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Different Demographic and Sexual Correlates for Chlamydial Infection and Gonorrhoea in Rotterdam

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Van Duynhoven Y T H P (Department for Infectious Diseases Epidemiology, National Institute of Public Health and the Environment, PO Box 1, 3720 BA Bilthoven, The Netherlands), van de Laar M J W, Schop W A, Mouton J W, van der Meijden W I and Sprenger M J W. Different demographic and sexual correlates for chlamydial infection and gonorrhoea in Rotterdam. *International Journal of Epidemiology* 1997; **26:** 1373–1385.

Background. The objective of the study was to estimate the prevalence of gonorrhoea and chlamydial infections and to determine sexual and demographic correlates for these sexually transmitted diseases (STD) among visitors of an STD clinic.

Methods. In 1994, a cross-sectional study was carried out among 2984 consecutive visitors of the STD clinic of the University Hospital Rotterdam.

Results. The prevalence of chlamydial infection was 12.1% for women and 12.3% for men. For gonorrhoea, prevalence was 3.2% and 6.0%, respectively. For men, gonorrhoea was independently associated with multiple partners in the last month, homosexual activities, a history of gonorrhoea, last sexual contact in the past 4–14 days and casual partners. In contrast, chlamydial infection was less likely to be found in homosexual men and male intravenous drug users. Additionally, chlamydial infection was independently associated with young age, multiple partners in the last 6 months and with last sexual contact in the past 2 months. For women, intravenous drug use (associated with commercial sex work) and a history of trichomoniasis were independent risk factors for gonorrhoea. Independent risk factors for chlamydial infection in women were: young age, two or three sexual partners during life and last sexual contact within 2 months. Chlamydial infection was uncommon in commercial sex workers.

Conclusions. The differences in the epidemiological correlates suggest that chlamydial infection is more diffusely spread into the general population than gonorrhoea. Additionally, it is hypothesized that men acquire their chlamydial infection through less stable relationships and subsequently infect their regular female partner.

Keywords: sexually transmitted diseases, chlamydial infection, gonorrhoea, epidemiology, risk factors

Most bacterial sexually transmitted diseases (STD) have been declining in industrialized countries since the 1980s.[1–8] However, a considerable proportion of gonococcal infections (about 5% of infections in men and 30–60% in women) and chlamydial infections (25–35% of infections in men and 65–75% in women) remain asymptomatic and may escape treatment.[9,10] Subsequent complications still result in substantial morbidity and high costs for health care due to severe adverse effects on reproductive health.[9,11] Control measures for infection with *Chlamydia trachomatis* have not yet been or were only recently implemented in many countries. The guidelines presented by the Centres for Disease Control and Prevention, include universal screening of women visiting STD clinics, abortion clinics, juvenile detention centres, family planning clinics and teen health clinics and selective screening of at-risk pregnant women.[12] In the US, large-scale control programmes have been consistently followed by a marked reduction in chlamydial infection.[13,14] In The Netherlands, universal screening is restricted to some gynaecological practices and STD clinics, and a decline in prevalence was observed some years after the introduction of the screening programme.[15]

Chlamydia trachomatis and gonorrhoea are infections which have similar modes of transmission, develop equivalent symptoms, and coinfections with chlamydia

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occur frequently in gonorrhoea patients.[16] Nonetheless, chlamydial infection is less often clinically apparent, seems less contagious and has a longer incubation period for men.[16,17] In the US and Canada the epidemiology of chlamydial infection appeared to be different from that of gonorrhoea;[18–20] chlamydia cases were younger, more often white, had a higher mean income and were geographically more diffusely distributed than their gonorrhoea counterparts.[18,20] In addition, men with recent, casual or new sexual partners were less likely to have chlamydial infection than gonorrhoea compared to men with only regular partners. For women only younger age distinguished chlamydia from gonorrhoea cases.[19]

The epidemiology of chlamydial infections is imperfectly understood in The Netherlands. A knowledge of epidemiological differences might help in the design of future control activities for STD. In 1994 a study was carried out which investigated the epidemiology of STD among consecutive visitors of the STD clinic in Rotterdam, The Netherlands. This STD clinic is the second largest of six STD clinics located at Municipal Health Services and University Hospitals in four major cities in the Netherlands. Services are offered anonymously if desired and free of charge. These STD clinics may be consulted more often by individuals with low socioeconomic status, ethnic minorities, intravenous drug users, commercial sex workers (CSW) and those without health insurance. In general, attendees at these clinics are considered high-risk populations for STD. The major aim of this study was to estimate the prevalence of gonorrhoea and genital infections with *C. trachomatis* among visitors at an STD clinic and to identify subgroups with increased risk.

MATERIALS AND METHODS

Study Design, Population and Data Collection

Between 1 January and 16 December 1994 a cross-sectional study was carried out among visitors of the STD clinic of the Department of Dermatology and Venereology, University Hospital Rotterdam. The study was approved by the Medical Ethical Committee of the University Hospital Rotterdam.

All visitors, except for those attending for confirmative serology for syphilis or for long-term therapy, were eligible for the study. First, the reason for presentation and a brief medical history were recorded by a physician on specially designed pre-tested forms. Visitors were asked about specific urogenital complaints and previous STD. For women additional information was collected on their menstrual cycle (date of last period, regularity, interval bleeding), the number of pregnancies, deliveries and abortions, current type of contraception and period of use of oral contraceptives. For all visitors, a sexual history was recorded by the physician: age at first sexual intercourse, gender of sexual contacts, type (steady, casual, commercial) and gender of last and former sexual contact, the number of sexual partners in three periods (last month, half year and lifetime), orogenital and anal contact in the past 6 months and condom use while having intercourse with casual partners in the past 6 months. Also intravenous drug use (last 3 months, ever or never) and CSW or being a client of CSW (last 3 months, ever or never) was reported. Finally, visitors were questioned about nationality, native country and use of antibiotics in the preceding 4 weeks.

