European Journal of Obstetrics & Gynecology and Reproductive Biology 172 (2014) 93–96

Contents lists available at ScienceDirect

European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: www.elsevier.com/locate/ejogrb

# Strong association between the prevalence of bacterial vaginosis and male point-concurrency

Chris R. Kenyon [a,b,*], Robert Colebunders [a]

[a] HIV/STD Unit, Institute of Tropical Medicine, Antwerp, Belgium
[b] Division of Infectious Diseases and HIV Medicine, University of Cape Town, Anzio Road, Observatory 7700, South Africa

ARTICLE INFO

*Article history:*
Received 2 May 2013
Received in revised form 14 September 2013
Accepted 9 October 2013

*Keywords:*
Concurrency
Sexual network
HIV
Southern Africa
Ethnic

ABSTRACT

*Objective:* The prevalence of bacterial vaginosis (BV) differs considerably between different populations, and individual-level risk factors such as number of sex partners seem unable to explain these differences. The effect of network-level factors, such as the prevalence of partner concurrency (the proportion of sexual partnerships that overlap in time as opposed to running sequentially) on BV prevalence has not hitherto been investigated.
*Study design:* : We performed linear regression to assess the relationship between the prevalence of male concurrency and prevalence of BV in each of 11 countries for which we could obtain comparable data. The data for concurrency prevalence were taken from the WHO/Global Programme on AIDS (GPA) sexual behavioural surveys. BV prevalence rates were obtained from a systematic review of the global patterning of BV.
*Results:* We found a strong relationship between the prevalence of male concurrency and BV prevalence (Pearson's $R^2 = 0.57$; $P = 0.007$).
*Conclusions:* The findings of a strong ecological-level association between BV and partner concurrency need to be replicated and augmented with different types of studies such as multilevel prospective studies tracking the incidence of BV and associated individual, partner and network level risk factors.


## 1. Introduction

Why do some ethnic groups have a prevalence of bacterial vaginosis (BV) up to three times greater than others within the same location, and why does BV prevalence vary by a similar degree between countries [1–4]? A systematic review and meta-analysis of the relationship between sexual activity and BV found that BV "is significantly associated with sexual contact with new and multiple male and female partners and that decreasing the number of unprotected sexual encounters may reduce incident and recurrent infection" [5]. However, individual-level risk factors such as the numbers of lifetime sexual partners do not co-vary with BV prevalence between different ethnic groups [6]. The same is true at an international level. Although countries in Southern Africa have amongst the highest BV prevalence rates in the world [5,6], the number of sexual partners there is the same or lower than low BV prevalence parts of the world such as Europe [7]. Might network-level factors be responsible?

Various empirical and theoretical considerations led Aral et al. to conclude: "whereas individual-level parameters may influence which individuals in a given population acquire an STI, it is population-level parameters that affect the prevalence of the infection"[8]. Although there is still debate on this topic [9,10], a population/network-level determinant that has been shown to explain a large part of the variation in HIV and sexually transmitted infection (STI) prevalence by ethnic group in the USA and Southern Africa is the variation in concurrency rates – that is the proportion of sexual partnerships that overlap in time as opposed to running sequentially [11–13]. This paper examines the relationship between national male concurrency prevalence and BV prevalence in the general population.

## 2. Methods

### 2.1. Point-concurrency

To overcome the problems of comparability with different datasets using different methodologies and definitions of concurrency, we used one of the only multinational surveys that assesses

* Corresponding author at: Division of Infectious Diseases and HIV Medicine, University of Cape Town, Anzio Road, Observatory 7700, South Africa.
Tel.: +27 21 404 9111; fax: +27 21 404 9113.
*E-mail addresses:* chriskenyon0@gmail.com (C.R. Kenyon), bcoleb@itg.be (R. Colebunders).

0301-2115/$ – see front matter © 2013 Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.ejogrb.2013.10.011

concurrency using the same methodology. These are the World Health Organisatsion (WHO)/Global Programme on AIDS (GPA) sexual behavioural surveys conducted in 1989/1990. All 11 countries that performed these surveys between 1989 and 1990 and asked questions about concurrency are evaluated here [14,15]. All these surveys followed WHO/GPA protocols. These included that national probability samples of the general populations aged 15–49 should be utilized. In two cases, Manila and Rio de Janeiro, the samples were representative of these large cities rather than being nationally representative. All samples were selected based on the probability principle with various designs depending on national factors. A two stage sampling strategy was the norm, with census enumeration areas as the first stage and households as the second. The sample sizes were typically 1000–3000 men and women. Response rates were high in all cases. The variable for concurrency was derived from the question "Do you now have one or more than one spouse/regular partner?" The concurrency variable we used in our analysis was the percentage of 15–49 year old men who had more than one active sexual partnership at the time of the survey. Only 7 of the countries surveyed asked the women if they had concurrent partners. As a result, we limited our analysis to male concurrency. We related point-concurrency to estimated BV prevalence.

