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Is sex work policy a determinant of HIV prevalence among sex workers? Ecological regression analysis of 27 European countries

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Abstract:

Background: Sex workers are disproportionately affected by HIV and other STIs compared with the general population. To date, most studies of HIV risk among sex workers focus on individual-level risk factors, with few studies evaluating potential structural determinants of HIV risk. In this paper we examine whether criminal laws around sex work are associated with HIV prevalence among sex workers.

Method: To test our hypothesis, we estimate cross-sectional, ecological regression models using data from 27 European countries on HIV prevalence among sex workers from the European Centre for Disease Control; sex-work legislation on U.S. State Department's Country Reports on Human Rights Practices; the Rule of Law and GDP per capita, adjusted for purchasing power, from the World Bank; and the prevalence of injection drug use among sex workers.

Findings: We found that countries which have legalised some aspects of sex work (n = 10) have significantly lower HIV prevalence among sex workers than those which have not (n = 17) (β = -2.09, 95% CI: -0.80 to -3.37, p = 0.003), even after controlling for the level of economic development and the proportion of sex workers who are injecting drug users.

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We observe that the relationship between sex work policy and HIV among sex workers may be partially moderated by the effectiveness and fairness of enforcement, suggesting legalization of some aspects of sex work may reduce HIV among sex workers to the greatest extent in countries where the enforcement is fair and effective.

Interpretation: Our findings suggest that legalizing some aspects of sex work may help reduce HIV prevalence in this high-risk group, particularly in countries where the judiciary is effective and fair.

Funding: European Centre for Disease Prevention and Control.

Research in Context

Evidence before this study We searched PubMed on 8 September 2016 using the terms "HIV", "sex worker*", "Europe", "structural" and we found 17 previous studies. Of which, six were studies of specific countries (such as Germany, Armenia, or Russia), which alone are unable to illuminate cross-national patterns in HIV across sex workers. Five were review essays and programmes of action which called for such changes to occur. Two were qualitative studies which did not attempt to explore cross-national differences in sex work policy and HIV. Two were systematic reviews and meta-analyses. One, which estimated the prevalence of HIV among sex workers worldwide, was not explicitly concerned with legal context. The other conducted simulation modelling of changes to legal context. The simulation modelling exercises offer an approximation of how sex work policy affects HIV but are necessarily reliant on parameter estimates from earlier studies of the effect of legal context for specific locations, which, to date, are inferred from related outcomes, such as police harassment. Two conducted cross-national analysis of structural risk factors but neither specifically examined legal structures. This is consistent with the recent review by Shannon et al. which draws attention to important gaps in this literature. To date, studies in this area have been based on country-specific analyses of simulation modelling. These have provided important evidence but there is a need for more detailed analyses examining structural risk factors for HIV among sex workers. Specifically, previous ecological analyses do not examine the association between legal structures and HIV risk among sex workers.

Added value of this study This is the first study – despite its limitations – to conduct an ecological analysis of the association between HIV risk among sex workers and legal structures that may influence this risk. We offer cross-national evidence of an association between sex work policy and HIV prevalence among sex workers, results that will support future simulation modelling of changes to sex work policy. We also show that association between sex work policy and HIV among sex workers is moderated by an effective and fair legal system.

Implications of all the available evidence Our findings suggest that legalising sex work may help reduce HIV prevalence in this high-risk group.

Introduction

Sex workers – those who exchange sex for money – are disproportionately affected by HIV compared with the general population.(1-4) Elevated risk occurs because sex workers have multiple sexual partners who may request condomless sex.(5) Sex work can be accompanied by other high risk behaviours, including injecting drug use(6) and substance use.(7) Sex workers are also often exposed to physical and sexual violence, commonly have limited access to (and utilization of) healthcare services,(7, 8) and may face exclusion / social stigma.(9) Whilst HIV prevalence among sex workers appears to be substantially higher than the wider population in some contexts, prevalence rates vary markedly across countries in Europe.(2, 3, 10) For example, HIV prevalence among sex workers seems to be quite low in Czech Republic (0.1%), but high in Latvia (22%), suggesting that structural factors may shape HIV prevalence among those who exchange sex for money.(2)

To date, the impact of structural determinants of HIV risk on sex workers remains uncertain, in part because most existing studies do not explicitly consider structural drivers, instead focusing on individual-level predictors of HIV risk, such as knowledge about HIV transmission.(3, 5) A 2015 review of the global epidemiology of HIV in female sex workers concluded, "an understanding of how structural factors (e.g., contextual factors external to the individual) shape HIV acquisition and transition risks has only just begun to emerge".(5)

