key population programmatic mapping exercise conducted in Kenya in 2018. The study extends and updates the mapping exercise conducted in the country in 2012 offering a more comprehensive overview of KP programming needs in the country. This article is largely complete, and a useful addition to the literature, but would benefit from elaboration and editing in some places.

A minor comment is to focus on ensuring consistency when using of abbreviations. It would also be useful to define the size estimate bounds (e.g. as min and max estimates) at first reporting in the abstract and results for ease of interpretation.

Section-specific comments as follows:

Introduction:

The background literature on countries with KP size estimates could be updated. A recent review by Stevens et al identified estimates for a larger number of countries than the existing citation (Supplement Table 3 from Stevens 2024).

The final sentence of the introduction, identifies “comprehending changes in KP dynamics over time” as an aim - this feels vague and would benefit from clarifying exactly what is being investigated here.

Methods:

In the description of the Level One stage, it may be useful to describe how KP informants were selected to contribute to the consulting process to understand where bias was avoided, or may have been introduced.

The methods discuss scaling up the MSM PSEs by 25% to account for individuals seeking partners virtually. However, in the discussion, there is the statement “Thus the overall estimated number of MSM in Kenya might be 20% to 25% higher than the numbers presented in this study”, which seems to conflict the methods. Please clarify whether or not an adjustment was applied.

Results:

The number of venues for each KP do not match the numbers listed in the abstract. The TG size estimate is also missing min/max bounds.

Discussion:

Regarding the comments surrounding difficulty engaging female PWID in programs, it may be useful to provide an estimate of the ratio between male and female PWID engaged in programmes to compare against the number mapped, as there are still considerably fewer female injectors estimated, relative to men.

Updating the 2012 mapping exercise is undoubtedly useful, but it may also be useful to discuss these results in the context of the Phase II PSE exercise finalised in 2020 - how do these mapping estimates compare to the other methods implemented?

References

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Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: HIV epidemiology in key populations

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Version 3

Reviewer Report 19 July 2024

<https://doi.org/10.21956/gatesopenres.16399.r36634>

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Rajatashuvra Adhikary

World Health Organization -India Country Office, New Delhi, Delhi, India

Overall, I found it as an excellent piece of work. The methodology is pretty comprehensive and pragmatic. Both language as well as flow of the paper is simple but very convincing. I am considerably impressed with this work. It will make significant contributions to the existing knowledge base in this technical area or domain. However, I do have few observations, inputs, queries and suggestions to share for authors' consideration:

1. An appropriate abbreviation for 'programmatic mapping and size estimation' could be 'p-MPSE'.
2. The sub-title 'Sampling' may not be appropriate in the context of this exercise. In fact, it is the 'Coverage' of the p-MPSE in Kenya during 2018.
3. In 'Abstract', please refer to a specific figure mentioned in the second line of 'Results' as '10,951 (8,160 to 13,742)' - It is not the estimated number of FSW or MSM or PWID or TG. Then, what is it?
4. Generally at the hotspot level, In-depth Interviews with Key Informants are preferred to collect the necessary information due to several advantages. Why FGDs were conducted in this exercise is not clear and could be explained properly.
5. It is mentioned in the text that the participants for the FGD were 'randomly' selected at the hotspot level. Why and how we did so need to be explained. In fact, we should be a bit careful in using the word 'randomly'.
6. Generally, in other p-MPSE, we estimate maximum and minimum numbers at the hotspot level.

It is not clear why this exercise had three estimates (low, mid and high) for each hotspot. How was it beneficial?

7. In page 6, it is mentioned that there was 2.4 MSM per adult men. It must be a very serious typo. Let's correct it immediately.

8. Table 1 : It will be good to reflect the percentage of female PWID (which is 15%) beside absolute number.

9. Table 2: Why 'hours of operation' and 'days of operation' are missing in case of TG population?

10. It seems most of the TG venues are 'mixed venues' (mixed with FSW or MSM venues). However, may be, Nairobi may have some exclusive TG venues (bars where only TGs are soliciting). Do we have that?

Anyway, these are very minor observations and comments. Once again, I highly appreciate this excellent piece of work. It must be indexed soon.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Research, Surveillance and Strategic Information including routine program monitoring, evaluation etc.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 21 Aug 2024

Janet Musimbi

Dear Mr. Rajatashuvra Adhikary,

Thanks a lot for reviewing the manuscript "Programmatic mapping and estimating the

population size of female sex workers, men who have sex with men, people who inject drugs and transgender populations in Kenya.”

