Sampling studies to estimate the HIV prevalence rate in female commercial sex workers

ABSTRACT

Introduction: We investigated sampling methods being used to estimate the HIV prevalence rate among female commercial sex workers. **Methods:** The studies were classified according to the adequacy or not of the sample size to estimate HIV prevalence rate and according to the sampling method (probabilistic or convenience). **Results:** We identified 75 studies that estimated the HIV prevalence rate among female sex workers. Most of the studies employed convenience samples. The sample size was not adequate to estimate HIV prevalence rate in 35 studies. **Discussion:** The use of convenience sample limits statistical inference for the whole group. It was observed that there was an increase in the number of published studies since 2005, as well as in the number of studies that used probabilistic samples. This represents a large advance in the monitoring of risk behavior practices and HIV prevalence rate in this group.

Keywords: HIV, AIDS, commercial sex workers, sampling.

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INTRODUCTION

The several measures being adopted to prevent HIV dissemination, both at national and international levels, are based on the natural history of the infection, the experience of AIDS-related health programs, and the results of simulations and mathematical models that seek to translate the dynamics of the disease transmission.[1]

From the epidemiological point of view, it is known that there are population subgroups presenting a higher risk of HIV-infection, such as men who have sex with other men (MSM), injection drug users (IDU), and female commercial sex workers (SW), who are the most affected and have been infected on the early days of the epidemics. It is also known that sexually-transmitted diseases (STD) act as cofactors to promote disease transmission; and that sexual practices, such as multiple sex partners and irregular condom use are important determinants.[2]

From mathematical models' point of view, sexual relations patterns among the population subgroups constitute other important factor in the dissemination of HIV, as small alterations in the rate of contacts between the low-risk segment and the high-risk one can significantly change the dissemination of the epidemics.[3]

The AIDS epidemics in Brazil took place during the first years of the 80's. Throughout this period of more than 20 years, it has been shown to be a concentrated epidemics,[4] maintaining a prevalence rate of HIV infection in the general population lower than 1% and high rates in the population subgroups that are more vulnerable to HIV infection, such as SW.[6]

The SW group size is estimated at 1% of the Brazilian female population, aged 15 to 49 years, corresponding to more than half a million women.[7] The prevalence rate for this population group according to some studies carried out in the country, has been estimated to be always higher than that of the general female population. In the study carried out in the city of Santos, state of São Paulo, Brazil, in 1997, the prevalence rate was of 8%.[8] In another study carried out between 2000 and 2001, with 2,712 female sex workers in some cities of Brazil, the prevalence rate was estimated at 6.1%.[6] These studies indicate a prevalence that is approximately 15-fold higher among the commercial sex workers when compared to the Brazilian female population as a whole.[5] It is noteworthy to mention, however, that convenience samples have been used and, therefore, these results must be interpreted considering such limitation.

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From the year 2005 on, the United Nations Joint Program on HIV/AIDS (UNAIDS) has emphasized the need to monitor indicators in the groups at higher risk of HIV-infection in countries with concentrated epidemics. In Brazil, current efforts are being made to carry out several studies that allow the estimation of the prevalence of HIV and other STDs and characterize the risk practices and behavior in the groups at higher risk of HIV infection, particularly SW.

The higher risk among the SW suggested by previous studies requires studies with a probabilistic sampling to attain adequate monitoring of the risk practices related to HIV-infection. Currently, obtaining representative samples of population subgroups of hard-to-reach individuals, such as commercial sex workers, is one of the biggest challenges for epidemiologic surveillance.[9] Traditional sampling methods are inadequate to generate representative samples, considering that, to estimate solid enough parameters, it is necessary to select very large samples, which are rendered impossible due to operational and cost difficulties.[10]

Another challenge in carrying out home-based studies with SW is the fact that this profession is surrounded by a great deal of stigma, which leads many women to not declare themselves as such or to hide their profession from family members and friends. Additionally, many of these women do not live in permanent private homes of their own, very often residing at their workplaces, which are not included in the traditional researches.

The present study carried out a literature review of scientific articles to investigate the sampling methodologies that are being used in studies estimating the prevalence rate of HIV among SW.