One commonly invoked structural risk factor is sex work policy, particularly the existence of laws that criminalise buying, selling, and/or procuring sex (see Figure 1).(11, 12) Such laws may exacerbate stigma and exclusion faced by sex workers, abrogating access to essential health services and increasing risks of exploitation and violence.(8, 13) These provisions can result in more precarious working environments and greater poverty, all of which increase HIV risks.(5, 14) Such insecurity may make it more difficult for sex workers to negotiate condom usage, as they may: i) feel compelled to engage in condomless sex (as condoms can be used as evidence in judicial proceedings) or ii) work in hidden areas away from possible police detection and/or police harassment.(12, 15, 16) Moreover, criminalization of sex work may force sex workers to work in isolation, deprived of any protection police may offer. Thus, criminalization may infringe on the rights of sex workers, increase marginalization, reducing access to HIV services, and ultimately increasing their risk for HIV infection. For example, recent modelling estimates project that decriminalising sex work in Canada could avert 39% of infections among female sex workers over a 10-year period.(5)

Legal structures may only affect health outcomes if they are effectively and fairly implemented, suggesting enforcement may moderate the relationship between sex work policy and HIV prevalence.(17) Thus, in figure 1, the rule of law influences whether legal context affects police practices or access to services which, in turn, may affect condom use and HIV prevalence. Importantly, the rule of law may affect sex workers differently depending on sex work policy. Among countries that criminalise sex work, we would not anticipate a clear association between the rule of law and HIV among sex workers, because police activity can increase stigmatization and isolation. Whereas, among countries that legalise or decriminalise sex work, we would anticipate a negative association between the rule of law and HIV prevalence among sex workers,

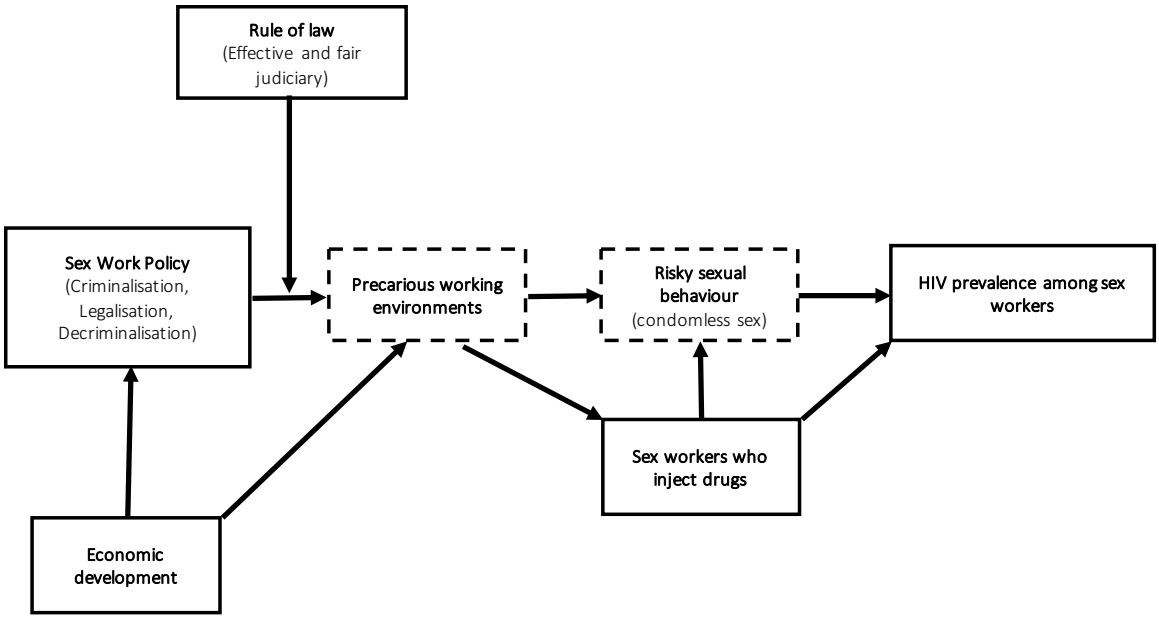

Figure 1: Conceptual framework of the relationship between sex work policy and HIV prevalence among sex workers

because sex workers will receive appropriate protections from law enforcement.

In this study, to our knowledge for the first time, we take advantage of the diversity of legal frameworks across European countries to test the hypothesis that legalising some aspects of sex work is associated with lower HIV prevalence among sex workers when compared to countries that retain criminal laws. We also explore whether better enforcement mediates the relationship between sex work policy and HIV prevalence among sex workers.

Methods

Data sources

Sex work can involve many forms of erotic labour but in this paper we focus on sex workers who exchange sex for money.(18) We collected data on the proportion of sex workers living with HIV from the ECDC's latest estimates for 27 European countries.(2) These data are provided through the Dublin Declaration as part of the Global Aids Response Progress Reporting (GARPR) indicators, one of which is HIV prevalence. Survey strategies differ across countries, in terms of methods and sample size (Web Appendix 1).

The laws governing sex work vary considerably across European countries (see Table 1).(19) We collected data on the laws governing sex work in Europe from country reports on human rights from the U.S. State Department and country-specific legal documents, a widely used source for laws related to sex work.(17) Where necessary, we have supplemented these data with other sources, such as statute documents (Table 1).