We would like to acknowledge and thank you and editors for their positive reviews and comments. We have had discussion with our authoring team and have revised the manuscript based on the changes proposed. Please find enclosed our response to the reviewer’s comments.

Thanks a lot again and we remain with our kindest regards

JANET.

REVIEWER 01 COMMENTS RESPONSE AND REVISIONS MADE

1

An appropriate abbreviation for 'programmatic mapping and size estimation' could be 'p-MPSE'.

Thank you for this suggestion. We however request to maintain the use of “Programmatic mapping and Size Estimation” as this is a term that is commonly in use and easily identifiable with programs.

2

The sub-title 'Sampling' may not be appropriate in the context of this exercise. In fact, it is the 'Coverage' of the p-MPSE in Kenya during 2018.

Similarly to the response above we request to maintain the use of “Programmatic mapping and Size Estimation”

3

In 'Abstract', please refer to a specific figure mentioned in the second line of 'Results' as '10,951 (8,160 to 13,742)' - It is not the estimated number of FSW or MSM or PWID or TG. Then, what is it?

Thank you for this and this has been corrected.

This was the estimated number of People who use drugs but since the focus was on PWIDs, we will focus on them and delete this.

4.

Generally at the hotspot level, In-depth Interviews with Key Informants are preferred to collect the necessary information due to several advantages. Why FGDs were conducted in this exercise is not clear and could be explained properly.

We focused on the peers to provide hotspot wide information in a manner that engages the members of that hotspot. So, FGDs helped peers to share their knowledge and insights about the hotspot and eventually agreed on the different aspects of the questions including

the number of people who congregate there.

5.

It is mentioned in the text that the participants for the FGD were 'randomly' selected at the hotspot level. Why and how we did so need to be explained. In fact, we should be a bit careful in using the word 'randomly'.

The approach was that once the mapping team approached a particular hotspot, with the help of the peer educator for that hotspot, approached peers who were in the hotspot at that time and requested them if they wished to participate in the FGD. This ensured that the team was heterogenous in terms of age and risk behavior and therefore becoming representative.

6.

Generally, in other p-MPSE, we estimate maximum and minimum numbers at the hotspot level. It is not clear why this exercise had three estimates (low, mid and high) for each hotspot. How was it beneficial?

In this exercise we had low and high numbers of KPs at the hotspot. The mid is the average number of the KPs and this was used to as the estimated number of KPs that were then populated for the country. This is beneficial in planning and target setting for programs.

7.

In page 6, it is mentioned that there was 2.4 MSM per adult men. It must be a very serious typo. Let's correct it immediately.

This figure is per 1000 men and not a percentage. It is based on the population of adult male as per 2019 Kenya Population Housing Census Volume III.

8.

Table 1: It will be good to reflect the percentage of female PWID (which is 15%) beside absolute number.

Thank you for this and it has been included.

9.

Table 2: Why 'hours of operation' and 'days of operation' are missing in case of TG population?

Thanks for highlighting the missing information for Transgender populations. We cannot say that the peak day and time concept is not applicable for transgender people, as it was not collected from them. This could be one of the limitations and we have now mentioned this in the limitations.

10.

It seems most of the TG venues are 'mixed venues' (mixed with FSW or MSM venues). However, may be, Nairobi may have some exclusive TG venues (bars where only TGs are soliciting). Do we have that?

For this specific study, exclusive TG venues were not identified. However, there was a follow mapping exercise that was carried out for the country and exclusive TG venues were also identified.

Competing Interests: None.

Version 2

Reviewer Report 05 September 2023

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Denton Callander

¹ The Kirby Institute, University of New South Wales, Sydney, New South Wales, Australia

² Médecins Sans Frontières, Mombasa, Kenya

Jonathan Odingo

Medecins Sans Frontieres, Mombasa, Kenya

To the authors' reply, we make the following comments. These relate to how populations were conceived in this study and from our perspective they represent significant conceptual flaws in the current description of this study, which can be rectified but only with further semantic clarification in the manuscript.

Author Report:

This study did not include transmen, and only focused on transwomen, hence the denominator is 1000 adult men. For this mapping exercise we used the broader term of transgender, as been used in other similar studies. As per your suggestion, we have now indicated this in the manuscript, but would like to continue using the term Transgender.