METHODOLOGY

A literature review was carried out through a systematic search of scientific articles involving SW and the estimate of the HIV prevalence rate. The search for articles was conducted between October and November 2008, and was attained through the MEDLINE and PUBMED databases.

This review consisted of cross-sectional studies that: included the population group of SW; estimated the HIV prevalence rate through serological tests; and that had been published in English, Portuguese or Spanish, from 2000 to 2008. We excluded review articles, clinical trials or longitudinal studies, as well as studies that did not include the estimate of the HIV prevalence rate through serological tests.

The multiple combinations of the following keywords were used during the systematic search: "HIV"; "prevalence"; "AIDS"; "female"; "women"; "prostitution"; "CSW"; "commercial sex workers"; "sex workers"; and "SW".

The following data were collected for the systematization of the information obtained from the selected articles: year of publication; country where the study was carried out; type of sampling; whether the sampling design was considered in data analysis; sample size; and the HIV prevalence rate.

The studies were classified according to the adequacy or not of the sample size used to estimate the HIV prevalence rate. For that purpose, the estimate error for simple random samples was calculated using the following formula:

$$Error = z\sqrt{\frac{pq}{n}}$$

Where p = HIV prevalence rate; q = 1 - p; n = sample size; and z = 1.96, which is the value established for 95% confidence. When the error was > p/2 (half the HIV prevalence rate), the sample size was considered to be inadequate.

We also analyzed the type of sampling technique used in the study, classified as probabilistic method or convenience sampling method. Convenience samples are those in which the population elements are chosen according to their availability to participate in the study or the researcher's interest.[13] Among the studies with convenience samples, we specifically identified the "snowball sampling". In this type of sampling, the selection of the individuals is carried out by the participants themselves, through the indication of acquaintances until the established sample size is achieved.[14]

In probabilistic samples, each element of the population is associated with a known selection probability and is different from zero.[13,15] Among the studies with probabilistic sampling are the conglomerate sampling and the respondent driven sampling (RDS). The conglomerate sampling is a probabilistic sampling employed very often in population surveys, in which the sampling unit is the conglomerate.[13,15] Proposed by Heckathorn[16] in 1997, the RDS is a variant of chain-based sampling and, as such, assumes that hard-to-reach members of a population are better at recruiting their peers than other individuals, such as healthcare agents or researchers. Moreover, it introduces a mathematical model that allows the weighing of the sample to compensate the bias generated by the non-random selection of the seed-individuals and over-representation of some subgroups in the studied population.

The studies were classified regarding their quality, according to the following criteria: 1) only the sample size was adequate; 2) the study used a probabilistic sampling method; 3) the sample size was adequate and the study used a probabilistic sampling method; and 4) the sample size was adequate, the study used a probabilistic sampling method and considered the sampling design at the analysis of the study.

RESULTS

Initially, 1,197 scientific indexed articles were identified during the search at the PUBMED database, using the aforementioned keywords, of which 921 were excluded as they did not meet the established eligibility criteria. Of the remaining 276 articles, 201 were excluded due to duplicity. Thus, 75 articles were included in this review.

Table 1 presents information on the 75 articles included in the study, such as: authorship; year of publication; country where the study was carried out; sampling type; whether the sampling design was considered in data analysis; sample size and HIV prevalence rate.

