Systematic review of HIV prevalence studies among key populations in Latin America and the Caribbean

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Abstract

Objective. This systematic review aims to synthesize articles, abstracts and reports of HIV prevalence studies conducted among men who have sex with men (MSM) and female sex workers (FSW) in Latin America and the Caribbean (LAC). **Materials and methods.** Authors searched online databases and collected gray literature on HIV prevalence among MSM and FSW from LAC. Year, location, sampling methodology, study design, sample size, HIV prevalence and confidence intervals were abstracted. **Results.** A total of 73 studies, dating from 1986 to 2010 were included. The median prevalences for MSM and FSW were 10.6% (interquartile range: 7.4-17.4) and 2.6% (IQR: 0.6-4.2), respectively. Variability was high, especially for MSM. The majority of studies recruited participants using convenience methods. **Conclusion**. HIV prevalence among MSM was higher than that among FSW. Sampling techniques should be standardized for future studies, prioritizing probability methods.

Key words: HIV; vulnerable populations; Latin America; Caribbean region

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Resumen

Objetivo. Esta revisión sistemática tiene el objetivo de sintetizar artículos, resúmenes y reportes de estudios de prevalencia de VIH en hombres que tienen sexo con hombres (HSH) y mujeres trabajadoras sexuales (MTS) en América Latina y el Caribe (ALC). **Material y métodos.** Se realizaron búsquedas en bases de datos electrónicas y se recopiló literatura gris sobre la prevalencia de VIH en HSH y MTS de América Latina y el Caribe. Los datos recolectados fueron año, lugar, metodología de muestreo, diseño del estudio, tamaño muestral, prevalencia de VIH e intervalos de confianza. **Resultados.** Se incluyó un total de 73 estudios, realizados de 1986 a 2010. La mediana de la prevalencia para HSH y MTS fue 10.6% (rango intercuartil: 7.4-17.4) y 2.6% (RIC: 0.6-4.2), respectivamente. La variabilidad de las prevalencias estimadas fue alta, especialmente para HSH. La mayoría de estudios usaron muestras por conveniencia. **Conclusiones**. La prevalencia de VIH entre HSH es superior a MTS. Los métodos muestrales deben ser estandarizados para estudios futuros, priorizando métodos probabilísticos.

Palabras clave: VIH; poblaciones vulnerables; América Latina; región del Caribe

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HIV/AIDS continues to be a pressing public health problem around the world. The Joint United Nations Programme on HIV/AIDS (UNAIDS) recently reported that in 2010 33.3 million people were infected, while in 2009 1.8 million deaths occurred as a result of HIV worldwide. Since new infections peaked in 1999, UNAIDS estimates a 19% decrease in new infections globally, with increases witnessed principally in several countries in Eastern Europe and Central Asia. Based on data from 120 countries, 2.6 million new infections were estimated to have occurred in 2009.[1,2]

The epidemic in Latin America is characterized as stable and concentrated with an estimated population prevalence of 0.5% (95% CI: 0.4-0.6), while in the Caribbean prevalence varies widely from country to country with an overall estimate of 1.0% (95% CI: 0.9-1.1).[2] Brazil is thought to be the most affected country, home to one third of all infected people in the region. Key populations at higher risk of HIV exposure and most affected by the epidemic include: men who have sex with men (MSM), reported prevalence between 7.9%-25.6%,[3] female sex workers (FSW), 3.2%-4.3%[4] and intravenous drug users (IDU), 0-78.0%.[5]

Data on the incidence and prevalence of HIV and other STI among MSM are very poor in most of the developing world.[6] Even in countries where more information is available, the contribution of homosexual behavior to the HIV/AIDS epidemic is not fully appreciated, in part due to either a lack of data or lack of analysis of the available data.[7] A number of more detailed epidemiological studies have shown that same sex behavior is more common and the HIV prevalence among MSM is higher than previously thought.[8-10] In urban centers of Latin America, HIV prevalence has remained high among MSM, even as the epidemic has expanded to other populations.[11]

FSW have lower reported HIV prevalence than MSM but are still one of the key populations for HIV and STI transmission in Latin America and the Caribbean due to the large proportion of men who visit sex workers (2.5%-6.5%).[12] Clients of FSW have sex with members of both high risk (FSW) and low risk (wives, regular partners) female populations.[13] HIV/STI transmission networks are thus formed between populations at higher and those at lower risk, allowing for transmission of HIV and other STI between FSW and their partners, as well as transmission of STI among FSW. Given their central role in the epidemiology of HIV and other STI in Latin America, FSW must also be a major focus of HIV/STI surveillance and control efforts.

In response to differentiated epidemiological characteristics of the pandemic, UNAIDS recommends differentiated national strategic plans attuned to the situation in each country.[14] A principal difficulty in creating such proposals, however, is the availability of accurate information on different sub-populations or widely varying estimates for the same country.[15] Considering the mix of available information, we conducted a systematic review of the HIV prevalence among different key populations in Latin America and the Caribbean to gain a greater understanding of the epidemiologic profile in the region and help inform strategies in response to the HIV epidemic.

Materials and methods

This systematic review aims to synthesize articles, abstracts and reports of HIV prevalence studies conducted among key populations in Latin America and the Caribbean. From May to October, 2010, two independent investigators conducted searches of the PubMed and National Library of Medicine's meeting abstract databases for published articles and abstracts using the following key words: high-risk groups; female sex workers; men who have sex with men; homosexual men; HIV; prevalence; Latin America; and individual country names. Reference listings from previous reviews and papers were also used to identify original articles, conference proceedings and reports. "Gray literature," most often in the form of study reports, was included based on the knowledge of co-authors. We considered peer-reviewed articles, abstracts and documents published up to September 2010.