Reply:

It is fine to use the term 'transgender' but without specifying this study's interest in 'transgender women' then it becomes meaningless and inappropriate (especially in the context of adult men as a denominator).

In the strongest terms, we encourage the authors to specify throughout that this is a study of transgender women rather than transgender people broadly. The exclusion of transgender men should also be explained as a limitation of the method.

Author Report:

As already mentioned, this study focused on transmen and Lesbian/Transgender women were not included. When at the hotspot we only focused on the population defined. We had Social mobilizers from these hotspots involved in the exercise and we had definitions of these populations. Different levels of data collection were done and the social mobilizers had a clear instruction on which type of KPs to interview.

Reply:

The point in our original comment has been somewhat missed; it is about the likely overlap of key populations. How does the method deal with a sex worker who uses drugs? Why is the likely overlap never mentioned? The conceptualisation of so-called 'typologies' seems to assume that one can only be classified as one 'key pop' at a time; how was the dealt with in the method?

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

Author Response 13 Oct 2023

Janet Musimbi

Dear Mr. Denton and Mr. Jonathan,

Thanks a lot for reviewing the manuscript "Programmatic mapping and estimating the population size of female sex workers, men who have sex with men, people who inject drugs and transgender populations in Kenya."

We would like to acknowledge and thank you and editors for their positive reviews and comments. We have had discussion with our authoring team and have revised the

manuscript based on the changes proposed. Please find enclosed our response to the reviewer's comments.

Thanks a lot again and we remain with our kindest regards

JANET.

RESPONSES

1

It is fine to use the term 'transgender' but without specifying this study's interest in 'transgender women' then it becomes meaningless and inappropriate (especially in the context of adult men as a denominator).

In the strongest terms, we encourage the authors to specify throughout that this is a study of transgender women rather than transgender people broadly. The exclusion of transgender men should also be explained as a limitation of the method.

Thank you for this suggestion and the paper has been revised to include that the study's focus was transgender women and the exclusion of transgender men included in the limitations.

2

The point in our original comment has been somewhat missed; it is about the likely overlap of key populations. How does the method deal with a sex worker who uses drugs? Why is the likely overlap never mentioned? The conceptualisation of so-called 'typologies' seems to assume that one can only be classified as one 'key pop' at a time; how was the dealt with in the method?

Thank you for this clarification. The study was not able to identify the overlap of typologies among the key population and this has been documented as a limitation of the study.

Competing Interests: No competing interests were disclosed.

Version 1

Reviewer Report 05 July 2023

<https://doi.org/10.21956/gatesopenres.14899.r33412>

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Minja Milovanovic

University of the Witwatersrand Johannesburg, Johannesburg, Gauteng, South Africa

General Comments

The current article outlines the approach and outcomes of the 2018 programmatic mapping and size estimation for key populations in 34 counties in Kenya. The mapping processes allowed for the validation of existing site and size estimations. The populations that were mapped included: female sex workers, MSM, PWID and transgender people.

The authors, their partners and collaborators need to be acknowledge for the very important work done. Programmatic mapping and size estimations are crucial for understanding the scope of key populations and prioritizing their health needs.

Overall the manuscript is well written, concepts are clearly defined and the rationale well established.

The below points serve to help the authors refine their manuscript and point where additional information is required.

Abstract

- In the concluding part of the abstract there is mention that the study provided information on young KP the abstract also mentions Female PWID – did the authors intend to highlight ‘young’ key pop and specifically Female PWID despite this not being the main focus of the manuscript?

Introduction

- In the first part of the introduction the authors outline 3 points for why programmatic mapping and size estimations are important: “helps to estimate population size...” What are the other benefits of mapping and size estimations for the programmes apart from retention?
- As this is the first time that a size estimation on the transgender population is being done, some additional information in the introduction would be beneficial.
- What type of interventions (public health, clinical?) were scaled up in the 34/47 counties post the 2012 mapping and size estimation.
- Provide some additional information on why mapping and size estimations were only done in the 34 counties where KP programmes were being implemented. Is it cause there are no programmes in the other counties and if so some insight into why that is the case. Does it have anything to do with the previous mapping following which interventions were implemented in the 34 counties. Is the idea to update size and understand changes in the initial 34 sites only or potentially also expand.
- Last section of the Introduction: mapping and size estimation are highlighted as distinctly different steps however there seems to be a sentence missing that links the two steps.