Table 1. Characteristics of the selected studies. 2000-2008

Year of publication	Year of the study	Citation	Country	Sampling type	Considered the design at the analysis	Sample size	HIV prevalence rate
2000	1998-99	Azim *et al.*, 2000[44]	Bangladesh	Convenience	No	Fluctuating: 400 Brothel A: 392 Brothel B: 267	Fluctuating: 0.3% Brothel A: 2.8% Brothel B: 2.6%
2000	ND	Ohshige *et al.*, 2000[45]	Cambodia	Convenience	No	202	54%
2000	1997-98	Ford *et al.*, 2000[46]	Indonesia	Convenience	No	614	1/631 (0.158%)
2001	1997-98	Morison *et al.*, 2001[31]	Sub-Saharan Africa	Cluster sampling	Yes	Cotonou: 433 Yaoundé: 328 Kisumu: 300 Ndola: 332	Cotonou: 55% Yaoundé: 34% Kisumu: 74% Ndola: 69%
2001	1998-99	van den Hoek *et al.*, 2001[47]	China	Convenience	No	966	1.4%
2001	1998	Aklilu *et al.*, 2001[48]	Ethiopia	Convenience	No	372	73.7% (95% CI: 69.2%-78.2%)
2001	1997-99	Asamoah-Adu *et al.*, 2001[49]	Ghana	Convenience	No	1013	50%
2001	1995-99	DAntuono *et al.*, 2001[50] (Abstract)	Italy	Convenience	No	558	9/558 (1.6%)
2001	1997-98	Verster *et al.*, 2001[51]	Italy	Convenience	No	102	5.6%
2001	ND	Ishi *et al.*, 2001[52]	Japan	Convenience	No	308	0%
2002	1993 1995-96 1999	Alary *et al.*, 2002[53]	Benin	Convenience	No	1993: 374 1995-96: 365 1998-99: 591	1993: 53% 1995-96: 49.4% 1998-99: 40.6%
2002	1999-2000	Chan *et al.*, 2002[54] (Abstract)	China	N/A	N/A	1451	0.1%
2002	1992 1998	Ghys *et al.*, 2002[55]	Ivory Coast	Convenience	No	1992: 356 1998: 853	1992 = 89% 1998 = 32%
2002	1997-98 1998 1998-99 1999	Ford *et al.*, 2002[56]	Indonesia	Convenience	No	1997-98: 631 1998: 629 1998-99: 614 1999: 618	1997-98: 1/600 (0.16%) 1998: 1/600 (0.16%) 1998-99: = 2/598 (0.33%) 1999: = 2/544 (0.37%)

Year of publication	Year of the study	Citation	Country	Sampling type	Considered the design at the analysis	Sample size	HIV prevalence rate
2002	ND	Bakare *et al.*, 2002[57] (Abstract)	Nigeria	Convenience	No	169	34.3%
2002	1998-99	Mgone *et al.*, 2002[58]	Papua New Guinea	Convenience	No	407	10%
2002	2000	Hawken *et al.*, 2002[59]	Kenya	Snowball	No	503	30.6%
2003	ND	Sopheab *et al.*, 2003[60] (Abstract)	Cambodia	ND	No	114	42%
2003	2000	Desai *et al.*, 2003[61]	India	Convenience	No	124	43.2%
2003	1999	Davies *et al.*, 2003[62]	Indonesia	Convenience	No	288	0% (95% CI: 0%-1.29%)
2003	1999-2000	Miyazaki *et al.*, 2003[63]	Japan	Convenience	No	171	0%
2003	1999	Behets *et al.*, 2003[64]	Madagascar	Convenience	No	986	0.2% (2/986)
2003	1998-99	Xueref *et al.*, 2003[65]	Madagascar	Convenience	No	316	0%
2003	1994-95	Uribe-Salas *et al.*, 2003[66]	Mexico	Convenience	No	484	0.6%
2003	1997-2001	Resl *et al.*, 2003[67]	Czech Republic	Convenience	No	561	0.18%
2003	2000	Laurent *et al.*, 2003[32]	Senegal	Cluster sampling	Yes	390	HIV-1: 6% (95% CI: 2.8%-9.1%) HIV-2: 3.6% (95% CI: 1.6%-5.7%) HIV-1+2: 0.4% (95% CI: 0%-1.1%)
2003	1999	Camejo *et al.*, 2003[68]	Venezuela	Convenience	No	212	0%
2004	1999-2000	Belza *et al.*, 2004[69]	Spain	Convenience	No	579	0.17% (95% CI: 0.01%-1.12%)
2004	2000-01	Belza *et al.*, 2004[70]	Spain	Convenience	No	3149	0.7%
2004	1998-2000	Pal *et al.*, 2004[71] (Abstract)	India	Convenience	No	867	13.2%
2004	2000	Nguyen *et al.*, 2004[72]	Vietnam	Convenience	No	398	16.3%
2005	ND	Dunkle *et al.*, 2005[73] (Abstract)	South Africa	NA	NA	295	46.7%
2005	1999-2000	Chen *et al.*, 2005[18]	China	Convenience	No	505	10.3% (95% CI: 7.6%-13%)
2005	2000-01	Ding *et al.*, 2005[74]	China	Snowball	No	621	0.4%
2005	2004	Sarkar *et al.*, 2005[75]	India	Convenience	No	622 tested 362 behavioral questionnaire	9.6%