Eligibility criteria

Publications were assessed based on target population, location, year, sampling methodology, sample size and language. Inclusion criteria for studies were determined a priori to be: studies including HIV prevalence data among MSM or FSW; publication in a peer-reviewed journal, country report or an abstract at a conference with peer-reviewed blinded abstract selection process; studies from the Latin American and Caribbean regions. Inclusion criteria for studies among FSW included exchanging sex for money or goods in different periods (i.e.: last month, last six months and last year). Inclusion criteria for MSM included anal or oral sex with another man, recall periods varying (i.e.: last month, last six months and last year). Studies in English, Spanish and Portuguese published between 1986 and 2010 were included in the review.

Exclusion criteria were studies with 100 or fewer participants and studies that combined participants from the target populations with other populations such as clients of FSW. When multiple reports existed for a single study, one paper was chosen based on complete-

ness of the information. Only original research articles and reports were taken into account for this study, excluding those reported in a review for which we could not locate the abstract, original paper or report. Authors kept records of all excluded publications.

Classification and analysis of the published work

We created a master table in Microsoft Excel (Redmond, WA, USA), extracted key information from included surveys, and entered data into the table. We extracted 1) the first author; 2) the year of the study; 3) survey location; 4) sampling methodology; 5) study design; 6) inclusion criteria; 7) sample size; 8) HIV prevalence; and 9) respective confidence intervals. When unavailable in the selected publications, confidence intervals were calculated assuming a simple random sample: this included 48 studies among MSM and 38 studies among FSW.

City estimates were reported as separate data points if the study presented the prevalence disaggregated by city. We originally arranged sampling methodologies into seven categories: unspecified convenience; snowball convenience; institutional convenience; cluster sampling including time-location sampling (TLS); stratified random sampling; census; and respondent-driven sampling (RDS). Institutional samples included those recruited at HIV testing, sexual/reproductive health, STI treatment and community centers. Institutional samples were presented as convenience samples in tables I, II and III. More recent data from 2000 to 2010 were summarized in a graph (figure 2).

Results

A total of 2 566 conference abstracts and 3 983 articles abstracts were originally identified. Of those, 2 539 conference proceedings and 3 876 articles were excluded because they were not from Latin America or the Caribbean, were out of scope or because they lacked an HIV prevalence estimate. One hundred and thirty-four records were deemed relevant by any reviewer and marked for full-text retrieval. Of those, 84 more were excluded due to duplicated data or sample size less than 100 (figure 1). Twenty-three studies considered gray literature were added to relevant peer-reviewed studies and conference papers for a total of 73 studies.

Men who have sex with men

Forty-eight studies screened 60 421 MSM (sample size range 102-7 041; median 306) and provided 78 population –and city– specific data points. Studies were published between 1988 and 2010. Data points were available from 19 countries. Most sites were large metropolitan centers. Studies were mostly cross-sectional, with the exception

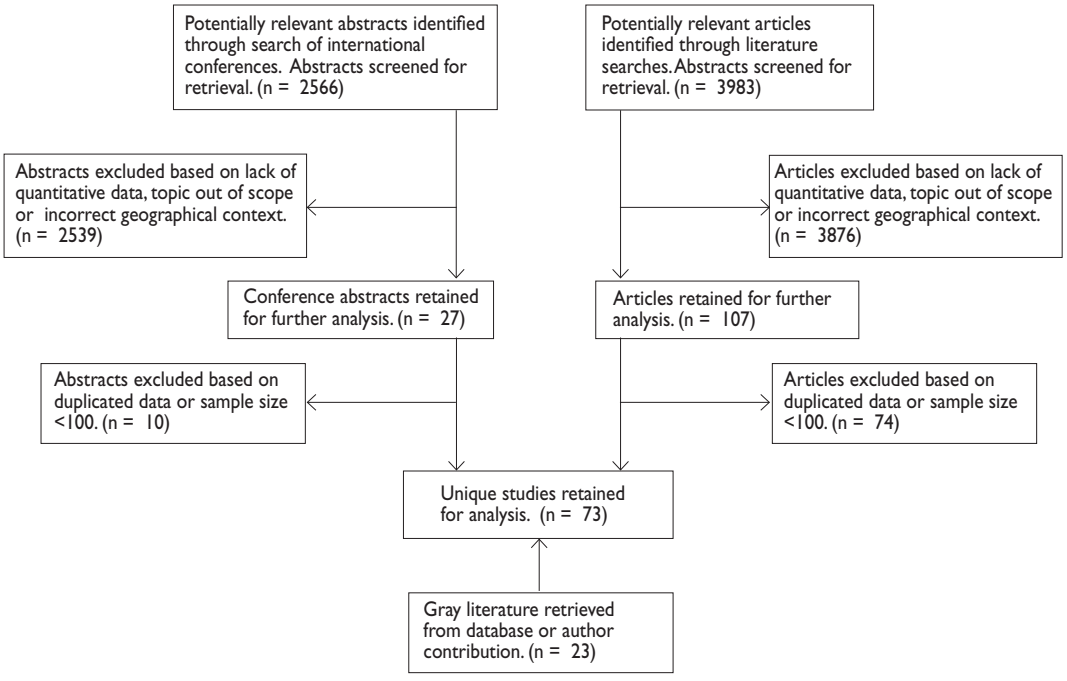


Figure 1. Search protocol

of six prospective cohort studies in four cities in South America and one Caribbean island. Recruitment venues included HIV testing clinics, medical and community-based organizations serving MSM, street locations, and social and workplace venues. The majority (77.1%) of studies was conducted using convenience sampling, and often a combination of techniques (advertising, active recruitment, HIV/STI testing centers, snowball, etc.) was used to reach the desired sample size. There were seven (14.6%) that used RDS, most of these in Central America, three (6.3%) cluster designs and one (2.1%) stratified random sample (table I). RDS studies were first reported in 2008. In countries where both RDS studies and convenience samples were conducted, there was a tendency for RDS studies to report lower HIV prevalence, though differences were not statistically significant based on confidence intervals.