Methods

Overall the methodology is well implemented and involved relevant stakeholders, who were trained and outputs were monitored. However, there were some points that required additional

clarity

- Were all hotspots (past and new) physically validated and if so how did the teams (implementing partners) achieve that in a 3 month period especially when there were over 10 000 female SW venues? Was the mapping, validation and size estimates completed in 3 months?
- Define operational typologies – does this refer to venue type such as bar etc?
- Need clarity regarding programme selection – of the 34 counties only those that provided services to specific KPs were selected. For example, of the 34 counties, 15 provided services for PWID and hence only 15 were included?
- The authors mention that estimates were adjusted to account for the overlap of KPs visiting more than one spot. How did authors account for duplicate counting/estimations such that female SWs provide one estimate and PWID provide another estimate but the groups might overlap?
- In level 2: how were the 3-5 KP members that partook in FGDs identified?
- Were the 3-5 members all part of the same KP group and were the KPs interviewed at the same time or separately?
- Who identified the gatekeeper and how were gatekeepers approached to ensure buy in?
- Was any method used to guide KP member estimates
- For data that was being captured via paper form, what was the time frame for electronic data capture?
- Why was the MSM data revalidated in 10 counties?
- Was only verbal consent obtained and if so explain why this was sufficient if participants were debriefed and referred following participation? Also, why were participants debriefed and around what? Is the referral to care facilities standard of care for all KPs or was it specific to only those that took part in the study?
- Did FGDs participants provide a percentage (eg. 9%) of KPs who were younger than 18 years or did they give an estimated value?

Results and Discussion

- Table 2 is divided into two parts with one part providing values while the second part provides percentages. How were the percentages calculated for hours and days of operation. Explain why hours and days of operation were not applicable for transgender people.
- How many of the KP venues overlapped? When aggregated by KP type there were a total of 14760, it was noted in the paper that key pops such as transgender people shared venues/hotspots with female SW and MSM.

- Under methods it is described that 30 counties were selected for mapping transgender people however the results report on information from 32 counties. Explain the inclusion of the additional counties.
- Include percentages in table 3 for ease of reading.
- Why is there no map of the transgender population?
- In the discussion the authors highlight that a high number of MSM also work as male SW. Is there any data from the mapping process to show this.
- Explain the significance of finding females and males who inject drugs sharing venues?
- In the discussion, bring in the other counties for which there are no mapping and size estimations – is there any potential to gather data from these places
- The authors cannot say that 18 counties in the whole of Kenya, rather it's 18 counties of all those that have been mapped.
- If the authors mapped 15 counties for PWID but only account for 85% of the cohort please explain the difference?
- How did the KP members (peer educators and outreach workers) use the information to provide services and what services?
- What was the total number of respondents that the estimates are based on?

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public Health, Infectious Diseases, Key Populations, Violence, Prevention, Community Centric Research

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Author Response 13 Aug 2023

Janet Musimbi

Dear Ms. Minja,

Thanks a lot for reviewing the manuscript “Programmatic mapping and estimating the population size of female sex workers, men who have sex with men, people who inject drugs and transgender populations in Kenya.”

We would like to acknowledge and thank you for the positive reviews and comments. We have had discussion with our authoring team and have revised the manuscript based on the changes proposed. Please find enclosed our response to the reviewer’s comments.

Thanks a lot again and we remain with our kindest regards

JANET.

COMMENTS AND RESPONSES:

Abstract:

In the concluding part of the abstract there is mention that the study provided information on young KP the abstract also mentions Female PWID – did the authors intend to highlight ‘young’ key pop and specifically Female PWID despite this not being the main focus of the manuscript?

We wanted to show that other than giving estimates of the KP in Kenya, this paper also shares data on young KP across all the typologies and specifically for the PWID, we were also able to disaggregate between male and female. We believe that providing this information will be useful for government and donors as they could look at these numbers and plan for services for these sub-populations

Introduction:

In the first part of the introduction the authors outline 3 points for why programmatic mapping and size estimations are important: “helps to estimate population size...” What are the other benefits of mapping and size estimations for the programmes apart from retention?

Mapping and size estimations is also important as it provides evidence to decision makers on numbers within the counties and therefore supports in resource mobilization for interventions for KPs. It also shows where KPs congregate and enables implementing partners and peer educators

plan for outreach. It also provides denominators which can be used to track the progress of a program and interventions

As this is the first time that a size estimation on the transgender population is being done, some additional information in the introduction would be beneficial.

