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Population attributable risk for chlamydia infection in a cohort of young international travellers (backpackers) and residents in Australia

Handan Wand,[1] Rebecca Guy,[1] Basil Donovan,[1,2] Anna McNulty[2,3]

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[1]National Centre in HIV Epidemiology and Clinical Research, Sydney, New South Wales, Australia
[2]Sydney Sexual Health Centre, Sydney Hospital, Sydney, New South Wales, Australia
[3]National Centre in HIV Social Research, University of New South Wales, Sydney, New South Wales, Australia

Correspondence to
Handan Wand;
hwand@nchecr.unsw.edu.au

ABSTRACT

Aim: To estimate the population attributable risk (PAR) for *Chlamydia trachomatis* infection in young men and women in Sydney, Australia.

Method: Multivariate logistic regression was used to examine the association between demographic, sexual behaviour and other potential risk factors and chlamydia positivity in young (≤30 years) heterosexual international travellers (backpackers) and Australian residents attending a sexual health clinic. Point and interval estimates of PAR were calculated to quantify the proportion of chlamydia infections that can theoretically be prevented if a combination of risk factors is eliminated from a target population.

Results: In males, the PAR associated with inconsistent condom use in the past 3 months was 65% (95% CI 56% to 71%) in backpackers compared to 50% (95% CI 41% to 56%) in non-backpackers and the PAR associated with reporting three or more female sexual partners in the past 3 months was similar between male backpackers and non-backpackers (33% (95% CI 28% to 40%) and 36% (95% CI 32% to 41%), respectively). In females, the PAR associated with inconsistent condom use in the past 3 months was 51% (95% CI 42% to 59%) in backpackers compared to 41% (95% CI 31% to 51%) in non-backpackers, and the PAR associated with reporting three or more male sexual partners in the past 3 months was 14% (95% CI 11% to 18%) in backpackers compared to 30% (95% CI 25% to 37%) in non-backpackers.

Conclusion: These findings suggest that the largest number of chlamydia infections could be avoided by increasing condom use, particularly in backpackers. Reporting multiple partners was also associated with a large proportion of infections and the risk associated with this behaviour should be considered in health promotion strategies.

ARTICLE SUMMARY

Article focus

- Risk factors for chlamydia infection were determined among young, heterosexual backpackers and Australian residents.
- A novel statistical methodology was used to investigate the potential impact of eliminating risk factors on chlamydia infection at a population level.

Key messages

- Results suggest that the majority of the chlamydia infections could be avoided by increased condom use, particularly among backpackers.
- Multiple sex partners in past 3 months was also associated with a high proportion of chlamydia infections at the population level.

Strengths and limitations of this study

- This is the first study to investigate the potential impact of sexual risk behaviours for chlamydia infection at the population level.
- The study population was sexual health clinic attendees who are likely to be at higher risk for chlamydia infection compared to the general population.

INTRODUCTION

Australia remains a popular destination among young international travellers (backpackers), with 545 000 visiting Australia in 2006 with a mean length of stay of 72 days. Sydney alone hosted 407 000 backpackers.[1] We previously reported that, compared with age-matched non-backpackers at our clinic, backpackers reported more recent sexual partners and were more likely to drink at hazardous levels.[2] Similar proportions of each group reported inconsistent condom use in the previous 3 months, although backpackers were more likely to be diagnosed with chlamydia.[2–4] Studies also have found that 35%–40% of sexually active young travellers report multiple sexual partners in the past year and 30% inconsistent condom use with casual partners.[5–7] In response, in Australia there have been numerous social marketing campaigns aimed at raising awareness about condom use and chlamydia screening among young people,[7–9] including targeted campaigns for travellers.

Understanding the risk associated with various sexual behaviours and other factors is important to ensure health promotion strategies are evidence-based and appropriately targeted. Although odds ratios can quantify the association between a disease and a risk factor, they do not provide information about the potential impact on disease occurrence by reducing or eliminating various risk factors. In this paper, we use the population attributable risk (PAR), which takes account of both the odds ratio of specific risk factors and their prevalence in the population, to provide a quantitative assessment of the potential impact of reducing a risk factor on disease incidence at a population level. Instead of the using traditional method of calculating PAR, we used a novel method described by Spiegelman *et al*[10] and Wand *et al*[11] that adjusts for the effects of other variables.

METHODS

Setting

Sydney Sexual Health Clinic is a large urban public sexual health clinic in close proximity to the city and beach areas of Sydney which are popular destinations for backpackers.

From each patient, information on demographics, alcohol and drug use, sex work, sex overseas, sexual behaviour and the reason for attending the clinic are collected and entered into a computerised medical records system. All new attendees are offered a *Chlamydia trachomatis* nucleic acid amplication test.