Seventy-eight HIV prevalence points for MSM yielded a range of 0.5% in Paraguay (conducted in 2006)[16] to 31.1% in Guadalajara, Mexico (1985-87),[17] with a median of 10.6% (IQR: 7.4-17.4) (table II). Prevalence rates from 2000 to 2010 are presented in figure 2. Data points from the Caribbean, Central America, and Mexico showed less variability than the Andean region.

A few studies reported HIV incidence. In Brazil, three cohort studies were implemented in the cities of Rio de Janeiro, Sao Paulo and Belo Horizonte which found incidence rates of 3.1, 1.5 and 2.0 per 100 person years, respectively.[18,19] In Peru, 1 140 men followed up between 1998 and 2000 yielded a seroincidence rate of 3.5 per 100 person years.[20] The BED assay has also been used to estimate incidence in cross-sectional studies reporting a range of 2.1-14.4% (95%CI: 5.4-29.7) in Central America[4] and 11.2% in Peru.[21]

Female sex workers

Forty-three prevalence studies surveyed 76 416 female sex workers (sample size range 101-24 500; median 265) and included 86 data points. Studies were published between 1986 and 2010 from 18 countries. Sites included capitals, ports and other tourist and commercial centers. The highest sample size, 24 500 was reached in Mexico (0.3% HIV prevalence), where women were recruited from HIV testing sites at health units across the country.[22] Cross-sectional studies predominated with the exception of one prospective cohort study. Recruitment venues included HIV testing clinics, medical and community-based organizations serving FSW, street locations, and social and workplace venues. Most studies (77.3%) used convenience sampling with the exception of six (13.3%) cluster designs, four (8.9%) RDS and one (2.2%) census (not exclusive; some studies used different sampling methods in different cities). RDS studies were first reported for FSW in 2009. Studies from Central America were more often conducted using RDS than those from other regions. FSW were sampled using probability methods more frequently than MSM, though the difference was small.

Table I
HIV PREVALENCE STUDIES AND DATA POINTS BY POPULATION, SAMPLING STRATEGY, STUDY DESIGN AND REGION

	MSM		*FSW*		*Total*	
	Data points	*Studies*	*Data points*	*Studies*	*Data points*	*Studies*
Sampling method						
Convenience	56	37	59	34	115	61
Respondent-driven sampling	15	7	11	4	28	8
Cluster	6	3	14	6	19	6
Census	0	0	2	1	2	1
Stratified random sample	1	1	0	0	1	1
Summary sampling method						
Convenience	56	37	59	34	115	61
Probability	22	11	27	10	50	15
Region						
Central America	15	7	18	6	33	7
Caribbean	8	5	21	6	29	10
Mexico	16	9	11	8	28	13
Brazil	11	11	10	9	21	19
Southern Cone	8	7	11	6	19	9
Andean	20	10	15	9	35	16
Study design						
Cross-sectional	72	42	85	42	158	66
Cohort	6	6	1	1	7	7
Total	78	48	86	43	165	73

Note: Convenience studies include 9 MSM (10 data points) and 17 FSW studies (30 data points) where participants were recruited at health establishments and 2 MSM (2 data points) and 1 FSW study (1 data point) recruited through snowball sampling. The total number of studies by sampling method, study design and region are not the same as one multisite study for both MSM and FSW was conducted in two different regions. Two multisite studies recruited FSW using cluster sampling in one city and convenience sampling or a census in another city. Overall, 18 studies included both MSM and FSW

MSM: men having sex with men
FSW: female sex workers

Table II

HIV prevalence studies among men having sex with men in Latin America and the Caribbean, 1984-2010