This is noted and have revised accordingly

What type of interventions (public health, clinical?) were scaled up in the 34/47 counties post the 2012 mapping and size estimation.

The 2012 mapping and size estimations was done in the then 8 provinces of Kenya and through this results, Biomedical, Structural and behavioral were scaled up to 34 counties out of the 47. For example counties that only had programs for the FSW subpopulation, scaled up services to include services for MSM. This information has now been added to the manuscript.

Provide some additional information on why mapping and size estimations were only done in the 34 counties where KP programmes were being implemented. Is it cause there are no programmes in the other counties and if so some insight into why that is the case. Does it have anything to do with the previous mapping following which interventions were implemented in the 34 counties. Is the idea to update size and understand changes in the initial 34 sites only or potentially also expand.

This was not a stand alone research study, and was conducted as part of the key population program of the Kenya's National government initiative. We focused on the counties where HIV prevention programs were already providing services to key populations.. There was a consultative process during the national technical working groups for key populations and it was agreed to conduct the KPSE exercise as part of the programs and to update size estimates of key populations in these 34 counties.

Last section of the Introduction: mapping and size estimation are highlighted as distinctly different steps however there seems to be a sentence missing that links the two steps.

Thanks for highlighting this. This has been relooked at and revised.

Methods:

Were all hotspots (past and new) physically validated and if so how did the teams (implementing partners) achieve that in a 3 month period especially when there were over 10 000 female SW venues? Was the mapping, validation and size estimates completed in 3 months?

Yes the hotspots were physically validated. This was achieved through the use of mobilizers/peer educators within the counties that were trained and used in the exercise. In our guidelines, peer educators are attached to hotspots were they provide services and meet with their peers. This meant that the spots were known and it was easy to quickly validate them as well as any new

spots that were identified during the process.

Define operational typologies – does this refer to venue type such as bar etc?

Yes, typology refers to the different types of hotspots and they were merged as follows: Streets, Parks/Beaches/toilets, Sex dens/brothels, residential, strip clubs/massage parlor/salon, bar with lodging, bar without lodging, guest house, uninhabited building, drug dens, casino/club and others.

Need clarity regarding programme selection – of the 34 counties only those that provided services to specific KPs were selected. For example, of the 34 counties, 15 provided services for PWID and hence only 15 were included?

Similarly to the response above, we were working with Implementing partners within the counties. At the time of the size estimations only 34 counties had FSW partners implementing for the FSW, 15 counties had PWID implementing partners and 30 counties had MSM implementing partners. These are the counties that were then the focus of the size estimations as partners were already providing different interventions for the KPs in these counties. We have added this explanation in the manuscript

The authors mention that estimates were adjusted to account for the overlap of KPs visiting more than one spot. How did authors account for duplicate counting/estimations such that female SWs provide one estimate and PWID provide another estimate but the groups might overlap?

The adjustment were made independent of overlapping group participation. We agree that there are some overlapping behaviors, but we included the KP member in the group where he/she was originally counted.

In level 2: how were the 3-5 KP members that partook in FGDs identified?

The KP members were identified randomly from the hotspots at the time of the size estimation hence they were found physically at the hotspot during the exercise.

Were the 3-5 members all part of the same KP group and were the KPs interviewed at the same time or separately?

The 3-5 members were homogeneous in the sense that they belonged to the same KP group. The interview was conducted as a group so the 3-5 members participated in the same group discussion and the moderator took them through the questions, asking them and providing responses as a group.

Who identified the gatekeeper and how were gatekeepers approached to ensure buy in?

The gate keepers were identified consultatively by the research teams and the KPs (social mobilizers) who were able to identify who the gatekeepers in their hotspots were to get their buy in before the size estimation exercise started at the hotspot.

Was any method used to guide KP member estimates?

The members of the group discussed among themselves and after building consensus, the number which was agreed upon was used as the estimate for low, mid and high estimate. We did not use another size estimation technique.

For data that was being captured via paper form, what was the time frame for electronic data capture?

The electronic format- ODK was used to upload data and submit. For instances where that could not be done onsite, then interviewer uploaded the earliest he/she accessed internet.

Why was the MSM data revalidated in 10 counties?