Clinical Evaluation and Laboratory Testing. During the medical examination, for men two urethral samples were taken for detection of *C. trachomatis*, both by cell culture and Gen-Probe PACE 2 (a patient was defined positive if at least one was positive).[21] Secondly, specimens of the urethra and oropharynx were collected for culture for *Neisseria gonorrhoeae.* Rectal samples for *N. gonorrhoeae* were only taken if anal sexual contact was reported in the past 6 months. In first-void urine samples the average number of leukocytes per microscopic field was determined (magnification 400×). Urethral discharge on examination was categorized as watery, mucous, mucopurulent or purulent. The amount and colour of the discharge were also recorded.

In women first urethral samples were obtained for *N. gonorrhoeae* culture and for Gram-staining. Vaginal discharge was categorized as floccular, homogeneous, curd-like, frothy or watery and the amount and colour were recorded. During speculum examination, endocervical material was collected for *N. gonorrhoeae* culture and for microscopy. Gram-negative intracellular diplococci were sought in the Gram-stained smears from urethra and cervix and the average number of leukocytes per field was determined. After wiping the cervix, two endocervical samples, for culture and Gen-Probe PACE 2, for detection of *C. trachomatis* were obtained. The cervix was also evaluated for ectopy, cervical bleeding induced by taking swabs and disorders of the cervical mucosa. Other cervical disorders, such as purulent discharge could also be recorded. Finally, rectal samples and oropharyngeal samples were obtained for culture for *N. gonorrhoeae.*

Blood samples were taken by a doctor's assistant for evaluation of hepatitis B virus infection (HBsAg, anti-HBc [MEIA, Abbott, Chicago], Virology Department, University Hospital Rotterdam), syphilis (VDRL (Oxoid, PCH diagnostics, Haarlem), TPHA (*Treponema*

pallidum haemagglutination assay) (Medac, PCH diagnostics, Haarlem), confirmation with FTA-abs (fluorescent treponemal antibody absorption assay) (bioMérieux, Lyon), Regional Public Health Laboratory Rotterdam) and if requested for HIV infection ([ELFA, bioMérieux, Lyon; confirmation Western blot, Genelabs, Singapore] Virology Department, University Hospital Rotterdam).

Statistical Analysis

Separate analyses were conducted for men and women. Univariate analyses identified factors associated with gonorrhoea and chlamydial infection. For statistical testing the χ^2 test or the two-tailed Fisher exact test was used. Factors associated with the STD with a *P*-value <0.10 were further analysed by multiple logistic regression analysis. Age was always included in the model, as it is consistently described as associated with chlamydial infection and gonorrhoea. For some associations, because effect modification by age and native country was theoretically possible, (limited) stratified analysis was executed to inspect the stratum-specific odds ratios (OR). Because no relevant effect modification was found and none was known from previous studies (except for gender), no first-order interactions were entered into the models. If variables were missing for at least 5% of the individuals, a category 'unknown' was included in the analyses. The number of lifetime partners reported by men was not considered because 31% of these data was missing. A full model including the main effects of the univariate analysis was compared to models excluding every other factor. A factor remained in the model if either the likelihood ratio test was significant ($P < 0.05$) or the estimates of the beta-coefficients for other variables in the model changed by at least 10%. Odds ratios are presented with 95% confidence intervals (95% CI).

RESULTS

Participation Rate

Of the 3277 visitors eligible for the study, 71 (2%) could not be included because medical records were unavailable. In addition, 222 visitors (7%) were not tested for one of the STD of interest, mainly because they came for an HIV test and refused further examination. Consequently, 2984 visitors (91%) were available for analysis. The 222 nonparticipants were similar to the participants with respect to age, gender and median number of partners, but they were born in The Netherlands more often and reported an STD history as well as drug use and commercial sex contacts less often (data not shown).

General Characteristics of the Study Population

The mean age was 34.3 years for men and 29.7 for women. About 60% of both men and women were born in The Netherlands (Table 1). The majority of visitors attended for urogenital symptoms. One in 10 women attended because of urogenital complaints in her sexual partner. The median age at first sexual intercourse was 17 for women and 16 for men. The number of partners in the last month were somewhat higher for men (not significant), but the median was one for both sexes. A history of STD was reported by 45% of the men and 41% of the women (32% when candidiasis was excluded).

Prevalence of Gonorrhoea and Chlamydial Infection

The prevalence of *C. trachomatis* was 12.1% in women and 12.3% in men (Table 1). Corresponding prevalences for gonorrhoea were 3.2% and 6.0%. Coinfections were also observed: about 8% of the chlamydial patients also had gonorrhoea. Conversely, 15% of the men and 28% of the women with gonorrhoea were coinfected with *C. trachomatis*.

A contingency table for each STD with the reason for visit showed that both chlamydial infection (15%) and gonorrhoea (9%) were more prevalent in men attending for symptom evaluation. Chlamydial infection was additionally more prevalent in men whose visit was prompted by an at-risk or infected sexual partner (18%). Chlamydial infection was more prevalent in women attending for an HIV antibody test (17%) and in those attending because their sexual partner was symptomatic, at risk, or had an STD (28%). Gonorrhoea was more likely in women whose visit was prompted by a steady partner with symptoms or with high-risk behaviour (%).

Univariate Analyses

Demographic and sexual factors associated with at least one of the STD are presented in Table 2 for men and Table 3 for women. If several items in the sexual history addressed the same behaviour or were highly correlated then one factor was chosen for (further) analyses, depending on assumed validity, number of missing values and the value of the estimated crude OR.