Region	*Country*	*City*	*Year*	*Methods*	*n*	*HIV Prevalence*	*Confidence intervals*	*Reference*
Central America	Guatemala	Guatemala City	2001-02	Convenience	157	12.1	7.5-18.3	[4]
			2005-06	Convenience	300	18.3	13.9-22.7	[55]
			2010	Cluster	438	7.7	5.2-10.2*	[56]
	El Salvador	San Salvador	2001-02	Convenience	281	15.3	11.3-20.2	[4]
			2008	RDS	516	10.8	7.4-14.7	[57]
		San Miguel	2008	RDS	183	8.8	4.2-14.5	[57]
	Honduras	Tegucigalpa	2001	Convenience	110	8.2	3.1-13.3*	[58]
			2006	RDS	200	5.7	2.5-8.9*	[59]
		San Pedro Sula	2001	Convenience	175	16.0	10.6-21.4*	[58]
			2006	RDS	200	9.7	4.6-15.2	[59]
		La Ceiba	2006	RDS	200	4.8	1.4-8.6	[59]
	Nicaragua	Managua	2002	Convenience	145	7.6	3.9-13.3	[4]
	Costa Rica	San José	2010	RDS	311	10.9	5.3-18.3	[60]
	Panama	Panama City	1984-86	Convenience	287	3.1	1.1-5.1*	[23]
			2002	Convenience	235	8.9	5.7-13.5	[4]
Caribbean	Cuba	National	1986-88	Convenience[‡,§]	710	5.1[&]	3.5-6.7*	[61]
	Dominican Republic	Santo Domingo, Puerto Plata, Samana	2004	Convenience	597	10.7[&]	8.2-13.2*	[62]
		Santo Domingo	1994	Convenience	344	11.0	7.7-14.*	[63]
			2008	RDS	488	5.9	3.8-8.0*	[64]
		Santiago	2008	RDS	298	5.1	2.6-7.6*	[64]
		Barahona	2008	RDS	233	5.6	2.6-8.6*	[64]
		La Altagracia	2008	RDS	262	7.6	4.4-10.8*	[64]
	Jamaica	Kingston	1985-86	Convenience	125	9.6	4.4-14.8*	[65]
Mexico	Mexico	National	1985-90	Convenience[§]	4507	17.8[&]	16.7-18.9*	[22]
			1991-96	Convenience[§]	6274	15.5[&]	14.6-16.4*	[22]
		Guadalajara	1985-87	Convenience	383	31.1	26.5-35.7*	[17]
			1988	Convenience	104	13.5	6.9-20.1*	[66]
			1984-90	Convenience [#]	267	29.2	23.7-34.7*	[67]
			2003	Cluster	392	13.8	10.4-17.2*	[68]
		Tijuana	1988	Convenience	102	6.9	2.0-11.8*	[66]
			1991	Convenience	233	11.6	7.5-15.7*	[69]
		DF	1988	Convenience	135	25.4	18.1-32.7*	[66]
			1988-89	Convenience[§]	2314	31.0	29.1-32.9*	[70]
			1993-95	Convenience[§]	2328	28.2	26.4-30.0*	[71]
			2005	Cluster	225	10.5	6.5-14.5*	[72]
		Monterrey	1988	Convenience	124	2.4	0-5.1*	[66]
			2005	Cluster	315	10.8	7.4-14.2*	[72]
		Acapulco	2005	Cluster	301	9.3	6.0-12.6*	[72]
		Tampico	2006	Cluster	270	8.9	5.5-12.3*	[72]
Brazil	Brazil	Salvador	1989	Convenience[§]	550	10.0	7.5-12.5*	[76]
		Porto Alegre	1996	Convenience[§]	461	24.1	20.2-28.0*	[35,74]
		Sao Paulo	1994-97	Convenience[‡]	944	12.5	10.4-14.6*	[75]
		Belo Horizonte	1994	Convenience[§]	167	6.6	2.8-10.4*	[73]
			1994-2001	Convenience[‡]	621	9.8	7.5-12.1*	[77]
		National military conscripts	2002	Stratified random simple	898	0.6[&]	0.3-0.9	[78]
		Campinas	2005-06	RDS	621	7.4	4.7–10.7	[79]

(Continued...)

(Continuation)

		Rio	1987	Convenience	128	25.0	17.5-32.5*	[80]
			1994-98	Convenience‡	1165	24.1	21.6-26.6*	[81]
			1995-98	Convenience‡	927	12.1	10.0-14.2*	[82]
			2006	Convenience	290	9.7	6.3-13.1*	[83]
Southern Cone	Paraguay	Asuncion	1987-90	Convenience	182	8.8	4.7-12.9*	[84]
		Ciudad del Este	2006	RDS	296	0.5	0-1.2	[16]
	Uruguay	Montevideo, Artigas, Rivera, Tacuarembó	1996	Convenience	479	4.8 &	2.9-6.7*	[85]
		5 border cities w/Brazil ≠	2001-02	Convenience	102	2.0 &	0-4.7*	[30]
	Argentina	NR	1987∞	Convenience	1419	17.8	15.8-19.8*	[86]
		Buenos Aires	1987∞	Convenience	348	29.0	24.2-33.8*	[87]
			2000-01	Convenience	742	15.4	12.8-18.0*	[30]
			2003-04	Convenience‡	877	7.5	5.9-9.5	[88]
Andean	Bolivia	Santa Cruz	2001-02	Convenience	186	23.7	17.6-29.8*	[30]
			2008	RDS	361	15.0	9.5-21.5	[89]
		Cochabamba	2008	RDS	232	10.2	6.1-18.1	[89]
		La Paz/El Alto	2008	RDS	203	9.6	0-26.2	[89]
	Peru	NR	1987∞	Convenience§	1236	6.7	5.3-8.1*	[90]
		NR	1986-90	Convenience	4300	26.0	24.7-27.3*	[91]
		Lima	1988	Convenience	124	6.5	2.2-10.8	[92]
			1996	Convenience #	444	18.5	15.0-22.4	[21]
			1998	Convenience	1211	4.8	2.1-9.6	[93]
			1999-2000	Convenience	7041	13.7	12.9-14.5*	[30]
			2000	Convenience	1357	12.4	7.4-20.3	[93]
			2002	Convenience	1358	22.3	20.1-24.6	[93]
		Iquitos, Pucallpa, Trujillo, Arequipa, Tacna, Sullana	1999-2000	Convenience	3898	6.1&	5.3-6.9*	[30]
		Lima, Trujillo, Chiclayo	2001-02	Convenience	166	9.6&	5.1-14.1*	[94]
	Ecuador	Guayaquil	1999-2001	Convenience	227	27.8	22.0-33.6*	[30]
		Quito	1999-2001	Convenience	263	14.5	10.2-18.8*	[30]
		4 port cities ≠	2001-02	Convenience	142	2.8	0.1-5.5*	[30]
	Colombia	Bogota	1985-87	Convenience§	294	21.1	16.4-25.8*	[95]
			2002	Convenience	660	19.7	16.7-22.7*	[30]
	Venezuela	NR	1992	Convenience	315	30.8	25.7-35.9*	[96]