Year of Publication	Year of the study	Citation	Country	Sampling type	Considered the design at the analysis	Sample size	HIV prevalence rate
2005	2002	Jahani *et al.*, 2005[76]	Iran	Convenience	No	149	0%
2005	ND	Gare *et al.*, 2005[19]	Papua New Guinea	Convenience	No	211	0%
2005	2002	Tran *et al.*, 2005[21]	Vietnam	Cluster sampling	Yes	400	12% (95% CI: 8.6%-15%)
2005	ND	Cowan *et al.*, 2005[77]	Zimbabwe	Convenience	No	363	55.7% (95% CI: 50.6%-60.9%)
2006	1999-2002	Bautista *et al.*, 2006[25]	Latin America	Convenience	No	13,600	1.2% (0%-4.5%)
2006	2000-02	Pando *et al.*, 2006[78]	Argentina	Convenience	No	625	3.2% (0%-6.1%)
2006	2004-05	Ruan *et al.*, 2006[79]	China	Convenience	No	343	0.6%
2006	2005	Papadogeorgaki *et al.*, 2006[80]	Greece	Convenience	No	299	0%
2006	2000	Allen *et al.*, 2006[81]	Guiana	Snowball	No	299 (241 tested)	30.6%
2006	2004	Sarkar *et al.*, 2006[82]	India	Convenience	No	2076	5.9% (95%CI: 4.9%-6.9%)
2006	ND	Cwikel *et al.*, 2006[83]	Israel	Convenience	No	43	0%
2006	2001-02	Nigro *et al.*, 2006[84]	Italy	Convenience	NA	118	0%
2006	2004-05	Patterson *et al.*, 2006[85]	Mexico	NA	No	295	Tijuana: 4.8% Ciudad Juarez: 4.9%
2006	1999-2000	Bruckova *et al.*, 2006[86]	Czech Republic	Convenience	No	585	0.7% (95% CI: 0.2-1.7)
2006	2002	Pisani *et al.*, 2006[87]	East Timor	Convenience	No	100	3%
2006	2003-04	Todd *et al.*, 2006[88]	Uzbekistan	Convenience	No	448	10%
2006	2004	Johnston *et al.*, 2006[28]	Vietnam	RDS	Yes	628 (including seeds) Ho Chi Minh City (HCMC) = 413 Hai Phong (HP) = 215	HCMC: Visible = 14.5%; Semi-visible = 13.8%; Non-visible = 13.5%; HP: Visible = 35.2%; Semi-visible = 30.2%; Non-visible = 30%
2007	2004	Mosoko *et al.*, 2007[89]	Cameroon	Convenience	No	1005	26.4% (95% CI: 23.6%-29.2%)
2007	ND	Barrientos *et al.*, 2007[90]	Chile	Stratified random sample	Yes	626	0%
2007	2003-04	Lau *et al.*, 2007[91]	China	Convenience	No	293	0%

Year of publication	Year of the study	Citation	Country	Sampling type	Considered the design at the analysis	Sample size	HIV prevalence rate
2007	ND	Lau *et al.*, 2007[38]	China	Convenience	No	336	0%
2007	2000-03	Vall-Mayans *et al.*, 2007[92]	Spain	Convenience	No	301	1%
2007	2005	Enkhbold *et al.*, 2007[93]	Mongolia	Convenience	No	342	0%
2007	2002	Hagan & Dulmaa, 2007[37]	Mongolia	Snowball	No	179	0%
2007	ND	Chersich *et al.*, 2007[94] (Summary)	Kenya	Snowball	N/A	Never drank: 161 Drank sometime during life: 558	Never drank: 23.2% Drank sometime during life: 39.9%
2007	2002	Vandepitte *et al.*, 2007[95]	Democratic Republic of Congo	Convenience	No	502 (of 585 recruited)	Total: 12.4% Hotel = 11.8%; Home = 24%; Street = 20%; Phaseures = 10%; Masquées = 6.6%
2007	2000-04	Wang *et al.*, 2007[96] (Abstract)	Senegal	Convenience	No	1,052	19.8%
2007	2004	Vu *et al.*, 2007[97]	Vietnam	Convenience	No	982	2002: 4.5% 2004: 3.6%