Univariate associations—men. Among men, age was inversely associated with chlamydia prevalence, but only a weak association with age was found for gonorrhoea (Table 2). Both STD were more common among men born in Surinam or the Dutch Antilles. Additionally, gonorrhoea was more likely in Moroccan men. Men reporting intravenous drug use were less likely to

TABLE 1 *Sociodemographic and sexual characteristics of 2984 study participants attending the sexually transmitted disease (STD) clinic, University Hospital Rotterdam, 1994*

	Men (N = 1696)		Women (N = 1288)	
	n	%	n	%
Age (years)				
10–19	60	4	132	10
20–24	250	15	301	23
25–29	375	22	309	24
30–34	350	21	253	20
>34	661	39	293	23
Native country				
The Netherlands	960	57	803	62
other European country	100	6	78	6
Surinam	186	11	139	11
Morocco	103	6	33	3
Turkey	92	5	25	2
Dutch Antilles	64	4	51	4
other	191	11	159	12
Reason for presentation at clinic				
urogenital symptoms	1064	63	605	47
routine follow-up	187	11	168	13
new relationship	181	11	194	15
HIV-antibody test	117	7	91	7
sexual partner with symptoms	84	5	132	10
other	63	4	98	8
Sexual orientation				
sexual contact men and women	85	5	13	1
sexual contact men only	177	10	1222	95
sexual contact women only	1414	83	13	1
unknown	20	1	40	3
Number of partners in last month				
0	267	16	155	12
1	982	58	874	68
2	277	16	66	5
3–5	88	5	13	1
⩾6	21	1 (0 ⩾100)	46	4 (16 ⩾ 100)
unknown	61	4	134	10
History of STD	770	45	522	41
a.o. gonorrhoea	335	20	127	10
non-gonococcal urethritis	259	15	–	–
chlamydia	130	8	140	11
Current STD (number examined)				
gonorrhoea	98	6.0 (1631)	39	3.2 (1210)
chlamydia	197	12.3 (1602)	146	12.1 (1204)
HBsAg positive	35	2.1 (1648)	17	1.4 (1228)
syphilis (primary/secondary)	8	0.5 (1665)	1	0.1 (1258)

have chlamydial infection. Drug use was not related to gonorrhoea. Of the sexual characteristics, only age at first intercourse and commercial contacts in the last 3 months were not associated with either STD. Gonorrhoea was strongly associated with increasing numbers of sexual partners, particularly those in the last month. For chlamydial infection the association was less strong and no increase in risk was observed over two partners. Gonorrhoea was more common in men whose last sexual contact was a casual partner (Table 2), of which at least 23% were CSW ($OR_{\text{last contact CSW}} = 2.3$, 95% CI : 1.3–4.0, not in Table). For chlamydial infection a similar effect was observed for casual partners (Table 2), although it was less clear ($OR_{\text{last contact CSW}} = 1.0$, 95% CI : 0.6–1.7). Consistent condom use and orogenital contacts were protective for both STD. Men with homosexual contacts had more gonorrhoea, but less chlamydial infection than heterosexual men. For

TABLE 2 *Univariate analyses of demographic and sexual factors for gonorrhoea and chlamydial infections among male visitors of the sexually transmitted disease (STD) clinic, University Hospital Rotterdam, 1994*

	Chlamydia			Gonorrhoea		
	n	% CT	OR (95%CI)	n	% NG	OR (95%CI)
	1602	12.3		1631	6.0	
Demographic characteristics						
Age (years)			[a]			[b]
Chlamydia: 11–19 gonorrhoea: 11–19	56	10.7	1.4 (0.6–3.4)	57	10.5	2.1 (0.9–5.2)
20–24 20–29	235	18.7	2.7 (1.7–4.1)	604	6.8	1.3 (0.9–2.1)
25–29 ⩾30	360	15.3	2.1 (1.4–3.1)	970	5.2	1.0
30–34	334	12.9	1.7 (1.1–2.6)			
⩾35	617	7.9	1.0			
Native country			[a]			[a]
The Netherlands	903	10.2	1.0	923	4.3	1.0
Surinam	181	22.1	2.5 (1.7–3.8)	183	10.9	2.7 (1.5–4.8)
Dutch Antilles	61	19.7	2.2 (1.1–4.2)	62	9.7	2.4 (1.0–5.8)
Morocco (for chlamydia in 'other')	–	–	–	101	12.9	3.3 (1.7–6.3)
other	457	11.6	1.2 (0.8–1.7)	362	5.2	1.2 (0.7–2.1)
Intravenous hard drug use			[b]			[c]
never	1454	12.8	1.0	1481	5.8	1.0
last 3 months	55	1.8	0.1 (0.02–0.9)	57	5.3	0.9 (0.3–2.9)
ever (>3 months ago)	54	9.3	0.7 (0.3–1.8)	54	7.4	1.3 (0.5–3.7)
Sexual characteristics						
Number of partners in last month			[a]			[a]
0	250	7.2	1.0	248	2.8	1.0
1	921	12.8	1.9 (1.1–3.2)	947	4.3	1.6 (0.7–3.5)
2	270	14.4	2.2 (1.2–3.9)	273	9.5	3.6 (1.5–8.5)
>2	106	15.1	2.3 (1.1–4.7)	109	18.3	7.7 (3.2–18.9)
Number of partners in last 6 months			[a]			[a]
0–1	712	9.1	1.0	726	3.2	1.0
2	441	14.5	1.7 (1.2–2.4)	449	6.5	2.1 (1.2–3.7)
>2	389	16.7	2.0 (1.4–2.9)	396	11.1	3.8 (2.3–6.4)
Last sexual contact with			[b]			[a]
steady partner	863	11.0	1.0	882	3.1	1.0
casual partner	711	14.2	1.3 (1.0–1.8)	721	9.8	3.5 (2.2–5.5)
Condom use in casual contact last 6 months			[a]			[a]
not always condom	698	16.9	1.8 (1.1–2.9)	715	10.6	2.5 (1.3–4.8)
always condom	237	10.1	1.0	243	4.5	1.0
no casual contacts	590	8.3	0.8 (0.5–1.3)	599	1.7	0.4 (0.2–0.9)
unknown	77	7.8	0.8 (0.3–1.9)	74	1.4	0.3 (0.04–2.3)
Sexual contact with men in last 6 months			[a]			[a]
no	1301	13.4	1.0	1323	5.2	1.0
yes	226	4.0	0.3 (0.1–0.5)	233	11.2	2.3 (1.4–3.7)
unknown	75	18.7	1.5 (0.8–2.7)	75	4.0	0.8 (0.2–2.5)
Orogenital contact last 6 months			[a]			[a]
no	711	14.5	1.0	723	7.6	1.0
yes	801	10.1	0.7 (0.5–0.9)	820	5.1	0.7 (0.4–1.0)
won't answer/unknown	90	14.4	1.0 (0.5–1.9)	88	1.1	0.1 (0.02–1.0)
Time passed since last sexual contact			[a]			[a]
CT: <1 month NG: 0–3 days	1197	13.4	1.0	373	4.8	1.0
1–2 months 4–14 days	200	15.0	1.1 (0.8–1.7)	710	9.3	2.0 (1.2–3.5)
>2 months ⩾15 days	181	3.9	0.3 (0.1–0.6)	524	2.7	0.5 (0.3–1.1)
History of gonorrhoea			[c]			[a]
no	1264	11.6	1.0	1284	4.9	1.0
yes	320	15.3	1.4 (1.0–2.0)	329	10.3	2.2 (1.4–3.5)
History of genital herpes			[a]			[c]
no	1515	12.7	1.0	1543	6.2	1.0
yes	69	4.3	0.3 (0.1–1.0)	70	2.9	0.4 (0.1–1.9)