Definitions

Heterosexual was defined as sex with the opposite sex only in the past 12 months. Backpacker was defined as having been born outside Australia, lived outside Australia for most of the last 5 years and been in Australia for less than 2 years, or self-identification as a 'traveller'. Non-backpackers included all other attendees who were ≤30 years old. Hazardous alcohol consumption was considered to be more than 140 g per week for women and more than 280 g per week for men as defined by the National Health and Medical Research Council.[12] Current sex workers and students were excluded from both groups. All analyses were conducted on available data only.

Statistical analysis

Chlamydia positivity was calculated as the number of positive test results divided by the total number of test results. Indeterminate chlamydia results were excluded from this calculation. Univariate and multivariate logistic regression analysis was undertaken to identify factors independently associated with chlamydia positivity. The multivariate models considered all variables statistically significant ($p<0.05$) in the univariate analysis and used forward stepwise methods.

The following variables were included in the regression model: age group, country of birth, marital status, employment status, smoking status, hazardous alcohol consumption, history of prior chlamydia infection, condom use and number of sexual partners in the past 3 months, and sex overseas (Thailand, other countries, no sex overseas). Separate regression models were established for male backpackers, male non-backpackers, female backpackers and female non-backpackers.

Population attributable risk

PAR quantifies the potential impact of a risk factor on disease occurrence in the population.[10 11] The PAR is formulated as a function of odds ratio (OR) and the prevalence (p) of the risk factor(s). When there is only one risk factor at two levels (1 vs 0)

$$\mathrm{PAR} = \frac{\mathrm{p}(\mathrm{OR}-1)}{\mathrm{p}(\mathrm{OR}-1)+1} = 1 - \frac{1}{\sum_{s=1}^{2} \mathrm{p}_s \mathrm{OR}_s} \qquad (1)$$

where OR is the odds ratios, p is the prevalence of the risk factor in the population and s indexes the two strata determined by the value of the risk factor. Equation 1 can be generalised to the multi-factorial setting when there is more than one risk factor at multiple levels, as

$$\mathrm{PAR} = \frac{\sum_{s=1}^{S} \mathrm{p}_s(\mathrm{OR}_s - 1)}{1 + \sum_{s=1}^{S} \mathrm{p}_s(\mathrm{OR}_s - 1)} = 1 - \frac{1}{\sum_{s=1}^{2} \mathrm{p}_s \mathrm{OR}_s} \qquad (2)$$

where OR_s and p_s, $s=1,\ldots S$, are the odds ratios and the prevalences in the target population for the sth combination of the risk factors. Full PAR can be estimated by using Equation 2 and interpreted as the per cent reduction expected in the number of chlamydia diagnoses if all known risk factors were eliminated from the target population.

In a multifactorial disease setting, at least some key risk factors such as age and sex are not modifiable. This limits the practical utility of the full PAR which is based on modification of all variables of interest. In an evaluation of a preventive intervention in a multifactorial disease setting, the interest is in the per cent of cases associated with the exposures to be modified, when other risk factors, particularly those that are non-modifiable, exist but do not change as a result of the intervention. Therefore we derived and used the partial PAR which kept unmodifiable variable(s) unchanged.

Under the assumption of no interaction between the modifiable and non-modifiable risk factors of interest, the partial PAR is formulated as

$$\begin{aligned}\mathrm{PAR} &= \frac{\sum_{s=1}^{S}\sum_{t=1}^{T} \mathrm{p}_{st}\mathrm{OR}_{1s}\mathrm{OR}_{2t} - \sum_{s=1}^{S}\sum_{t=1}^{T} \mathrm{p}_{st}\mathrm{OR}_{2t}}{\sum_{s=1}^{S}\sum_{t-1}^{T} \mathrm{p}_{st}\mathrm{OR}_{1s}\mathrm{OR}_{2t}} \\ &= 1 - \frac{\sum_{t=1}^{T} \mathrm{p}_{\cdot t}\mathrm{OR}_{2t}}{\sum_{s=1}^{S}\sum_{t=1}^{T} \mathrm{p}_{st}\mathrm{OR}_{1s}\mathrm{OR}_{2t}} \end{aligned} \qquad (3)$$

where t denotes a stratum of unique combinations of levels of all background risk factors which are not modifiable and/or not under study, $t=1,\ldots,T$ and OR_{2t} is the odds ratio in combination t relative to the lowest risk level, where $\mathrm{OR}_{2,1}=1$. As previously, s indicates a risk

factor defined by each of the unique combinations of the levels of the modifiable risk factors, that is, those risk factors to which the PAR applies, $s=1,\ldots,S$, and $OR1_s$ is the odds ratio corresponding to combinations relative to the lowest risk combination, $OR_{1,1}=1$. The joint prevalence of exposure group s and stratum t is denoted by p_{st}, and $p_{\cdot t} = \Sigma_{s=1}^{S} p_{st}$. The PAR represents the difference between the number of cases expected in the original cohort and the number of cases expected if all subsets of the cohort who were originally exposed to the modifiable risk factor(s) had eliminated their exposure(s) so that their RR compared to the unexposed was 1, divided by the number of cases expected in the original cohort.