2007	2002-04	Tuan *et al.*, 2007[33]	Vietnam	Cluster sampling	No	Lai Chau:
						street = 54;
						karaoke = 49
						Kien Giang:
						street = 216;
						karaoke = 449
						Dong Thap:
						street = 201;
						karaoke = 291
						An Giang:
						street = 400;
						karaoke = 363
							Lai Chau:
							street =1.9%;
							karaoke = 0%
							Kien Giang:
							street = 0%;
							karaoke = 1.3%
							Dong Thap:
							street = 1.5%;
							karaoke = 1.4%
							An Giang:
							street = 24.3%;
							karaoke = 16.5%

2008	2006	Xu *et al.*, 2008[98]	China	Convenience	No	96	8.3%
2008	2004	Ngo *et al.*, 2008[99]	China	Convenience	No	310	3.9%
2008	2006	Wang *et al.*, 2008[100]	China	Convenience	No	737	76/737 (10.3%)
2008	2005	Folch *et al.*, 2008[101]	Spain	Convenience	No	357	0.8%
2008	2005-06	Uusküla *et al.*, 2008[29]	Estonia	RDS	No	227	7.6% (95% CI: 4.6%-12.5%)
2008	2002-05	van Veen *et al.*, 2008[102]	Holland	Convenience	No	399	1.5% (95% CI: 0.6%-3.2%)
2008	2004-05	Shahmanesh *et al.*, 2008[30]	India	RDS	Yes	326	25.7% (95% CI: 21%-31.1%)
2008	ND	Linhart *et al.*, 2008[103]	Israel	Convenience	No	300	1/300 (0.33%)
2008	2004-05	Strathdee *et al.*, 2008[104]	Mexico	Convenience	N/A	924	6%
2008	2006	Imade *et al.*, 2008[105]	Nigeria	Convenience	N/A	398	Vaginal douche users: 48.8% Non-users: 48.2%
2008	2000 2005	Luchters *et al.*, 2008[17]	Kenya	Snowball	No	2000: 503 2005: 506	2000: 30.6% 2005: 33.3%

Almost 50% of the selected studies (48.3%) were published after 2006, and around 25% of them were published between 2000 and 2002 (Table 2).

Although the studies were published in 31 different journals, 49.3% of them were published in four journals: Sexually Transmitted Diseases; Sexually Transmitted Infections; AIDS; and International Journal of STD & AIDS.

Regarding the country where the study was carried out, almost half of the studies were carried out in only eight countries. Most of them were carried out in China (10) and around 7% in India (5) and Vietnam (5), and 5.3% in Spain. Three studies (4%) were carried out in each of the following countries: Indonesia, Italy, Mexico and Kenya.

Considering the region where the study was carried out, 42.7% of them were carried out in the Eastern, Southern and Southeastern Asia; 26.7% in the Sub-Saharan Africa; 10.7% in Latin America; and 2.7% in Eastern Europe and Central Asia (Table 2).

Table 2. Distribution of studies selected according to publication year, journal, country, and region where the study was carried out. 2000-2008

Characteristics	Number of studies	Distribution (%)
Total	75	100.0%
Year		
2000	3	4.0
2001	7	9.3
2002	7	9.3
2003	10	13.3
2004	4	5.3
2005	8	10.7
2006	13	17.3
2007	12	16.0
2008	11	14.7
Publication Journal		
Sexually Transmitted Diseases	13	17.3
Sexually Transmitted Infections	12	16.0
AIDS	7	9.3
International Journal of STD & AIDS	5	6.7
Journal of Acquired Immune Deficiency Syndromes	5	6.7
AIDS Care	3	4.0
Other	30	40.0
Country where study was carried out		
China	10	13.3
India	5	6.7
Vietnam	5	6.7
Spain	4	5.3
Indonesia	3	4.0
Italy	3	4.0
Mexico	3	4.0
Kenya	3	4.0
Other	39	52.0
Region where study was carried out		
East Asia	14	18.7
Eastern Europe and Central Asia	2	2.7
Latin America	8	10.7
South and Southeast Asia	18	24.0
Sub-Saharan Africa	20	26.7
Western and Central Europe	13	17.3