[a] $P < 0.05$, [b] $P < 0.10$, [c] $P \geqslant 0.10$ for either the χ^2 test or the Fisher exact test of the italic variable.
CT = chlamydia, NG = gonorrhoea. Numbers do not always add to the totals mentioned above due to missing values.

TABLE 3 *Univariate analyses of demographic and sexual factors for gonorrhoea and chlamydial infections among female visitors of the sexually transmitted disease (STD) clinic, University Hospital Rotterdam, 1994*

		Chlamydia			Gonorrhoea		
		n 1204	% CT 12.1	OR (95%CI)	n 1210	% NG 3.2	OR (95%CI)
Demographic characteristics							
Age (years)				[a]			[c]
Chlamydia: 14–19 gonorrhoea: 14–19		118	23.7	10.3 (4.5–23.4)	119	5.9	2.4 (0.9–6.2)
20–24	20–29	285	16.8	6.7 (3.1–14.5)	576	3.3	1.3 (0.6–2.7)
25–29	⩾30	290	13.8	5.3 (2.4–11.5)	515	2.5	1.0
30–34		238	9.2	3.4 (1.5–7.7)			
⩾35		273	2.9	1.0			
Native country				[a]			[a]
The Netherlands		749	11.6	1.0	755	2.1	1.0
Surinam		135	24.4	2.5 (1.6–3.9)	135	7.4	3.7 (1.6–8.3)
Dutch Antilles (for chlamydia in other)		–	–	–	49	10.2	5.2 (1.8–15.0)
other		320	8.1	0.7 (0.4–1.1)	271	3.0	1.4 (0.6–3.3)
Intravenous hard drug use				[c]			[b]
never		898	12.8	1.0	902	3.0	1.0
last 3 months		54	7.4	0.5 (0.2–1.5)	55	9.1	3.2 (1.2–8.8)
ever (>3 months ago)		41	7.3	0.5 (0.2–1.8)	40	2.5	0.8 (0.1–6.3)
unknown		211	11.4	0.9 (0.5–1.4)	213	2.8	0.9 (0.4–2.3)
Sexual characteristics							
Commercial sex work				[a]			[b]
never		914	14.1	1.0	918	2.7	1.0
last 3 months		144	2.8	0.2 (0.1–0.5)	147	4.8	1.8 (0.8–4.2)
ever (>3 months ago)		88	10.2	0.7 (0.3–1.4)	87	6.9	2.6 (1.1–6.6)
unknown		58	6.9	0.5 (0.2–1.3)	58	1.7	0.6 (0.08–4.7
Number of lifetime partners				[a]			[c]
1		133	11.3	1.0	137	3.6	1.0
2		117	19.7	1.9 (1.0–3.9)	116	0.0	–
3		124	21.8	2.2 (1.1–4.3)	125	5.6	1.6 (0.5–5.0)
>3		688	10.0	0.9 (0.3–1.6)	692	3.5	0.9 (0.4–2.5)
unknown		142	8.5	0.7 (0.3–1.6)	140	2.1	0.6 (0.1–2.4)
Time passed since last sexual contact				[a]			[c]
<1 month		895	13.7	1.0	907	3.0	1.0
1–2 months		136	10.3	0.8 (0.4–1.3)	135	5.2	1.8 (0.8–4.2)
>2 months		129	6.2	0.4 (0.2–0.9)	126	3.2	1.1 (0.4–3.1)
Condom use in casual cont last half year				[b]			[c]
never, sometimes, half the times		196	14.3	2.1 (1.1–3.9)	196	3.1	1.0 (0.3–2.8)
mostly (60–95%) or always		245	7.4	1.0	249	3.2	1.0
no casual contacts		687	13.4	2.0 (1.2–3.3)	691	3.3	1.0 (0.5–2.4)
unknown		76	10.5	1.5 (0.6–3.6)	74	2.7	0.8 (0.2–4.0)
Current type of contraceptives				[a]			[c]
none		355	10.1	1.0	354	3.4	1.0
oral contraceptive (OCP)		549	16.9	1.8 (1.2–2.7)	552	2.4	0.7 (0.3–1.3)
condom or intra uterine device (IUD)		138	4.3	0.4 (0.2–1.0)	140	3.6	1.1 (0.4–3.1)
other		133	6.8	0.6 (0.3–1.4)	134	5.2	1.6 (0.6–4.1)
History of trichomoniasis				[c]			[a]
no		1103	12.5	1.0	1108	2.5	1.0
yes		90	6.7	0.5 (0.2–1.2)	91	9.9	4.2 (1.9–9.3)
History of genital herpes or genital warts				[a]			[c]
no		1071	13.2	1.0	1078	3.3	1.0
yes		121	2.5	0.2 (0.1–0.5)	120	0.8	0.2 (0.03–1.8)
Number of deliveries				[a]			[a]
0		677	13.7	1.0	679	2.7	1.0
1		242	13.6	1.0 (0.6–1.5)	245	5.3	2.1 (1.0–4.3)
>1		255	7.5	0.5 (0.3–0.8)	256	2.0	0.7 (0.3–2.0)