While finalizing the estimates, the research and the program team felt that the numbers of MSM need to be revalidated as some of the numbers were different from what the program generated estimates were. Thus 5%–10% of the hotspots were randomly picked within randomly selected counties and were revalidated to check for under-reporting or over-reporting.

Was only verbal consent obtained and if so explain why this was sufficient if participants were debriefed and referred following participation? Also, why were participants debriefed and around what? Is the referral to care facilities standard of care for all KPs or was it specific to only those that took part in the study?

Verbal consent was obtained and it was sufficient as data collected was aggregate in nature. No specific information about individuals was collected. The debriefing of participants was to share on the importance of the information shared, share on the IPs present within their areas of operations and where they could access services if they were in need of them. The referrals to care facilities is a standard care for all KPs and not only those who participated.

Did FGDs participants provide a percentage (eg. 9%) of KPs who were younger than 18 years or did they give an estimated value?

They provided an estimated value which was used to compute the proportions. We also cross-checked this information using program data.

Results and Discussions:

Table 2 is divided into two parts with one part providing values while the second part provides percentages. How were the percentages calculated for hours and days of operation. Explain why hours and days of operation were not applicable for transgender people.

We collected information from each key population member interviewed about what are the peak days and time of their operation. This information was collected as a multiple response variable and each KP member provided information about what are the peak days and times of

their operation. The proportion for a particular hour and day was calculated based on the total times and days.

Thanks for highlighting the missing information for Transgender populations. We cannot say that the peak day and time concept is not applicable for transgender people, as it was not collected from them. This could be one of the limitations and we have now mentioned this in the limitations.

How many of the KP venues overlapped? When aggregated by KP type there were a total of 14760, it was noted in the paper that key pops such as transgender people shared venues/hotspots with female SW and MSM.

For the exercise we did not analyse which KP venues overlapped. It was however noted that transgender people share spots with FSW and MSM in 1,218 spots.

Under methods it is described that 30 counties were selected for mapping transgender people however the results report on information from 32 counties. Explain the inclusion of the additional counties.

This has been relooked at and revised to 30. Thank you.

Include percentages in table 3 for ease of reading.

It would be difficult to include percentages as the table provides data on the estimates per county and provides the reader with the minimum and maximum range for the estimates. If we add percentages also, the table will become very heavy.

Why is there no map of the transgender population?

This has been revised and the map for the transgender population included. Thank you.

In the discussion the authors highlight that a high number of MSM also work as male SW. Is there any data from the mapping process to show this.

Yes. A question that was asked and analyzed to provide this information was; Among the MSM visiting this hotspot how many sell sex for money? This information was used to develop the estimates of Male sex workers

Explain the significance of finding females and males who inject drugs sharing venues?

The significance of this was that interventions for PWID need to be tailored to ensure that the needs of the female PWIDs were taken into account and that they should not be standard. The PWID program had challenges in getting female PWIDs to come in for services and since they do share the same hotspots, it was imperative to design our programs to ensure our services appeal to them such as having female PWID only days/times for services, inclusion of care packages etc.

In the discussion, bring in the other counties for which there are no mapping and size estimations – is there any potential to gather data from these places.

Yes the subsequent size estimations that was done for the country estimated for all the counties in Kenya. This was followed up later in another mapping study which included those counties as well

The authors cannot say that 18 counties in the whole of Kenya, rather it's 18 counties of all those that have been mapped.

This is noted and have been revised accordingly

If the authors mapped 15 counties for PWID but only account for 85% of the cohort please explain the difference?

PWIDs are concentrated in certain parts of the country. For example, you will find more PWIDs in the coastal region, in Nairobi, parts of Central Kenya and Western County of Kisumu. Since the study was part of the prevention programs already implemented, there was no available evidence that PWIDs are available in other counties in epidemiologic proportions and were hence not mapped.

How did the KP members (peer educators and outreach workers) use the information to provide services and what services?

The data gathered had information about the names of the hotspots, the estimated number of KPs, the peak days and hours. This information was useful in planning for outreaches and scale up of services.

What was the total number of respondents that the estimates are based on?

This would be the number of L1 and L2 interviews

Competing Interests: No Competing Interests.