Table 1: Laws governing sex work across 27 European countries

Country or Territory	Selling	Buying	Brothels
Legalised			
Germany [1]	X	X	X
Legal, except brothels			
Armenia	X	X	
Belgium [2]	X	X	
Bulgaria	X	X	
Czech Republic	X	X	
Estonia	X	X	
France	X	X	
Israel	X	X	
Italy	X	X	
Kazakhstan	X	X	
Kyrgyz Republic	X	X	
Latvia [3]	X	X	
Poland	X	X	
Portugal	X	X	
Spain	X	X	
United Kingdom	X	X	
Legal to sell, illegal to buy			
Norway	X		
Sweden	X		
Illegal			
Azerbaijan			
Belarus			
Georgia			
Lithuania			
Montenegro			
Romania			
Serbia			
Tajikistan			
Ukraine			
Uzbekistan			

All data on the legal status of sex work come from the U.S. State Department's Country Reports on Human Rights Practices. For more information on these data see Jakobsson and Kotsadam (2013) (23). In some instances these data have been supplemented with data from other sources, indicated by the footnotes.

[1] Source

[2] Source

Some jurisdictions, such as Lithuania, criminalise selling, buying, and procuring sex. Other countries have legalised selling sex while criminalizing purchasing sex. Sweden, Norway, and Iceland are prominent European examples of this approach (commonly known as the Nordic model), although France and Northern Ireland have recently implemented similar laws. Although rooted in feminist legal scholarship,(20) this approach has been associated with similar harms to the criminalization model, such as violence, police repression, and greater risk of HIV.(21, 22) A third set of countries (e.g., the UK) have legalized buying and selling sex but have criminalized procurement through brothels or pimping. A final group of countries legalised most forms of organised and unorganised sex work (e.g. street workers and brothels), albeit regulating the industry. Following previous work in this area, sex work is labelled 'illegal' in countries criminalising all aspects of sex work while we categorise as 'legal' those countries that have legalized some aspects of sex work.(23, 24) Among 'legal' countries, we also distinguish i) those legalizing procurement and ii) those implementing the Nordic model of sex work policy.

Statistical models

We use ecological linear regression models to test whether legalizing some aspects of sex work is associated with a lower proportion of sex workers living with HIV compared to countries that criminalize sex work. We first present unadjusted models of the association between sex work policy and HIV prevalence, for example:

$$HIV_i = \beta_0 + \beta_1 Legal_i + \epsilon_{it} \quad (1)$$

Here i is country. HIV is the logged prevalence of HIV among sex workers drawn from the latest available data. The data are logged to adjust for positive skew in the distribution of HIV prevalence. $Legal$ is a binary exposure variable, where countries that retain criminal laws are coded as 0, and countries that have reformed some or all aspects of sex work are coded as 1. The dichotomous measure of sex work policy is used in all regression models except where otherwise stated.

Equation 1 – and all other regression models – are weighted according to the sample size of the country-specific data. To reduce the possible influence of measurement error, this places greater weight on HIV prevalence estimates coming from large samples, whilst recognising that larger sample sizes are still potentially biased. Our assumption is that larger samples of this hard-to-reach population are more representative of this population as a whole than smaller samples.

Next, we estimate adjusted models, which include each of our additional controls sequentially and independently, based on previous population risk factors identified in the literature (see figure 1). These include gross domestic product per capita in 2005, adjusted for inflation and purchasing power (World Bank) and the proportion of sex workers who are also injecting drug users.(10, 25)

We also explore the relationship between HIV prevalence among sex workers and other forms of sex work policy. First, we compare countries legalizing buying and selling sex but not procurement - coded as 1 - from countries legalizing buying, selling, and procurement - coded as 2. Second, we compare countries implementing the Nordic model to countries that i) permit the market for sex but not procurement and ii) permit both the market for sex and procurement through brothels. These tests explore in more detail some of the variation in sex work policy across countries masked by our primary (dichotomous) indicator.

In a final stage we test whether enforcement of sex work policy moderates the relationship between laws and HIV outcomes (see figure 1). To measure enforcement we use an indicator of the 'Rule of Law' taken from the World Bank's Governance Indicators,(25) which is measured on a scale of -1.4 to 1.9 in our data (with higher scores representing a better rule of law) and captures the confidence people have in effectiveness and fairness of judiciary, including the police force. To test the moderating effect of the Rule of Law on HIV risk among countries that criminalise or legalise some aspects of sex work we stratify the analysis by sex work policy and examine whether the Rule of Law is associated with reduced HIV prevalence in both sets of countries. Descriptive statistics are listed in table 2 (Raw data are listed in Web Appendix 2). All models were estimated using STATA v13.0.(26)

Table 2: Descriptive statistics

Variable	*N*	**Mean**	**Min**	**Max**	**Source**
HIV prevalence among sex workers	27	3.17%	0.1%	22.2%	ECDC, Surveillance report on Sex workers
Sex work is legal = 1	27	0.63	0	1	U.S. State Department's Reports on Human Rights Practices
GDP per capita, adjusted for PPP	27	$156.28	$3.4	$657.67	World Bank (all figures are divided by 100).
Prevalence of sex workers who are IDUs	22	12.64%	0.1%	55%	Platt et al., 2013 (10)
HIV cases in the population per million	27	1106.59	147	5736	Platt et al., 2013 (10)
Proportion of HIV cases provided ART	24	76.25%	9%	100%	ECDC, Surveillance report on HIV
Rule of Law	27	0.34	-1.4	1.9	World Bank Governance Indicators

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

RESULTS

First, we compare the mean HIV prevalence rates among sex workers in countries where sex work is criminalised and in countries where some aspects of it are legalised (see Figure 1; Web Appendix 3). In countries where sex work is partly legalized the HIV prevalence is lower than countries where sex work is criminalised (Table 3). For example, on average, 4.02% of sex workers had HIV in countries where the practice was illegal (n = 10) while only 0.50% had HIV in countries where some aspects of sex work have been legalized (n = 17).