Note: NR not reported
* Confidence intervals not presented in the publication and calculated confidence intervals based on simple random sample assumption
‡ Cohort studies
§ Institutional sampling
# Snowball sampling
& Prevalence presented as combined sample from various cities
≠ Names of cities not reported
∞ Estimated based on publication date

HIV prevalence ranged from 0% in parts of Honduras, Nicaragua, Panama, Uruguay, Chile, Bolivia, Peru and Venezuela (conducted between 1986 and 2006)*,[23-30,121] to 12.4% in Haiti (1987-1988)[31] with a median of 2.6% (IQR: 0.6-4.2) (table III). HIV prevalence among FSW by region and country from 2000-2010 are presented in figure 2. The data points showed lower prevalence and less variability than for MSM.

Discussion

Traditionally, the highest HIV prevalence among MSM have been reported in Mexico and the Andean countries. However, in the last 10 years the prevalence in Mexico appears to have decreased or studies have recruited a more heterogeneous sample and recent levels are similar to those reported in Central America. For FSW, the

Table III

HIV prevalence studies among female sex workeres in Latin America and the Caribbean, 1986-2010

Region	*Country*	*City*	*Year*	*Methods*	*n*	*HIV Prevalence*	*Confidence intervals*	*Reference*
Central America	Guatemala	Guatemala City	2001-02	Cluster	158	4.0	0.9-7.1 ‡	[97]
		Puerto San Jose	2001-02	Census	127	8.7	3.8-13.6 ‡	[97]
		Guatemala City, Escuintla, Quetzaltenango	2005-06	Convenience	298	1.1 ‡	0.4-1.7	[55]
		National	2010	Cluster	898	3.8 ‡	2.5-5.1 ‡	[56]
	El Salvador	Acajutla	2001-02	Census	352	3.7	1.7-5.7 ‡	[98]
		San Salvador	2001-02	Cluster	139	3.9	0.7-7.1 ‡	[98]
			2008	RDS	613	5.7	3.5-7.9	[57]
		Sonsonate	2008	RDS	174	2.5	0.7-5.2	[57]
	Honduras	Tegucigalpa	2001	Cluster	157	8.1	3.8-12.4 ‡	[99]
			2006	RDS	204	5.4	0.5-14.9	[121]
		San Pedro Sula	2001	Cluster	209	13.0	8.4-17.6 ‡	[31]
			2006	RDS	194	3.7	0.9-7.6	[121]
		La Ceiba	2006	RDS	181	1.9	0.4-3.9	[121]
		Comayagua	2006	RDS	212	0	-	[121]
	Nicaragua	Managua	2001-02	Cluster	324	0	-	[26]
	Panama	Panama City	1988	Convenience§	183	0	-	[23]
			2002	Cluster	241	1.9	0.2-3.6 ‡	[99]
		Colon	2002	Cluster	141	2.1	0-4.5 ‡	[99]
Caribbean	Domincan Republic	12 sites &	1987-88	Convenience§	3000	2.6≠	2.0-3.2 ‡	[100]
		Santo Domingo province west	2004	Convenience§	106	5.7	2.5-10.9	[101]
		Santo Domingo province north	2004	Convenience§	304	3.6	2.0-5.9	[101]
		Santo Domingo province east	2005	Convenience§	239	5.0	2.2-7.8 ‡	[102]
		Santo Domingo	2004	Convenience§	148	3.4	1.3-6.9	[101]
			2005	Convenience§	230	3.0	0.8-5.2 ‡	[102]
			2006-07	Convenience§	220	4.1	2.2-7.0	[103]
			2008	RDS	277	3.3	1.2-5.4 ‡	[64]
		Puerto Plata province	2004	Convenience§	127	3.9	1.6-8.1	[101]
			2005	Convenience§	326	2.8	1.0-4.6 ‡	[102]
			2006-07	Convenience§	285	1.1	0.3-2.7	[103]
		La Romana province	2004	Convenience§	267	2.5	1.2-4.7	[101]
			2005	Convenience§	300	4.7	2.3-7.1 ‡	[102]
			2006-07	Convenience§	292	3.8	2.1-6.2	[103]
		Duarte province	2004	Convenience§	185	1.1	1.9-3.4	[101]
			2005	Convenience§	299	2.7	0.9-4.5 ‡	[102]
			2006-07	Convenience§	252	1.6	0.5-3.6	[103]
		Santiago	2008	RDS	256	4.2	1.7-6.7 ‡	[64]
		Barahona	2008	RDS	178	8.4	4.3-12.5 ‡	[64]
		La Altagracia	2008	RDS	262	5.2	2.5-7.9 ‡	[64]
	Haiti	NR	1987-88	Convenience	185	12.4	7.7-17.1 ‡	[104]
Mexico	Mexico	National	1985-90	Convenience§	6449	0.9 ‡	0.7-1.1 ‡	[22]
			1991-96	Convenience§	24500	0.3 ‡	0.2-0.4 ‡	[22]
		Guadalajara	1986-87	Convenience∞	550	0.4	0-0.9 ‡	[105]
		DF	1987-89	Convenience	961	2.2	1.3-3.1 ‡	[106]
			1999	Convenience§	2340	0.3	0.1-0.5 ‡	[107]
		Soconusco	1998	Cluster	478	0.6	0-1.3 ‡	[108]
		Tijuana	1988	Convenience§	383	0.3	0-0.8 ‡	[69]
			2003	Cluster	204	6.4	3.0-9.8 ‡	[68]
		Veracruz	2003	Cluster	167	4.2	1.2-7.2 ‡	[68]
		Acapulco	2005	Cluster	285	1.1	0-2.3 ‡	[72]
		Monterrey	2005	Cluster	318	0.9	0-1.9 ‡	[72]