[a] $P < 0.05$, [b] $P < 0.10$, [c] $P \geqslant 0.10$ for either the χ^2 test or the Fisher exact test of the italic variable.
CT = chlamydia, NG = gonorrhoea. Numbers do not always add to the totals mentioned above due to missing values.

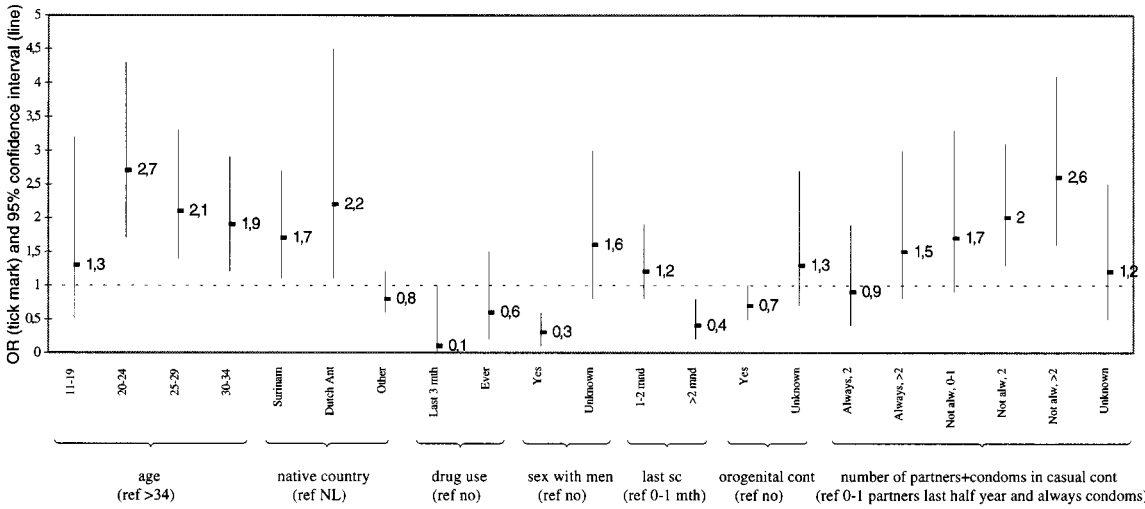

FIGURE 1 *Results of multiple logistic regression analyses for infection with* Chlamydia trachomatis *among men, sexually transmitted disease clinic, University Hospital Rotterdam, 1994*

–2 log likelihood presented model (n = 1546 men, 12.4% CT): 1051.1, d.f. = 21, $P = 0.0001$, Hosmer and Lemeshow Goodness-of-fit-statistic = 11.321, d.f. = 18, $P = 0.8802$.

gonorrhoea, prevalence was highest if the last sexual contact was 4–14 days before the visit, while for chlamydial infection high prevalences were found for sexual contact up to 2 months prior to STD clinic visit. Gonorrhoea was more common if a previous gonococcal episode was reported. Chlamydial infection was less often found if a history of herpes was reported.

Univariate associations—women. In women, chlamydial infection declined rapidly with age (Table 3). Gonorrhoea did not vary with age. Both chlamydial infection and gonorrhoea were more likely in women born in Surinam. Gonorrhoea was also more likely in women born in the Dutch Antilles. Current intravenous drug use was a risk factor for gonorrhoea, but not for chlamydial infection. For both STD no effect was observed for interval bleeding or other aspects of the menstrual cycle (data not shown). Only a few sexual characteristics were associated with gonorrhoea or chlamydial infection: no associations were observed for age at first intercourse, sexual orientation, reporting a steady partner, type of last and former sexual partner, orogenital or anal intercourse and number of partners in the last month or the last 6 months. For gonorrhoea, CSW, a history of trichomoniasis and one delivery in the reproductive history were risk factors (Table 3). For chlamydial infection negative associations were observed with the number of deliveries, a history of viral STD, CSW, condom use (in general and in casual contacts), use of an intra uterine device (IUD) and last sexual contact more than 2 months ago. However, oral contraceptives (OCP) were associated with a higher prevalence of chlamydial infection. Also, chlamydial infection was more common in women with two or three lifetime partners, but prevalence decreased for more partners.