Table 3: Sex work policy is associated with HIV prevalence among sex workers

	Logged HIV prevalence among sex workers (p-value)		
Covariates	(1)	(2)	(3)
Countries that legalise or decriminalise some or all aspects sex work (0 = criminalise sex work)	-2.09 (p = 0.003)	-1.86 (p = 0.038)	-1.93 (p = 0.026)
$100 greater GDP per capita		-0.0011 (p = 0.61)	
Proportion of sex workers who are also injecting drug users			0.23 (p = 0.45)
Number of countries	27	27	22
R^2	0.48	0.49	0.52

Notes: 1: Unadjusted model; 2: model adjusted for country-level GDP; 3: model adjusted for prevalence of injecting drug use among sex workers. Source: ECDC. Regression line weighted by sample size of the HIV prevalence data. Proportion of sex workers who are also injecting drug users comes from a recent paper by Platt et al., 2013. GDP is adjusted for purchasing power parity.

After adjusting for the level of GDP, we find HIV prevalence among sex workers remains lower in countries legalizing some aspects of sex work. We also include a measure of the prevalence of injecting drug use among sex workers and again find consistent results (despite reducing the sample size). Neither GDP nor the measure of the proportion of sex workers who are injecting drug users are associated with HIV prevalence after controlling for sex work policy.

Next we compare the associations of different approaches to legalisation. Table 4 shows the results of these models using a categorical (0 = criminalise, n = 10; 1 = legalise buying and/or selling but not procurement, n = 16; 2 = legalise buying, selling, and procurement, n =1) rather than dichotomous measure of sex work policy. We find that where selling sex is legal but brothels are not, HIV prevalence continues to be lower when compared with countries where sex work is criminalised. This association is even stronger when looking at countries which legalise profiting from all forms of sex work (including brothels). However, there is only one country in our analytic sample (Germany) that permits these forms of sex work and so these results should be treated with some caution.

Table 4: Sex work policy is associated with HIV prevalence among sex workers

	Logged HIV prevalence among sex workers		
		p-**value**	
Covariates	(1)	(2)	(3)
Legalise or decriminalise selling sex but not brothels	-1.83 (p = 0.015)	-1.84 (p = 0.049)	-1.72 (p = 0.088)
Legalise or decriminalise selling sex and brothels	-3.00 (p < 0.0001)	-3.04 (p < 0.0001)	-2.75 (p < 0.0001)
$ 100 greater GDP per capita		0.001 (p = 0.94)	
Proportion of sex workers who are also injecting drug users			0.19 (p = 0.51)
Number of countries	27	27	22
R^2	0.54	0.54	0.56

Notes: 1: Unadjusted model; 2: model adjusted for country-level GDP; 3: model adjusted for prevalence of injecting drug use among sex workers. Source: ECDC. Regression line weighted by sample size of the HIV prevalence data. Proportion of sex workers who are also injecting drug users comes from a recent paper by Platt et al., 2013. GDP is adjusted for purchasing power parity.

Ignoring countries that criminalise sex work, we then compare the Nordic model (Sweden and Norway – coded as 0, n = 2) to countries legalising buying and selling but not procurement (coded as 1, n = 14) and countries that legalise buying, selling, and procurement (coded as 2, n = 1). In an unadjusted model, we find no clear difference between the HIV prevalence among sex workers in the Nordic countries and the countries legalizing buying and selling. However, and whilst acknowledging the small number of observations involved, when we compare Sweden and Norway with Germany (a country which also legalises procurement), we observe that HIV prevalence is lower in Germany than the Nordic countries.

Enforcement of sex work policy may be an important moderator between laws and HIV outcomes (Figure 1). There is no correlation between HIV prevalence among sex workers and the Rule of Law (see Web Appendix 4) but, importantly, the Rule of Law may affect sex workers differently depending on sex work policy. To test this hypothesis, we stratify the analysis by sex work policy, finding that – as anticipated – the Rule of Law has a positive but uncertain relationship with HIV prevalence among sex workers in countries where sex work is criminalized (see Table 5: Model 1). Yet, the Rule of Law is associated with lower HIV risk for sex workers in countries that have legalized some aspects of sex work (see Table 5: Model 2). These findings suggest that effective and fair enforcement mediates the relationship between legalisation and HIV but only among countries that legalised some aspects of sex work.