Table 3 shows the results related to the sampling design and the adequacy of the sample size. A total of 84% (63) of the selected studies used convenience samples, and 8% (6) employed the snowball sampling method. It was not possible to obtain information on the type of sampling used in around 5% of the studies, as the authors had no access to the complete study text. Of eight studies that used probabilistic sampling, four used cluster sampling and three used RDS. Six studies with probabilistic sampling (75%) were carried out after 2006 and, among them, the three that used RDS. The studies that used RDS were carried out in Estonia, India and Vietnam. Two of the four studies that used cluster sampling were carried out in Vietnam.

Of the eight studies with probabilistic sampling, six had the sampling design considered at the analysis. One used a stratified sampling with proportional allocation and random selection in the strata; two used RDS and performed the analysis using the software program specific for the method (RDSAT®); and three used cluster sampling and considered the design effect at the analysis.

It was verified that the sample size was adequate for the estimation of the HIV prevalence rate in 53.3% of the studies (Table 3). Among the 35 studies that had an inadequate sample size for the estimation of HIV prevalence rate according to the criterion used in the present study, the prevalence rate was estimated at zero (0) in 16 of them.

The classification of the studies according to the quality criterion is shown in Table 4. Almost 50% of the studies (36) did not meet any of the adopted quality criteria. In 30 studies (40.5%), only the sample size was adequate, without using the probabilistic sampling method. Three studies, published from 2005 to 2008, used probabilistic methods, but the sample size was not adequate and the study design was not considered at the analysis. Only four of the analyzed studies had an adequate sample size for the estimation of the HIV prevalence rate, used a probabilistic method of sampling and considered the sampling design of the study at the analysis.

Table 3. Absolute (n) and percentage (%) distribution of articles selected according to sampling design, sample-size adequacy, and whether the study design was considered at the analysis

		n	%
Sampling method	Convenience	63	84.0
	Snowball	6	8.0
	Probabilistic	8	10.7
	Stratified random sample	1	1.3
	Cluster sampling	4	5.3
	RDS	3	4.0
	No information	4	5.3
	Total	75	100.0
Sampling design was considered at the analysis*	Yes	6	75.0
	No	2	25.0
	Total	8	100.0
Sample size	Adequate	40	53.3
	Not adequate	35	46.7
	Total	75	100.0

*Only among studies with probabilistic sampling.

Table 4. Classification of the selected studies according to the quality criteria

Quality criteria	2000-2004	2005-2008	2000-2008
Did not meet any of the criteria	15	21	36
Only sample size was adequate	13	17	30
Use of probabilistic method	0	3	3
Adequate sample size and use of probabilistic method	0	1	1
Adequate sample size, use of probabilistic method and design considered in analysis	2	2	4
Total	30	44	74

It was not possible to classify one of the studies (Chan *et al.*, 2002) as it did not provide information on the method used, or whether the study design was considered at the analysis.

DISCUSSION

The present study used the aforementioned keywords to identify 75 cross-sectional studies with female commercial sex workers that estimated the HIV prevalence rate. The studies supply information on 61,075 female SW and were carried out in 35 different countries, of which 10 were located in Asia. Many of the studies were published after 2006 and were concentrated in four scientific journals.

The higher risk among the female SW was observed in many of the countries where the studies reviewed here were carried out. Luchters *et al*,[17] in their study carried out in Kenya, emphasized that, in spite of the decrease in the HIV prevalence rate observed in the female population, there was no evidence that these changes were occurring among the higher-risk populations, such as the SW. The findings of a study conducted in China equally demonstrated a higher risk among the SW, especially related to the lack of condom use and the low level of education.[18] Considering the importance of this population for the control of the HIV/AIDS epidemics, in a study carried out in New Guinea, the authors pointed out that the development of specific interventions for this population subgroup is a cost-effective strategy for the control of HIV dissemination.[19]

This review shows that most of the studies that involved female SW used sampling techniques with non-probabilistic selection. When compared to the probabilistic samples, the convenience samples can generally be implemented more easily, faster and with fewer resources.[20] However, any inference to the target-population is limited and difficult to interpret, as the study sample might not be representative of the population as a whole.