(Continued…)

(…Continuation)

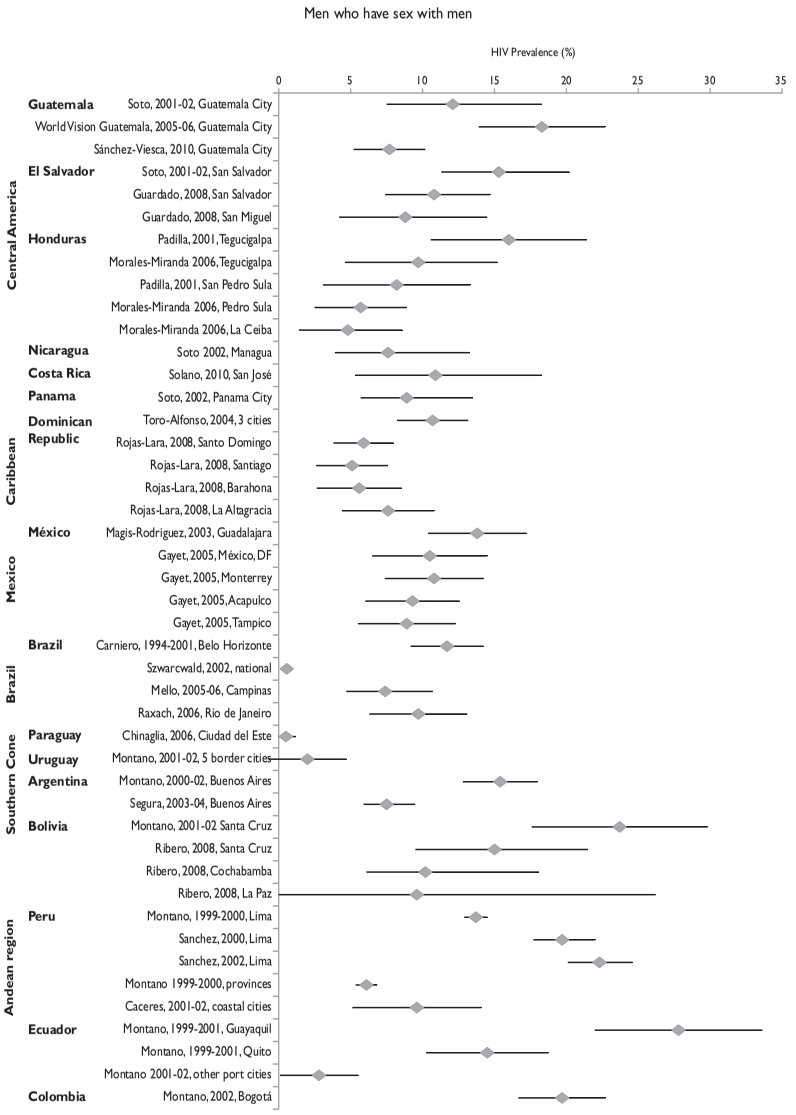
Brazil	Brazil	Rio de Janeiro	1987	Convenience	101	3.0	0-6.3 ‡	[80]
		Sao Paulo, Campinas, Santos	1990-91	Convenience	600	11.0≠	8.5-13.5 ‡	[109]
		Vitoria	1993-96	Convenience§	140	8.6	4.0-13.2 ‡	[110]
		Fortaleza	1993-94	Convenience	496	1.6	0.8-3.3 ‡	[111]
		Maranhão, Paraiba, Sergipe, Minas Gerais, São Paulo, Parana, Santa Catarina, Rio Grande do Sul provinces	2000	Convenience	2712	6.1≠	5.2-7.0 ‡	[112]
		Santos	1987	Convenience	529	4.3	2.6-6.1 ‡	[113]
			1989	Convenience	263	3.8	1.5-6.1 ‡	[113]
			1996	Convenience#	697	8.3	6.3-10.3 ‡	[114]
			2005-06	RDS	175	5.7	2.3-9.1 ‡	[115]
		Manaus, Amazonas	2006	Convenience§	114	2.6	0-5.5 ‡	[116]
Southern Cone	Paraguay	Asuncion Ciudad del Este, Encarnación, PJ Caballero, Coronel Oviedo	2002	Convenience	743	2.6≠	1.5-3.7 ‡	[30]
		Ciudad del Este	2006	Convenience	157	1.3	0-3.1 ‡	[16]
	Uruguay	Montevideo, Artigas	1991	Convenience§	592	0≠	-	[117]
		Montevideo	1997	Convenience	169	0.6	0-1.8 ‡	[85]
			2000-02	Convenience	308	0.3	0-0.9 ‡	[30]
		5 border cities with Brazil &	2000-02	Convenience	308	1.3≠	0-2.6 ‡	[30]
	Argentina	Buenos Aires	1991	Convenience	237	6.3	3.2-9.4 ‡	[118]
			2000-01	Convenience	304	6.3	3.6-9.0 ‡	[30]
		7 provincial cities &	2001-02	Convenience	322	2.8≠	1.0-4.6 ‡	[30]
	Chile	Asuncion	1987-90	Convenience§	2760	0.1	0-0.2 ‡	[84]
		Santiago	2000	Cluster	626	0	-	[30,119]
Andean	Bolivia	Santa Cruz	2001	Convenience	195	0.5	0-1.5 ‡	[30]
		Cochabamba	1997	Convenience§	230	0	-	[25]
			2002	Convenience	523	0.6	0-1.3 ‡	[120]
	Colombia	Bogota	2001-02	Convenience	514	0.8	0-1.6 ‡	[30]
	Ecuador	Guayaquil	2000-01	Convenience	1047	2.1	1.2-3.0 ‡	[30]
		Quito	2000-01	Convenience	200	0.5	0-1.5 ‡	[30]
	Peru	Callao	1986	Convenience§	140	0	-	[27]
		NR	1987	Convenience§	2449	0.3	0.1-0.5 ‡	[90]
		NR	198-90	Convenience	146	10.0	5.1-14.9 ‡	[91]
		Lima	1994	Convenience	158	0	0-1.8 ‡	[28]
			1999-2000	Convenience	3374	1.6	1.2-2.0 ‡	[30]
		Iquitos, Pucallpa, Trujillo, Arequipa, Tacna, Sullana	1999-2000	Convenience	4930	0.6≠	0.4-0.8 ‡	[30]
	Venezuela	Los Teques	1999	Convenience§	212	0	-	[24]
		Isla Margarita	1994-95	Convenience§	115	0	-	[29]
			2002	Convenience	652	0	-	[30]