Table 5: Sex work policy, HIV prevalence among sex workers, and the Rule of Law

	Logged HIV prevalence among sex workers	
	p-**value**	
	Sex work is criminalised	*Aspects of sex work are not criminalised*
Covariates	(1)	(2)
Rule of Law (Higher scores indicate better Rule of Law)	0.33 (p = 0.67)	-0.63 (p = 0.008)
Number of countries	10	17
R^2	0.49	0.52

Notes: Model 1: model only includes countries that criminalise sex work; 3: model only includes countries that legalise or decriminalise some aspects of sex work. Source: ECDC and World Bank Governance Indicators. Regression line weighted by sample size of the HIV prevalence data.

To ensure our results are not explained by our modelling choices we conduct a series of sensitivity tests: 1) removing outliers (Web Appendix 5), 2) including other possible confounders, such as ART coverage and the population prevalence of HIV (Web Appendix 6), and 3) adjusting for sample composition and data collection (Web Appendix 7). We also re-estimate the model using a bootstrap procedure to test whether our results are explained by any single country (Web Appendix 8). In each case, we find that our results do not qualitatively change.

Discussion

Countries that have legalised some aspects of sex work have fewer sex workers living with HIV.(5) In fact, countries that permit buying, selling, and procuring sex, appear to have the lowest HIV prevalence among sex workers. This association is observed even when we adjust for the level of economic development and the proportion of sex workers estimated to be injecting drug users.

These findings are consistent with other studies which observe that the removal of criminal laws protects sex workers, allowing them to enter the formal economy, to benefit from social insurance, and to receive protection from law enforcement.(3, 5) Removing criminal laws may also allow sex workers to exit the industry more easily, allowing them to pursue other avenues of employment. Such legal configurations also increase access to condoms, reduce the risk of violence, and potentially empower women in condom negotiation.(7, 12, 13, 27-29) Our results are also consistent with evidence that suggests the Nordic model may not reduce HIV risk among sex workers and stresses lingering questions about the expansion of this legal approach to sex work across the world.(21, 22)

Effective and fair enforcement of these laws appears to moderate the relationship between sex work policy and HIV prevalence, suggesting HIV prevalence among sex workers is lowest in countries that both legalise sex work and have an effective and fair judiciary. HIV risk for sex

workers will be high in countries that criminalise sex work and have an ineffective and unfair judiciary because they will be marginalised within society, potentially exposed to violence from clients and police, and face the risk of prosecution.(9, 28) Yet, countries with an effective and fair rule of law in contexts where sex work is criminalized may not necessarily improve HIV risk. It may reduce police violence but may also increase marginalization by increasing fear of arrest or prosecution.(12, 22) Among countries that legalise sex work the relationship will be different. Legalising sex work – even in countries with an ineffective and/or unfair judiciary – may still reduce HIV risk because legalisation will enable sex workers to access necessary services, organise their work, and work in safer environments.(18) Further, countries with an effective and fair rule of law in contexts where some aspects of sex work are legalized or decriminalized may lead to even lower HIV risk because there will be more effective protection against violence and better access to services.

However, the causal mechanisms linking legalization with HIV among sex workers remain unclear because the timing and sequence of reforms to sex work policy may also shape how legalization affects HIV prevalence.(30) Simply because a factor is causally associated with an increase in HIV prevalence, it does not mean the removal of this factor would necessarily lead to a reduction in HIV. For example, sex workers are less likely to forego condoms if they have ever been the victim of violence, suggesting that reducing future risk of violence may only have a limited effect on reducing HIV prevalence through increased condom usage.(5, 8) Moreover, laws may change statutory rights but 'stigma does not necessarily erode simply because sex work is legal'.(22, 31, 32) More work is need to understand how legalization (and decriminalization) may contribute toward reducing HIV prevalence among female sex workers.

There are a number of important limitations to this study. First, there is potential for ecological fallacies, arising from the use of population-level data. Ideally we could use multi-level data to compare situations across countries, including individual-level data, but these do not currently exist. Second, and importantly, the HIV prevalence estimates are based on unrepresentative samples of hard to reach groups. This creates several methodological challenges. One is the accuracy of estimates of HIV prevalence among sex workers, which may vary across contexts because the willingness of sex workers to engage with researchers and clinics may be lower in countries where sex work is criminalized. Further data collection procedures differ between countries, meaning that cross-national comparisons may lack reliability. Thus, although we use the best data available to test our research question, these differences between countries are not trivial and lead to significant measurement error, which can lead to conservatively biased estimates of associations, as well as downwardly biasing HIV estimates in association with criminal provisions.(2) Given these limitations, our findings are suggestive and point toward the need for better data collection and monitoring as a means of providing more accurate estimates of HIV prevalence in specific high-risk groups.(3)

Third, measuring sex work policy is difficult because two countries may differ in how strongly they enforce certain laws or, if they both permit sex work, because of subtle differences in how they have legalised sex work.(33) In short, our binary or even tripartite distinctions may mask important variation between and within these categories. To the extent that this measurement error is randomly distributed across categories this would lead to conservative estimates of

the association. Fourth, the reform of sex work policy has occurred at different times in different countries and our analysis does not account for these temporal differences. However, again, this is likely to lead to conservative estimates because we are assuming no differences between exposure to treatment, even though there are large differences between countries. These should be studied independently in future work.