### 2.2. BV prevalence

BV prevalence rates were obtained from a recently published systematic review of the global patterning of BV [6]. A search was conducted in the PubMed/Medline and Web of Science databases in April 2012. Search terms included "bacterial vaginosis and epidemiology." This resulted in the retrieval of 1692 articles. Cited references were also assessed for inclusion. Articles in English, French, Spanish and Polish were considered for inclusion. No date restrictions were applied. Studies were then selected according to a two-step process. (1) Studies were included if they were representative population-based or antenatal-based samples and the diagnosis of BV was based on Nugent's Scoring System (NSS). This step yielded 46 studies. (2) If no studies based on representative samples from a particular country were available then other convenience samples where the diagnosis of BV was based on NSS were considered. These included studies sampling outpatient attendees, as long as the populations sampled were not constituted only by individuals presenting with symptoms of an STI. Surveys that exclusively sampled sex workers or HIV positive populations were not included. This step yielded an additional 21 studies.

Only studies that used Nugent's scoring system (NSS) as the basis for the diagnosis of BV were used. In NSS the diagnosis is based on the interpretation of a Gram stain of vaginal secretions [16]. The degree of inter- and intra-observer variability is low and it has been established as a reproducible and reliable test [17–19]. The only exception to this was in the case of Tanzania, where no NSS-based survey has been published and we therefore used a population-based survey that used Amsel's criteria to diagnose BV. No BV surveys could be found for five countries and we substituted BV prevalence from the nearest neighbouring country for which the review provided prevalence data (details in Table 2). For countries where multiple population-based studies were performed, the mean BV prevalence for that country was computed and used. We related the prevalence of bacterial vaginosis to the point prevalence of concurrency through linear regression, whereby Pearson's $R^2$ reflects the proportion explained variance. All analyses were conducted with Stata 12.0 (College Station, TX).

## 3. Results

We found a strong relationship between the prevalence of male concurrency and BV prevalence (Pearson's $R^2 = 0.57$; $P = 0.007$; see Table 1 and Fig. 1). There was no relationship between BV prevalence and number of sex partners in the previous year for women and men (results not shown).

**Table 1**
International comparison of BV prevalence with male point-concurrency.

| | Concurrency (male point prevalence, %) | BV prevalence (%)[a] |
|---|---|---|
| Central African Republic | 20 | 29.1 |
| Brazil | 7 | 19.5 |
| Côte d'Ivoire | 36 | 25 |
| Kenya | 13 | 44 |
| Lesotho | 55 | 50.6 |
| Philippines | 3 | 15.6 |
| Singapore | 2 | 15.1 |
| Sri Lanka | 2 | 16.6 |
| Thailand | 3 | 13.3 |
| Zambia | 22 | 38.1 |
| Tanzania | 18 | 33.9 |

[a] No published data was available on BV prevalence in the general population from the following countries (countries used as substitutes in parentheses); Lesotho (South Africa), Philippines (Myanmar), Singapore (Vietnam), Sri Lanka (India) and Zambia (Botswana).

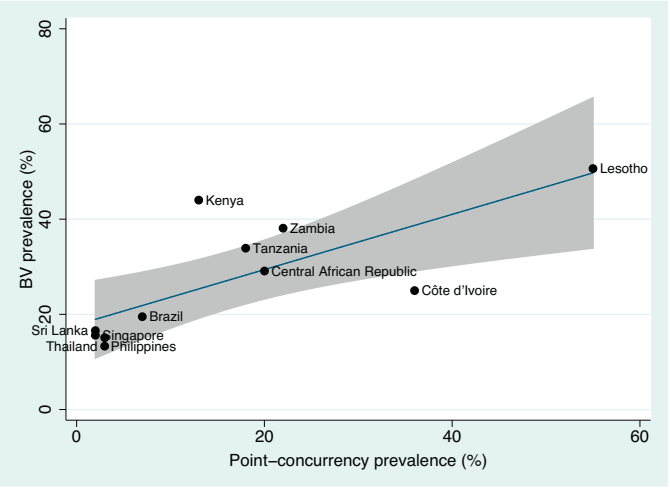


**Fig. 1.** Association between BV prevalence and point-prevalence of male concurrency – derived from GPA Behavioural Surveys ($R^2 = 0.57$; $P = 0.007$; Grey area = 95% CI).

## 4. Discussion

There are a number of limitations with our analysis. There is a striking lack of published studies on BV prevalence using standardized diagnostic tools, such as the NSS, from a number of countries. To circumvent this problem we were forced to use data from neighbouring countries. When we repeated the analysis without these countries it had little effect on the results. The lack of adequate data also resulted in gaps between the dates of the explanatory and outcome variables. The validity of the result of this study does therefore depend to a significant degree on the extent to which differences in network structure, such as concurrency and BV prevalence remain stable. The available evidence suggests that markers of network connectivity have remained stable over a considerable period [4]. In addition, in the USA, which has the most complete longitudinal data on BV prevalence by ethnic group, the overall prevalence and interethnic variations in prevalence have remained stable over the 20 years surveyed [1,20]. Our study is also liable to the ecological inference