Multiple Logistic Regression

Men. Independent correlates for chlamydial infection were: age, native country, intravenous drug use, sex with men, time since last sexual contact, orogenital contact, condom use in casual contacts and the number of partners in the last 6 months (Figure 1). Because collinearity problems arose for the latter two, a new variable was constructed combining the information. The effect estimates were very similar to the univariate analyses. However, the OR for Surinam origin fell due to correction for the higher number of partners. When the reason for visit was added to this model, the OR for the sexual and demographic factors demonstrated only minor changes. In this extended model, men attending for urogenital symptoms more often had chlamydial infection (OR = 2.1, 95% CI : 1.3–3.2), but chlamydial infection was no longer associated with consultation because

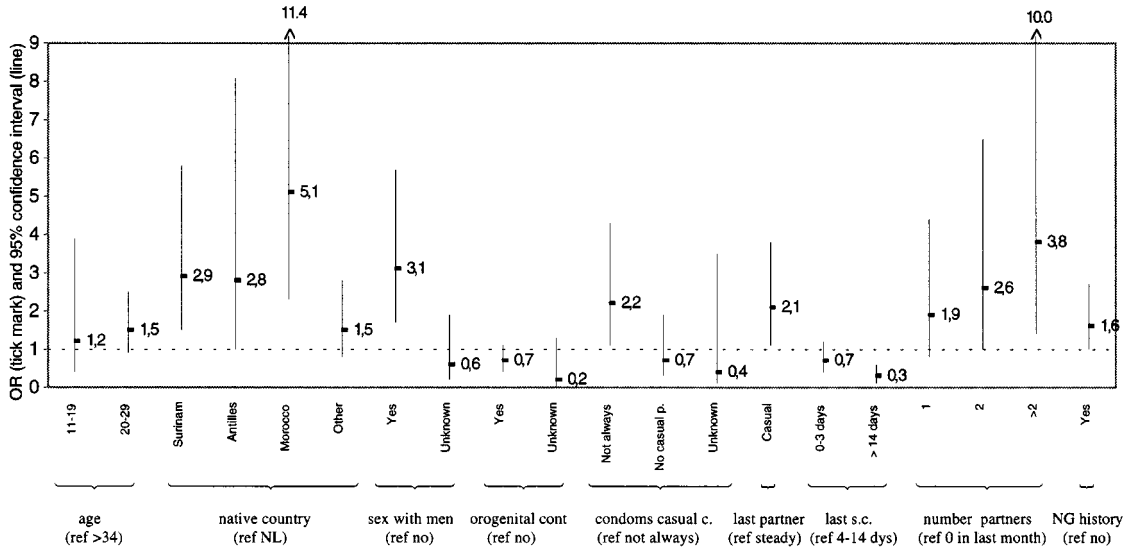

FIGURE 2 *Results of multiple logistic regression analyses for gonorrhoea among men, sexually transmitted disease clinic, University Hospital Rotterdam, 1994*

–2 log likelihood presented model (n = 1542 men, 6.0% NG): 577.5, d.f. = 20, $P = 0.0001$, Hosmer and Lemeshow Goodness-of-fit-statistic = 23.05, d.f. = 18, $P = 0.1887$ (model excluding time since last sexual contact: Hosmer and Lemeshow Goodness-of-fit-statistic: $P = 0.4243$).

of the status of sexual partners (OR = 1.7, 95% CI : 0.9–3.4). For gonorrhoea the model included: age, native country, homosexual contact, orogenital contact, condom use in casual contacts, type of last sexual contact, time since last sexual contact, history of gonorrhoea and the number of partners in the last month (Figure 2). To estimate the effect of the latter, a model excluding time since last contact was used. On the whole, the effect estimates for foreign native countries increased after correction for (infrequent) homosexual contacts. The estimates for the effect of number of partners decreased, mainly due to correction for condom use in casual contacts. When the reason for visit was included in this model, men attending for urogenital symptoms had an OR of 14.2 (95% CI : 4.4–46.4) and the OR for Surinam (2.5) and Moroccan (4.2) native country decreased and the OR for homosexual contacts (3.9) increased.

Women. For chlamydial infection the model included: age, native country, CSW, number of lifetime partners, history of viral STD, current contraceptive method and number of deliveries (Figure 3). Including the reason for visit showed an increased independent risk for women with a partner who was at risk, symptomatic or infected (OR = 2.9, 95% CI : 1.6–5.1). No association was found with attendance for symptom evaluation or for an HIV test request. The OR for the remaining factors were not affected in this extended model. The model for gonorrhoea consisted of: age, native country, intravenous drug use, history of trichomoniasis and the number of deliveries (Figure 4). The association with CSW disappeared due to correction for drug use. About half of the drug addicted women were CSW in the last 3 months and an additional 29% were CSW in the more distant past. These figures were 9% and 5%, respectively, for women who never used drugs. When the reason for visit was added to this model, women attending for urogenital symptoms were less likely to have gonorrhoea (OR = 0.4, 95% CI : 0.2–0.9), but other risk factors for gonorrhoea did not change.

DISCUSSION

Prevalence

The observed prevalence of chlamydial infection is relatively high in comparison to the rates of 5–15% found in similar populations in recent years.[15,19,22–24] The nonresponse in our study may have caused either a slight overestimation or a slight underestimation of the prevalence because low-risk Dutch individuals enrolled less often in the study, but low-risk drug users

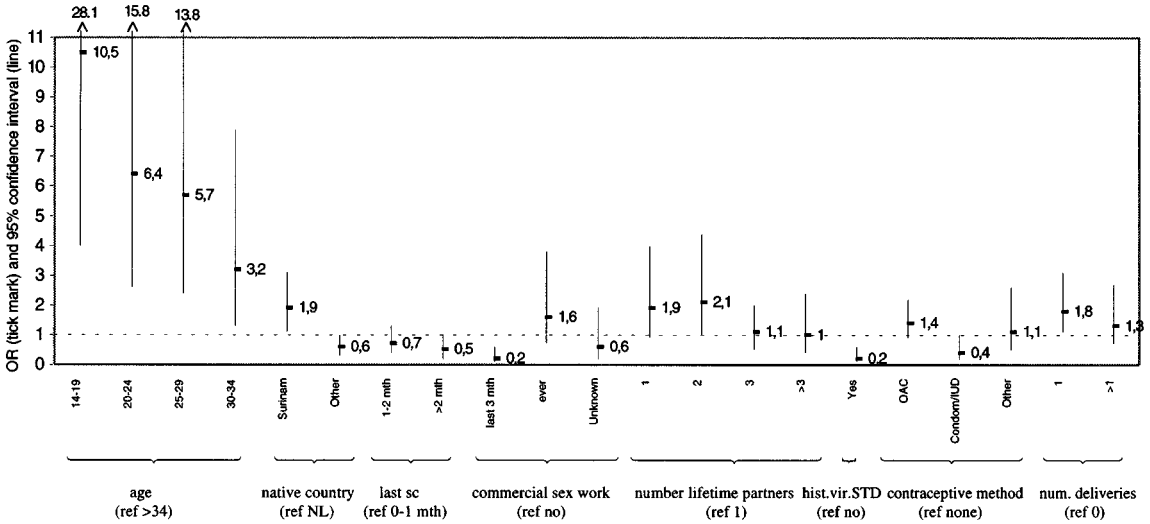

FIGURE 3 *Results of multiple logistic regression analyses for infection with Chlamydia trachomatis among women, sexually transmitted disease clinic, University Hospital Rotterdam, 1994*