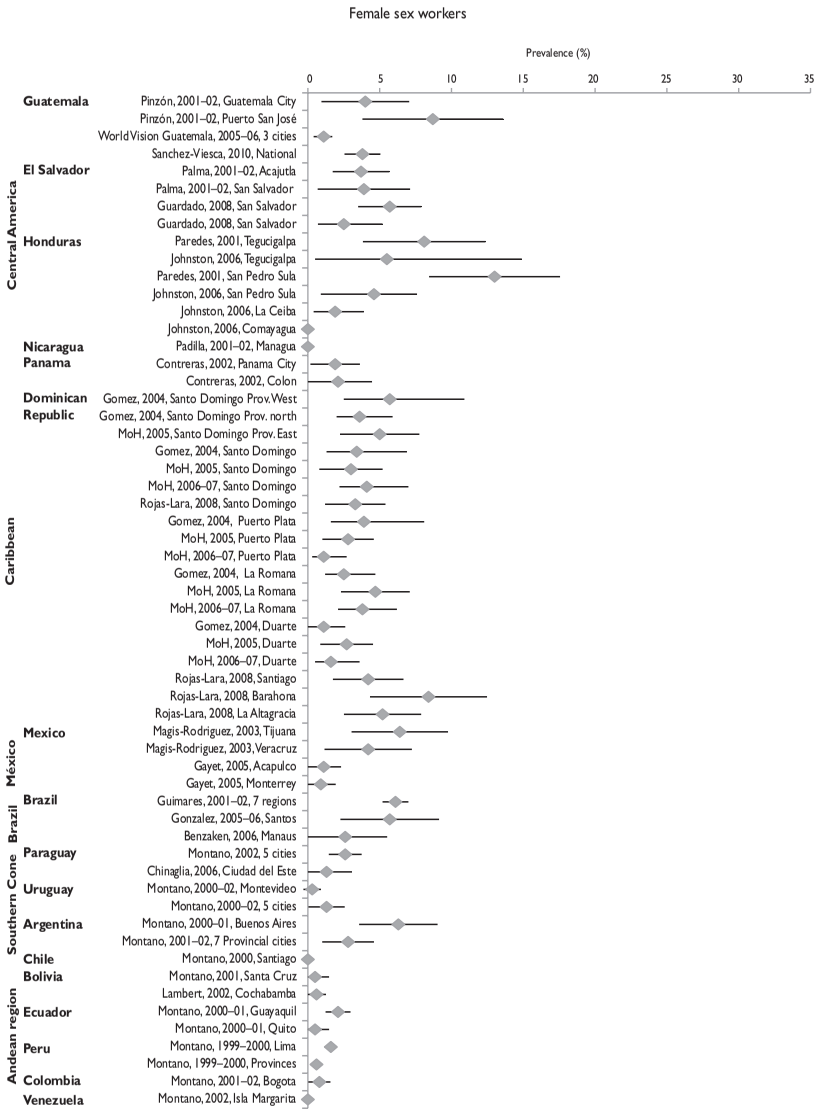
Note: NR not reported

‡ Confidence intervals not presented in the publication and calculated confidence intervals based on simple random sample assumption
§ Institutional sampling
# Snowball sampling
& Names of cities not reported
≠ Prevalence presented as combined sample from various cities
∞ Cohort

disease burden was greatest overall in Brazil, though recent rates were also lower than those from a decade ago. Taking into account the studies in this review, HIV prevalence among MSM was five times higher than among sex workers. HIV seroprevalence studies of other potentially key populations from Latin America and the Caribbean were lacking, and based on previous reviews men who have sex with men and female sex workers have proven to be the populations most affected by the HIV epidemic in countries across the region.[3,32-36]

One of most apparent characteristics regarding the prevalence among MSM, especially evident in the An-





Note: Each data point is identified by the study's first author, year and city where study was conducted