In general, although most of the analyzed studies used convenience samples, a mapping of the prostitution locations was performed before the start of the study and the SW were recruited at those locations. Although this ethnographic component might have contributed to the representativeness of the population group, the probabilities of selection remain unknown, which prevents any statistical estimate or inference.[18,21] Additionally, the SW that work in locations that were not mapped in the study, were excluded from it.[22]

Snowball sampling was used in 8% of the studies. In spite of its indisputable practical feasibility, several aspects prevent the statistical analysis of the data. First, as there is no maximum number of individuals that each participant can invite to the study, the estimates are biased by the individuals who belong to a larger social network,[16,23] with the final sample being strongly influenced by the initial participants.[9] Secondly, there is a structure of dependence between the observations, which is not considered at the analysis. As discussed by Erickson,[24] the individuals tend to recruit people who are similar to them, an effect known as homophily. Moreover, the lack of representativeness of the sample can also be observed.[25]

From 2005 on, there is an increase in the number of articles and studies with probabilistic sampling. This increase is probably associated with the new set of indicators, proposed in 2005, to follow the Declaration of Commitment on HIV/AIDS, established during the 26th United Nations General Assembly Special Session – UNGASS.[26] In this new version, in contrast to those proposed in 2002, two distinct sets of indicators were proposed, according to the type of epidemics of the country: concentrated or generalized. For countries with epidemics classified as concentrated, the indicators aimed at the follow-up of populations at higher-risk, determined by the countries themselves, according to the characteristics of their epidemics.[27]

Additionally, the development and the dissemination of the use of specific and probabilistic sampling methods for the study of populations that are hard to reach brought new possibilities and stimuli for researchers interested in the study of groups at higher-risk for infection HIV. Three studies that utilized probabilistic sampling methods, by using RDS, were the result of this process.[28-30] In Vietnam, this method showed to be efficient to recruit different types of SW.[28]

It is worth mentioning, however, that probabilistic sampling methods also present important limitations. In cases of conglomerate sampling, it is difficult to have a complete list of all prostitution locations and the selection probabilities are, in general, unknown, and approximations are considered at the data analysis.[21,31-33] As for the RDS technique, as the method is still being developed, data analysis is yet quite limited, not allowing multivariate analyses, which are essential for the study of the factors associated with HIV infection.[28,34-36]

Of the 75 articles analyzed in the present study, 35 presented an insufficient sample size to estimate the HIV prevalence rate with a simple random sample, which is the one that provides the lowest error among the sampling methods.[13] In 16 articles, the prevalence rate among female SW was of 0%, which might indicate that the sample size was not large enough to detect cases of HIV infection. Nevertheless, only three of the studies discussed the possibility of the result being related to the sample size.[33,37,38]

As for the quality assessment, most of the selected studies did not meet the quality criteria that would be adequate to estimate the HIV prevalence rate among the SW. In spite of the improvement in study quality in the two analyzed periods, only four studies[21,30-32] met the established criteria, i.e., having an adequate sample size, using probabilistic sampling method and considering the sampling design at data analysis.

It is also important to mention that not considering the sampling design at the analysis can lead to important errors in the estimation of parameters of interest. By ignoring the sampling design, the traditional statistical analysis, consid-

ering the assumed simple random sampling, can result in inaccuracies regarding the mean estimates, as well as for the respective variances, compromising the results, the hypothesis tests and the conclusions of the study.[39] In the specific case of RDS, Goel and Salganick[40] suggest design effects > 4, resulting from homophily between peers, meaning that the structure of dependence between the observations needs to be considered at data analysis.

The present literature review did not identify any Brazilian study. A further investigation at the Scielo database (www.scielo.br) disclosed three studies carried out between 2000 and 2008 in the country: one in Santa Catarina[41] and two in Amazonas.[42,43] All studies used convenience samples and, according to the criterion adopted in the present article, the sample size was inadequate for the estimation of the HIV prevalence rate in all three of them.

As for the international scenario, the present review showed that some recent studies used a probabilistic sampling technique, which represents a great advance for the monitoring of risk practices and HIV prevalence rates in this population group.

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