–2 log likelihood presented model (n = 1143 women, 12.3% CT): 726.6, d.f. = 21, $P = 0.0001$, Hosmer and Lemeshow Goodness-of-fit-statistic = 14.915, d.f. = 18, $P = 0.6678$.

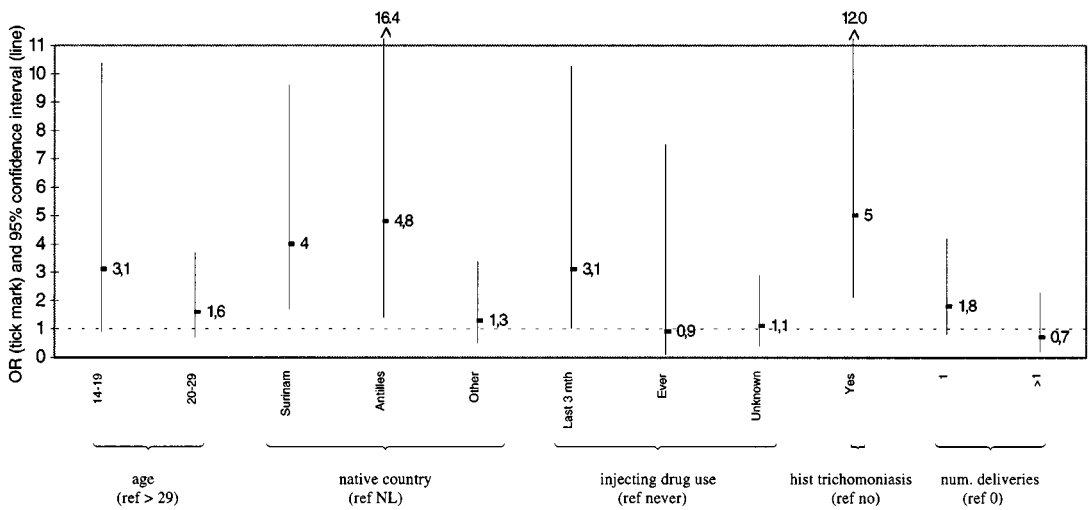

FIGURE 4 *Results of multiple logistic regression analyses for gonorrhoea among women, sexually transmitted disease clinic, University Hospital Rotterdam, 1994*

–2 log likelihood presented model (n = 1172 women, 3.0% NG): 279.9, d.f. = 11, $P = 0.0003$, Hosmer and Lemeshow Goodness-of-fit-statistic = 13.302, d.f. = 16, $P = 0.6506$.

and CSW enrolled more often. Gonorrhoea was far less prevalent than chlamydial infection. A wide range of prevalence rates for gonorrhoea among STD clinic patients has been documented: 1–5 % in western European countries and Australia and 15–30% in the US.[6,15,19,22,23,25] Although the characteristics of the 7% nonresponders suggest an underestimation of the gonorrhoea prevalence, we believe the effect to be limited.

Risk Factors

Apparent differences were present in the epidemiological correlates of chlamydial infections and gonorrhoea, especially among men. The small amount of coinfections, more pronounced in men, also suggests divergent networks for chlamydia and gonococcal transmission. Gonorrhoea was more often found in men with multiple partners in the recent past, in men with casual partners (including CSW) and in homosexual men. Additionally, drug addicted women, often CSW, were more often diagnosed with gonorrhoea. In contrast, chlamydial infection was uncommon in homosexual men, male intravenous drug users and CSW and was found more often in young attendees who had sex some time ago with an intermediate number of partners (two or three in lifetime for women and two or more in the last 6 months for men).

The observation that young age was strongly associated with chlamydial infection and far less with gonorrhoea, is in accordance with other studies.[18,23] For chlamydial infection several explanations have been suggested; the transformation during adolescence of the columnar epithelium, the 'target cells' for infection, may result in a decreased rate of infection in the elderly.[16,26,27] Secondly, it has been suggested that partial immunity prevents re-infection in elderly to some extent.[28,29] Our data on chlamydial history do not support this hypothesis; previously infected individuals appeared equally susceptible for infection. However, the value of self-reported chlamydial history is limited due to the large fraction of asymptomatic infections and different knowledge of this disease in subgroups of the community.[30] The age effect may also have contributed to residual confounding through nonmeasured sexual characteristics like the frequency of sexual intercourse per partner and the duration of one intercourse. Finally, Barnes *et al.* documented independent higher chlamydial inclusion counts in endocervical specimens of young, white-race and OCP-using women, which might facilitate detection of *C. trachomatis* in these groups.[31]

Among men, homosexual activity was an evident risk factor for gonorrhoea, but was protective for chlamydial infection. This divergence was also found in an Australian STD clinic, with OR of 3.1 and 0.3, respectively.[23] In addition, none of about 400 chlamydia cases seen at an STD clinic in Colorado reported homosexual activities.[18] This might be due to more efficient transmission or longer infectious periods for cervical chlamydial infections as opposed to rectal infections, as was suggested previously,[32] or it might be due to separate sexual networks.