Reviewer Report 02 June 2023

<https://doi.org/10.21956/gatesopenres.14899.r33183>

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Jonathan Odingo

Medecins Sans Frontieres, Mombasa, Kenya

Denton Callander

¹ The Kirby Institute, University of New South Wales, Sydney, New South Wales, Australia

² Médecins Sans Frontières, Mombasa, Kenya

The authors present an interesting study of population size estimation among 'key populations' in Kenya. This work is important and very difficult, so I wish to offer my congratulations on the study.

I know this work was done several years ago and was already published as a report, so my comments are mainly focused on opportunities for further explanation and contextualisation. Some things the authors may wish to consider:

1. In my opinion, far greater attention should be paid to the exclusion of counties. Why was this exercise limited only to "counties where HIV prevention programs and services were implemented"? Also, were there significant differences between included/excluded counties (e.g., population size and characteristics)? Some post-hoc tests here would help.
2. The conceptual treatment of the transgender population needs some work. Notably, I did not understand why the results are not disaggregated between trans men and trans women. Perhaps this is not possible, but it needs to be explained *why* as trans people are not a homogenous population. Further, the denominator in Table 1 ("No. of transgender people per 1000 adult men") is inappropriate, as this assumes only men can be transgender and seems to – from my reading – reflect a long history of focusing on trans women to the exclusion of their trans brothers.
3. The conceptual treatment of 'key populations' is not always clear. How does the counting exercise, for example, deal with the potential reality of a lesbian transgender woman who sells sex and uses drugs? The point is that these are not mutually exclusive groups, but the way they are presented here (conceptually and methodologically) seems to suggest they are.
4. I was not at all convinced by a claim in the limitations section that these results could be "an overestimation". I encourage the authors to engage more critically with the almost certain *underestimation* of their findings: the methods demand a certain level of visibility and public engagement, which many key populations do not have as a matter of protecting their safety. As a reader, I was expecting far more contextualization of the likely underestimation as a way to draw attention to the inherent limitations of this work (and, indeed, all population mapping among vulnerable and oppressed groups). I would strongly consider beefing this up in the Discussion section.
5. A small point, but I found offensive the repeated idea of social gathering as a way for key populations to find sexual partners. I think what the authors really mean is a measure of community connection, no? It is stigmatizing to imagine that the only reason key populations might gather together is for sexual purposes; perhaps the language throughout can better reflect the complex and diverse dynamics of community and social networks.
6. I was somewhat confused by this claim on pg 7: "It was noted that people who use drugs and not necessarily injecting drugs use the same venues as those who injected drugs". Who noted this? How was it noted? I ask because this claim is not borne out by any of the literature on drug use patterns. Injecting drugs are a very particular behaviour, which is

often totally different from people who use non-injecting drugs. If this kind of claim is to be made and believed, I would definitely need more information on its source and voracity – especially because it contravenes a lot of available evidence.

7. It looks like the frequency for female sex workers in Bungoma (Table 3) is incorrectly reported as 900, which falls outside the range.
8. I invite the authors to say more about the use of “mixed methods”. What exactly was mixed about these methods (i.e., model of mixing used)? Perhaps I have missed something, but from my reading of this paper it actually is not a mixed methods design. More information may help the reader better understand if and how methods were mixed.
9. I was surprised that the authors did not contextualize their work nationally, regionally, or jurisdictionally. How do these results compare with other exercises (outside of this NASCOP one)? More references to other attempts to estimate population size would help the reader feel more confident in the results.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Population demography; public health; key populations

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

Author Response 13 Aug 2023

Janet Musimbi

Dear Mr. Jonathan,

Thanks a lot for reviewing the manuscript “Programmatic mapping and estimating the population size of female sex workers, men who have sex with men, people who inject drugs and transgender populations in Kenya.”

We would like to acknowledge and thank you for the positive reviews and comments. We have had discussion with our authoring team and have revised the manuscript based on the changes proposed. Please find enclosed our response to the reviewer’s comments.

Thanks a lot again and we remain with our kindest regards.

JANET.

COMMENTS AND RESPONSE:

1.

In my opinion, far greater attention should be paid to the exclusion of counties. Why was this exercise limited only to “counties where HIV prevention programs and services were implemented”? Also, were there significant differences between included/excluded counties (e.g., population size and characteristics)? Some post-hoc tests here would help.

Thanks a lot for the comment. This was not a stand-alone research study and was conducted as part of the key population program of the Kenya’s National government initiative. We focused on the counties where HIV prevention programs are already providing services to key populations. There was a consultative process during the national technical working groups for key populations and it was agreed to conduct the KPSE exercise as part of the programs and to update size estimates of key populations in these counties. We focused on 34 counties out of the total 47 counties in Kenya, where KP programs are providing services.