FIGURE 2. HIV PREVALENCE AMONG MEN HAVING SEX WITH MEN AND FEMALE SEX WORKERS IN LATIN AMERICA AND THE CARIBBEAN, 2000-2010

dean region, was the high degree of variability among studies from different countries but also from the same country. This could be due to the different sampling methods used to recruit MSM. Few studies with probabilistic sampling methodologies had been carried out in the region. Furthermore, it is possible that researchers chose probability methods to sample female sex workers more often than for MSM on the assumption that the entire FSW population works from establishments that can be mapped and cluster sampled. In the U.S. venue based sampling has been used to conduct ongoing HIV behavioral surveillance among MSM,[37] but in Latin America researchers have not opted for venue-based methods. In fact, the majority of articles were based on convenience methods, often combining snowball recruitment, outreach referrals or advertisement methods. There are several possible explanations for this observation. MSM in Latin American countries might have been more difficult to recruit in venues compared to the U.S. due to lower social tolerance of sexual diversity and higher levels of stigma and discrimination. This could have resulted in insufficient number of MSM venues and safety concerns for field staff operating in dangerous areas. The high degree of convenience sampling and inclusion of larger proportions of MSM sub-populations at even higher risk such as male sex workers could have caused the large degree of variability on HIV prevalence among the MSM studies. Another explanation for the variability among studies is that RDS has been thought to produce lower seroprevalence estimates than other methods assuming that it reaches hidden segments of the target population, individuals who may have been sheltered from a lifestyle propitious to high rates of transmission.

More difficult to study are individuals who have sexual relations with key populations and with individuals at lower risk. In Latin America and the Caribbean, HIV has often been transmitted in this manner and data on infection rates in these populations were lacking. Mobile workers have exhibited high risk behavior via interactions with FSW: for example in 2003, in Santos, Brazil, 21.0% of 300 truck drivers reported paid sex in the last six months.[38] Migrants, yet another key population, have been at higher risk of HIV exposure, a product of the conditions and structure of the migration process.[39] Marginalized populations such as sex workers, injecting drug users and men who have sex with men traditionally have experienced internal and international migration and may become victims of exploitation, violence and exclusion.[40,41] A high level of mobility, legal status, language and cultural differences; lack of information, education and work; poor access to prevention, harm reduction and health care services; and gender related factors have led to migrants' underprivileged status. Stigma has further exacerbated their vulnerability. These key populations should also be the focus of surveillance to better monitor the HIV epidemic. The objective of surveillance and most prevalence studies is to document the gravity of disease burden in the target population and to make recommendations regarding allocation of resources to control the spread of disease. A primary challenge for surveillance of these key populations is obtaining 'representative' samples.[42,43] General population surveys with multi-stage cluster sampling are excessively expensive and cannot be used to reach hidden segments of the population.[44]

Several approaches have been proposed to balance the need for recruitment efficiency and inclusiveness in representation. Snowball sampling increases efficiency, identification, and inclusion of hidden populations by having members of the target population recruit other members.[45] However, snowball sampling suffers from sampling bias and leads to a group that is not representative of the population. Facility-based sampling is also not generalizable as those who obtain services are different from those who do not. Targeted sampling involves an ethnographic mapping of the target population to later sample subgroups as strata. The magnitude of the bias in targeted sampling depends on the thoroughness of the ethnographic assessment. Time-location sampling involves an ethnographic mapping of sites where the target population meets or works and random selection of participants at randomly selected sites, days and times. Time-location sampling is a probability sampling method but as with targeted sampling, its representativeness depends on the exhaustiveness of the mapping and assistance of all population subgroups at selected sites. Nevertheless, TLS has worked well with more visible populations including female sex workers and their clients,[46,47] and MSM in gay-identified areas of urban centers.[48,49]

Respondent-driven sampling has been used for surveillance of populations most at risk for HIV/AIDS in the United States and in more than 83 countries worldwide since 1994.[50,51] In theory, weighted estimates generated from RDS generalize to the population as a whole. However, recent assessments of the RDS sampling methodology have documented limitations in the RDS assumptions.[52,53] Despite these limitations, RDS is currently one of the only methods available to reach highly hidden populations that provides methodological rigor.

This review has several limitations. The use of different sampling methodologies diminished the validity of pooled prevalence estimates and only medians were presented as summary estimates in this paper. Calculated asymptotic confidence intervals were tighter than the true intervals, limiting the interpretability of the

data. More recent studies may not have been included due to the lag time between data collection and publication of results. The inclusion of gray literature may also have been biased by the authors' geographical expertise or familiarity. Different types of laboratory tests were used to diagnosis HIV, including rapid tests, ELISA, and Western Blot among others. Information on the types of tests, specific tests or diagnostic algorithms was not always available for the included studies. This variability and lack of information limited the ability to compare the results from different studies. Medians and inter-quartile ranges (IQR) were reported and should be interpreted with care due to the different recruitment methodologies. For the same reason, trend analyses have not been presented in this article.

High prevalence rates among MSM and moderate rates among FSW have been detected in countries across Latin America and the Caribbean. A toolbox of standardized sampling techniques and data collection practices is urgently needed to clear up the varied picture presented by studies in this review. While many researchers continue to question the generalizability of RDS and TLS samples, it is encouraging that researchers are employing probability sampling methods more often than in the past. The implications of this study for prevention include recognizing that in Latin America and the Caribbean sufficient resources should be dedicated to HIV programs for men who have sex with men and sex workers to slow or stop transmission. Historical stigma attached to these key populations and their perceived or estimated population size in comparison to other populations influence decision makers. Widespread efforts are needed to ensure that leaders are aware of the results and that resources are allocated based on burden of disease and prevention needs.[54] Periodic surveillance of MSM, FSW and other populations important to the HIV epidemic should continue.

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