The causal effect of legalising sex work on HIV prevalence among sex workers remains an important topic of future research. Studies examining this question may be able to use natural experiment research designs that exploit policy change within a particular context to test how these policies affect health (including HIV risk) among sex workers more broadly. For example, assuming appropriate data were available, the recent adoption of the Nordic model in France (2016) and Northern Ireland (2015) could be used to examine the short- and long-term health effects of these policies.

Our work has important policy implications. Legalizing aspects of sex work may reduce HIV prevalence among sex workers. Further, our evidence suggests that the greatest gains appear when countries have legalised buying, selling, and procuring sex. But legalizing sex work alone may be insufficient, unless these laws are administered effectively and fairly. Crucially, legal reform may not solve these problems on its own, but our data suggest legalisation may be one important part of a robust and effective response to HIV among sex workers.

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Conflicts of interest We declare that we no conflicts of interest.

Authorship contributions JCS initiated the study. AR and DS collected the data and designed and implemented the study; AR wrote the first draft and SS, DS, MM, AAG, and JCS offered comments on the draft and helped interpret the findings.

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Web Appendix

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Web Appendix 1: Raw data on HIV prevalence and their data sources

Country	Year	HIV Prevalence Estimate	Sample size	Sex	Source
Armenia	2010	1.2	250	F	IBBS
Azerbaijan	2011	0.7	300	F	I BBS
Belarus	2011	0.7	150	F	IBBS in Minsk
Belgium	2011	0.2	901	F	Routine programme data
Bulgaria	2011	0.3	700	F/M [1]	IBBS
Czech Republic	2010	0.1	2566	F	NGO: Bliss without risk
Estonia	2011	6.2	210	F	IBBS Talinn
France	2011	1.2	166	F	BSS
Georgia	2009	1.9	273	F	IBBS in Tbilisi and Batumi
Germany	2010	0.2	3037	F	Sentinel Surveillance
Israel	2002-8	1.25	571	F	ECDC
Italy	2001	2.5	121	?	ECDC
Kazakhstan	2011	1.5	2286	F	IBBS
Kyrgyz Republic	2010	3.4	531	F	Sentinel Surveillance
Latvia	2011	22.2	117	F	IBBS
Lithuania	2010	6.7	46	F	IBBS
Montenegro	2010	1.1	176	F	BBS
Norway	2008	1	746	F/M	Oslo Clinic
Portugal	2010	7.9	176	F	Behavioural Survey
Romania	2010	1	299	F	Time location sample
Serbia	2010	0.6	155	F	IBBS
Spain	2010	0.5	1141	F	20 Urban clinics
Sweden	2006/07	2.2	46	F	Swedish Prison Project
Tajikistan	2010	4.4	812	F	IBBS
Ukraine	2011	9	4816	F	IBBS
United Kingdom	2006	5	120	F	London outreach clinic
Uzbekistan	2011	2.2	3379	F	IBBS

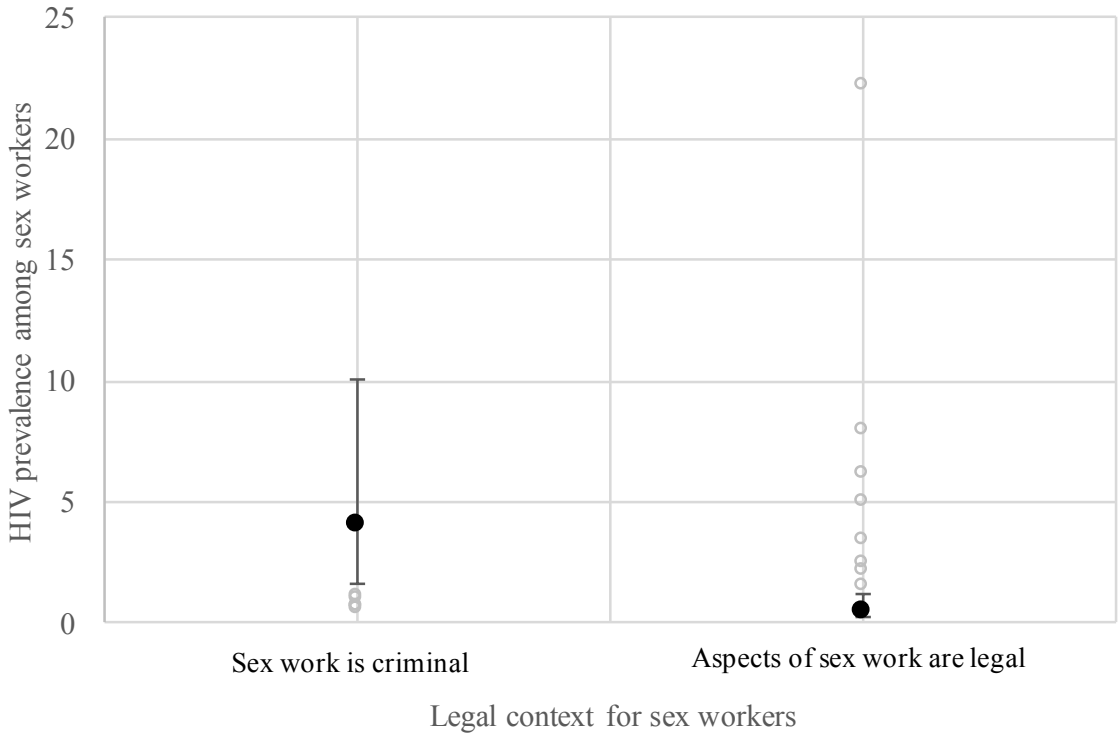
Notes: 1 – Bulgaria sample = 666 Females; 34 Males.