2.

The conceptual treatment of the transgender population needs some work. Notably, I did not understand why the results are not disaggregated between trans men and trans women. Perhaps this is not possible, but it needs to be explained *why* as trans people are not a homogenous population. Further, the denominator in Table 1 (“No. of transgender people per 1000 adult men”) is inappropriate, as this assumes only men can be transgender and seems to – from my reading – reflect a long history of focusing on trans women to the exclusion of their trans brothers.

This study did not include transmen, and only focused on transwomen, hence the denominator is 1000 adult men. For this mapping exercise we used the broader term of transgender, as been used in other similar studies. As per your suggestion, we have now indicated this in the manuscript, but would like to continue using the term Transgender.

3.

The conceptual treatment of ‘key populations’ is not always clear. How does the counting exercise, for example, deal with the potential reality of a lesbian transgender woman who

sells sex and uses drugs? The point is that these are not mutually exclusive groups, but the way they are presented here (conceptually and methodologically) seems to suggest they are.

As already mentioned, this study focused on transmen and Lesbian/Transgender women were not included. When at the hotspot we only focused on the population defined. We had Social mobilizers from these hotspots involved in the exercise and we had definitions of these populations. Different levels of data collection were done and the social mobilizers had a clear instruction on which type of KPs to interview.

4.

I was not at all convinced by a claim in the limitations section that these results could be “an overestimation”. I encourage the authors to engage more critically with the almost certain *underestimation* of their findings: the methods demand a certain level of visibility and public engagement, which many key populations do not have as a matter of protecting their safety. As a reader, I was expecting far more contextualization of the likely underestimation as a way to draw attention to the inherent limitations of this work (and, indeed, all population mapping among vulnerable and oppressed groups). I would strongly consider beefing this up in the Discussion section.

Thanks for highlighting this. We agree with your comment and the word overestimation has been removed from the manuscript text.

5.

A small point, but I found offensive the repeated idea of social gathering as a way for key populations to find sexual partners. I think what the authors really mean is a measure of community connection, no? It is stigmatizing to imagine that the only reason key populations might gather together is for sexual purposes; perhaps the language throughout can better reflect the complex and diverse dynamics of community and social networks.

This programmatic mapping was conducted to identify populations that are actively seeking partners at venues (FSW/MSM and TG) and/or congregating for injecting (PWIDs). We are cognizant that this is not the only reason why KPs congregate but due to the nature of how the questions were asked, this was the key factor as to why the KPs were at the hotspots. We take into account your concern and have tried to address it.

6.

I was somewhat confused by this claim on pg 7: “It was noted that people who use drugs and not necessarily injecting drugs use the same venues as those who injected drugs”. Who noted this? How was it noted? I ask because this claim is not borne out by any of the literature on drug use patterns. Injecting drugs are a very particular behaviour, which is often totally different from people who use non-injecting drugs. If this kind of claim is to be made and believed, I would definitely need more information on its source and voracity – especially because it contravenes a lot of available evidence.

The actual field data collected shows that at various drug spots we had both injecting and non-

injecting and the data has been uploaded as well. On the 402 spots identified and mapped, the study team identified 16,063 injecting and 10,951 non-injecting drug users, who were using the same hotspot. In Kenya this is a common occurrence and we had specific questions asked to differentiate between the two.

7.

It looks like the frequency for female sex workers in Bungoma (Table 3) is incorrectly reported as 900, which falls outside the range.

Thank you for this and this has been corrected to 3900.

8.

I invite the authors to say more about the use of “mixed methods”. What exactly was mixed about these methods (i.e., model of mixing used)? Perhaps I have missed something, but from my reading of this paper it actually is not a mixed methods design. More information may help the reader better understand if and how methods were mixed.

Agreed. Since this paper represents more of the programmatic data, we are removing the term mixed methods approach from the text and are saying that quantitative data was collected.

9.

I was surprised that the authors did not contextualize their work nationally, regionally, or jurisdictionally. How do these results compare with other exercises (outside of this NASCOP one)? More references to other attempts to estimate population size would help the reader feel more confident in the results.

Thanks for the suggestion. We have now added some more estimates to contextualize the work nationally and regionally.

Competing Interests: No Competing Interests.