For men, gonorrhoea was associated with the number of partners in the last month and chlamydial infection with those in the last 6 months. This implies that gonorrhoea was more often 'newly acquired', while chlamydial infection was more often prevalent. This difference should be considered in partner notification services. Next to different time frames of sexual activity, in men the risk for gonorrhoea, unlike chlamydia, increased gradually with higher numbers of partners. A similar tendency was found for gonorrhoea in women (not statistically significant). For chlamydial infection, only a marginal increase was observed in men with three or more partners in the last 6 months compared to less partners and in women a reduction was observed for more than three lifetime partners. Results reported by others demonstrate inconsistencies for the association with the number of partners, both for gender and STD.[15,19,33,34]

Gonorrhoea in men was also related to last contact with casual partners, but chlamydial infection was not. A relation between gonorrhoea and acquisition of new sexual partners has been suggested previously.[19,23] The more prevalent character of chlamydial infection might explain the inability to demonstrate similar results for chlamydial infection, since the last sexual contact might not be the source of infection. For gonorrhoea the relatively rapid development of symptoms[16] might more easily reveal the last sexual contact as the source of the infection. For women, gonorrhoea was more often found among drug using CSW (OR for this specific group was 6.4 after correction for age, native country, trichomoniasis history and number of deliveries). On the contrary, chlamydial infection was less often found among CSW, corresponding with low chlamydia prevalences in addicted CSW in Amsterdam[35] and in clients of CSW attending the Amsterdam STD clinic.[15] The presumed lower transmission probability per sexual contact for chlamydial infection opposed to gonorrhoea[17] might be responsible for the necessity of a more steady relationship for transmission of chlamydia. Furthermore, the lower prevalence among CSW may be due to the use of antimicrobial prophylaxis, although they reported use of antibiotics in the last month only slightly more often than other women (12–13% versus 9%).

In the univariate analyses, a history of genital herpes or genital warts was protective for chlamydial infection

and a similar tendency, although not significant, was found for gonorrhoea. In the logistic regression analyses only the association with chlamydial infection in women remained present. This association needs to be confirmed in other studies. Nonetheless, infections with herpes simplex type 2 are found to be strongly associated with high sexual activity of the patient,[36] which again suggests that individuals supporting transmission of *C. trachomatis* are from different, less sexually active, populations. Alternatively, the association might be explained by decreased sexual activity within a relationship in periods of active virus shedding or by other precautions taken to prevent transmission of the chronic viral infection.

Strong agreement for both STD was found in the higher prevalence among individuals born in Surinam or the Dutch Antilles, after adjustment for sexual behaviour. This observation is in accordance with two other Dutch studies.[37,38] Sexual surveys have found high degree of within group mixing for two sexual partners in general[39] and also for partners of individuals who ever had chlamydial infection or gonorrhoea.[40] A higher prevalence in the Surinam and Antilles group may increase the probability of infection through this choice of concordant partners.

Differences for Men and Women

For men far more sexual characteristics were associated with each STD than for women. The small number of female gonorrhoea patients (n = 39) may have obscured less strong associations. However, this does not apply to the 146 female chlamydia patients. It may be hypothesized that men acquire their infection through less stable relationships, and transmit the infection subsequently to their regular female partner. Hence, for a woman the sexual behaviour of her partner would be more important for the risk of STD than her own sexual behaviour. This is supported by the association with the reason for visiting the clinic; women who visited because of a sexual partner (at risk, symptomatic or infected), had a higher chlamydia prevalence independent of their own characteristics. This association was absent in men, who primarily visited the clinic for urogenital symptoms. Furthermore, this can be illustrated by the higher chlamydia prevalence for women with only two or three partners in lifetime, probably representing more steady relationships. In men, the prevalence was higher for those with two or more partners in the last 6 months, indicating at least one extra sexual contact in the recent past. Also, male chlamydia patients reported multiple partners in the last 6 months more often (65%) than female chlamydia patients (34%). This was also true for the gonorrhoea patients: 76% of the men versus 26% of the women reported more than one partner in the last 6 months.

General Remarks on the Study Design

We are aware that STD clinic visitors are not representative of the sexually active population at risk for STD, because risk behaviours like homosexual contacts, CSW, multiple partners and intravenous drug use are overrepresented in such a clinic population.[39,41] Consequently, the prevalences of STD cannot be generalized to populations outside the clinic. The uptake of the STD services by the populations at risk in the Rotterdam area is not known, and it is uncertain whether our results on risk factors were affected by excluding patients attending other health care providers such as general practitioners and obstetric/gynaecology units. However, as a means of identifying correlates for infection, we believe that the diversity in the population was sufficiently large with respect to age, ethnicity, sexual activity, including CSW, clinical presentation and STD status. Besides, the STD clinic contains one of few populations where STD rates are high enough to estimate the effect of several factors simultaneously.

Finally, in this study, cell culture and Gen-Probe PACE 2 were used for detection of chlamydial infections. However, in the recent past, diagnostic methods with markedly improved sensitivity have become available such as the polymerase chain reaction, the ligase chain reaction and the nucleic-acid-sequence-based amplification reaction.[42–44] Application of these techniques would probably have yielded a higher prevalence of chlamydial infection in our population than currently recognized. Also, misclassification of disease by our less than perfect diagnostic test might have introduced bias in the measures of association in our study.[45]

CONCLUSIONS

In conclusion, in our STD clinic population gonorrhoea was largely confined to individuals with high risk behaviour, who represent only a small group in the general population.[39] However, chlamydial infection seems more diffusely spread into the sexually active general population. These observations imply that, besides sexual health promotion for the control of both STD, specific prevention and intervention programmes for chlamydial infection should be developed and targeted at the sexually active general population. Additionally, while sexual activity was less clearly associated with chlamydial infections in women compared to men it is hypothesized that men often acquire their chlamydial infection through less stable relationships and subsequently infect their regular female partner.

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