Web Appendix 2: Raw data on covariates

Country	GDP	Prevalence of sex workers who are IDUs	HIV cases in population per million	Proportions of HIV cases provided ART	Rule of Law
Armenia	16.25	1	316	9	-.4
Azerbaijan	15.78	1	312	63	-.9
Belarus	31.26	15	1158	95	-1.1
Belgium	369.27		2210	87	1.4
Bulgaria	37.85	2	168	89	-.1
Czech Republic	133.18	10	147	95	1
Estonia	103.36	7	5736	38	1.2
France	348.80		696		1.4
Georgia	14.7	6	625	98	-.1
Germany	346.49	3	488	97	1.6
Israel	203.77	.1	933	64	1
Italy	319.731	9	404		.4
Kazakhstan	37.71	12	1015	83	-.6
Kyrgyzstan	4.77	5	607	31	-1.2
Latvia	71.65	53	2164	15	.8
Lithuania	78.51	1	522	75	.8
Montenegro	36.65		191	100	0
Norway	657.67		970		1.9
Portugal	187.84	55	2607	100	1
Romania	46.51	22	223	96	0
Serbia	35.28	27	264	99	-.3
Spain	265.10	1	594	92	1.2
Sweden	430.85		1024	99	1.9
Tajikistan	3.40	13	405	81	-1.2
Ukraine	18.28	24	3329	70	-.8
United Kingdom	399.34	4	1885	82	1.6
Uzbekistan	5.47	7	885	72	-1.4

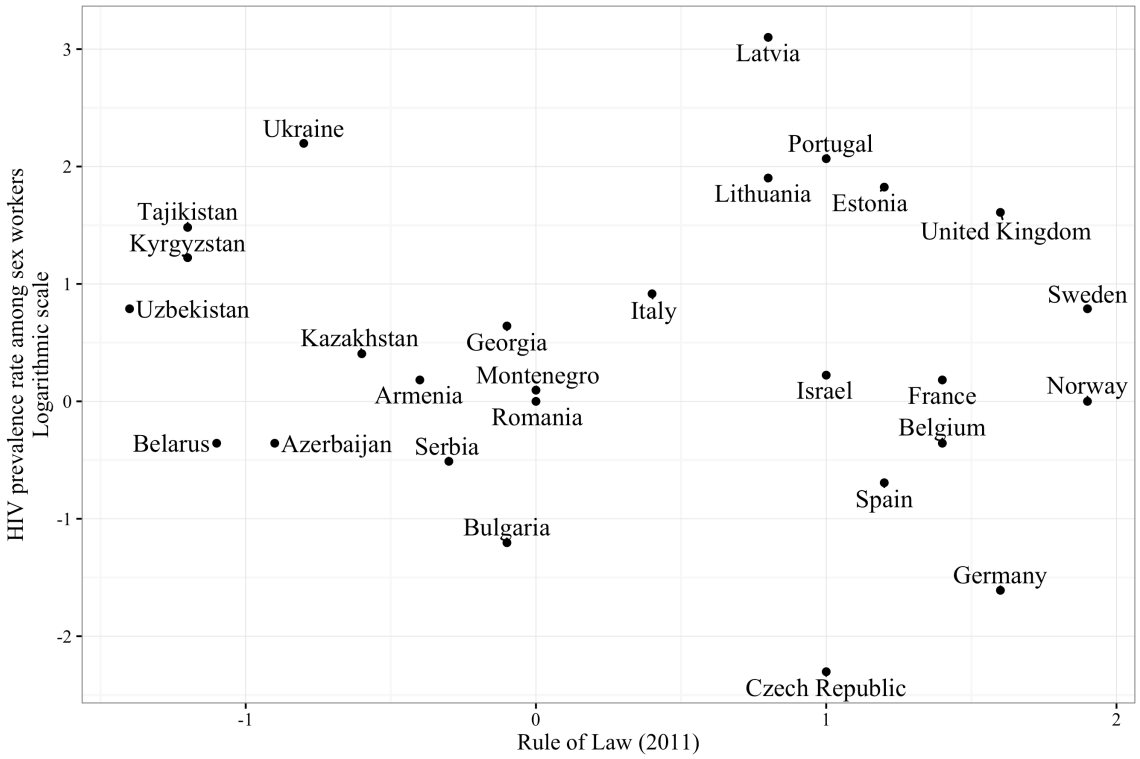
Sources: Listed in Table 1.

Web Appendix 3: Distribution of HIV prevalence among sex workers by legal context



Notes: Solid black circle is the mean HIV prevalence among sex workers in each legal context. Vertical lines are the 95% confidence intervals. Hollow circles are country specific observations that are outside the 95% confidence intervals. Outliers above the upper limit are higher among countries that have legalized sex work.

Web Appendix 4: Association between logged HIV prevalence and the rule of law



Notes: Raw correlation coefficient (r) = -0.09, p = 0.63.

Web Appendix 5: The legal context of sex work and HIV prevalence among sex workers, excluding outliers

As shown in web appendix 1, there are some outliers in these data that may be skewing our results. We re-estimate our models removing observations with standardized residuals greater than an absolute value of 2, finding that our results remain stable.

	Logged HIV prevalence among sex workers (p-value)		
Covariates	(1)	(2)	(3)
Countries that legalise or decriminalise some or all aspects sex work (0 = criminalise sex work)	-2.22 (p = 0.002)	-2.04 (p = 0.033)	-2.21 (p = 0.023)
$100 greater GDP per capita		-0.001 (p = 0.70)	
Proportion of sex workers who are also injecting drug users			0.12 (p = 0.71)
Number of countries	23	23	18
R^2	0.55	0.56	0.59

Notes: 1: Unadjusted model; 2: model adjusted for country-level GDP; 3: model adjusted for prevalence of injecting drug use among sex workers. Source: ECDC. Regression line weighted by sample size of the HIV prevalence data. Proportion of sex workers who are also injecting drug users comes from a recent paper by Platt et al., 2013. GDP is adjusted for purchasing power parity. Outliers are defined as those observations with standardized residuals greater than 2 or lower than -2 (n = 4).

Web Appendix 6: The legal context of sex work and HIV prevalence among sex workers, adjusting for ART coverage and the prevalence of HIV in the population

We examine whether our main association is explained by ART coverage or the number of documented cases of HIV per 1,000,000 people in the population. We find that although both ART coverage and the prevalence of HIV are associated with HIV prevalence among sex workers, they do not remove the association between sex work policy and HIV prevalence among sex workers.

	Logged HIV prevalence among sex workers (p-value)			
Covariates	(1)	(2)	(3)	(4)
Countries that legalise or decriminalise some or all aspects sex work (0 = criminalise sex work)	-2.09 (0.0027)	-1.70 (0.0026)	-1.21 (0.0014)	-1.13 (0.0024)
Proportion of documented HIV cases receiving ART		-0.043 (0.0006)		-0.027 (0.0005)
Number of documented HIV cases per 1,000,000 people in the population			0.96 (0.0000)	0.79 (0.0000)
Number of countries	27	24	27	24
R^2	0.48	0.69	0.81	0.89

Notes: 1: Unadjusted model; 2: model adjusted for proportion of documented HIV cases receiving ART; 3: model adjusted for prevalence of HIV in the population; 4: model adjusted for both the proportion of documented HIV cases receiving ART and the prevalence of HIV in the population. Source: ECDC. Regression line weighted by sample size of the HIV prevalence data. ART data comes from the ECDC's 2012 HIV progress report and the proportion of HIV in the population comes from a recent book by Platt et al., 2015.

Web Appendix 7: Sex work policy is associated with HIV prevalence among sex workers, adjusting for differences in sample composition and data collection

The focus of this paper is female sex workers but in Bulgaria, Italy, and Norway the ECDC's estimates of HIV prevalence include a small number of male and transgender sex workers, who are known to experience higher rates of HIV. We adjust our main model for these differences in sample composition, finding that our results are qualitatively similar. In addition, the data collection procedure differs across countries. Most use an Integrated Bio-Behavioural Survey (IBBS) but some do not. We again re-estimate our main model but now adjusting whether countries used IBBS (coded as 0) or not (coded as 1), finding that our results remain stable.

	Logged HIV prevalence among sex workers (p-value)		
Covariates	(1)	(2)	(3)
Countries that legalise or decriminalise some or all aspects sex work (0 = criminalise sex work)	-2.09 (p = 0.003)	-2.11 (p = 0.004)	-1.19 (p = 0.025)
Estimate of HIV prevalence among sex workers includes males and females		0.26 (p = 0.703)	
ECDC HIV prevalence estimate does not use IBBS (IBBS = 0)			-1.29 (p = 0.013)
Number of countries	27	27	27
R^2	0.48	0.48	0.57

Notes: 1: Unadjusted model; 2: model adjusted for whether sample is female only or includes male and females; 3: model adjusted for whether HIV estimates use IBBS or not. Source: ECDC. Regression line weighted by sample size of the HIV prevalence data.

Web Appendix 8: Association between sex work policy and HIV prevalence among sex workers, bootstrap procedure

To explore whether specific countries may be influencing our results we use a bootstrap approach where we re-estimate our main model 27 times. In each iteration we remove one country and then we plot the coefficient of the association between sex work policy and HIV from each model.