The PAR is calculated based on the odds ratio of the association between the risk factor (sexual behaviour) and the outcome (chlamydia positivity), combined with the prevalence of the risk factor.

All analyses were conducted using SAS software, v 9 (SAS Institute). Ethics approval for the study was obtained from the South Eastern Sydney and Illawarra Area Health Service Human Research Ethics Committee.

RESULTS

A total of 12 958 heterosexuals aged 18–30 years attended SSHC for the first time during the period 1998–2006; 5702 (44%) were backpackers and this proportion increased steadily over time from 36% in 1998 to 52% in 2006.

Prevalence of risk factors

The characteristics of the study population are presented by gender in table 1.

Males

Compared to male non-backpackers, a significantly (p<0.001) higher proportion of male backpackers were aged ≤25 years (56% vs 42%), had never married (94% vs 85%), were unemployed (27% vs 13%), were current smokers (39% vs 34%), reported excess alcohol consumption (17% vs 5%), reported three or more sexual partners in the past 3 months (26% vs 15%), reported sex in Thailand in the past 12 months (22% vs 9%), reported a past chlamydia diagnosis (15% vs 10%) and stated that the reason for presenting to the clinic was for a sexually transmissible infection (STI)/HIV screen (41% vs 36%) (table 1). The same proportion of male backpackers and non-backpackers reported inconsistent condom use in the past 3 months (31%).[2]

Females

Compared to female non-backpackers, a significantly (p<0.001) higher proportion of female backpackers were aged ≤25 years (63% vs 52%), had never married (92% vs 81%), were unemployed (26% vs 13%), were current smokers (42% vs 36%), reported excess alcohol consumption (27% vs 14%), reported two or more sexual partners in the past 3 months (31% vs 22%), sex in Thailand in the past 12 months (7% vs 4%), reported a past chlamydia diagnosis (13% vs 9%) and stated that the reason for presenting to the clinic was for an STI/HIV screen (34% vs 32%) (table 1). A significantly higher proportion of female backpackers reported inconsistent condom use in the past 3 months (31%) compared to female non-backpackers (28%; p=0.006).[2]

Risk factors for chlamydia

Among 12 958 young heterosexuals, 731 chlamydia tests were positive, equating to an overall chlamydia positivity of 5.6% (95% CI 3.6% to 6.0%): 8% in male backpackers, 7% in male non-backpackers, 5% in female backpackers and 3% in female non-backpackers. The chlamydia positivity increased significantly over time in backpackers from 5% (95% CI 3% to 7%) in 1998 to 12% (95% CI 10% to 14%) in 2006 (p<0.001) and also in non-backpackers from 3% (95% CI 2% to 4%) in 1998 to 8% (95% CI 6% to 10%) in 2006 (p<0.001). Increasing trends were seen for both males and females (p<0.001) (data not shown).

Tables 2 and 3 provide univariate and multivariate odds ratios for each factor considered in males and females, respectively.

Males

Independent predictors of chlamydia positivity in male non-backpackers were being aged ≤25 years (adjusted odds ratio (AOR) 1.46, 95% CI 1.12 to 1.89), excess alcohol intake (AOR 1.65, 95% CI 1.04 to 2.61), inconsistent condom use (AOR 1.94, 95% CI 1.38 to 2.74), reporting two (AOR 2.11, 95% CI 1.53 to 2.91) or three or more sexual partners in the past 3 months (AOR 3.03, 95% CI 2.20 to 4.18), known STI contact (AOR 3.69, 95% CI 2.42 to 5.65) and a past chlamydia diagnosis (AOR 1.50, 95% CI 1.03 to 2.18). Male backpackers had the same independent predictors of chlamydia positivity except age, excess alcohol intake and past chlamydia diagnosis (table 2).

Females

In female non-backpackers, independent predictors of chlamydia positivity were inconsistent condom use (AOR 1.78, 95% CI 1.14 to 2.76), reporting three or more sexual partners in the past 3 months (AOR 3.00, 95% CI 1.89 to 4.77) and known STI contact (AOR 3.54, 95% CI 2.18 to 5.74). Female backpackers had the same independent predictors of chlamydia positivity as female non-backpackers (table 3).

Population attributable risk

The partial PARs by sex and backpacker status are shown in table 4. In males, inconsistent condom use was associated with the highest PAR, with 65% (95% CI 56% to 71%) of the chlamydia cases attributed to this risk factor among backpackers and 50% (95% CI 41% to 56%) of the cases in non-backpackers. In females, inconsistent condom use was associated with 51% (95% CI 42% to 59%) of the chlamydia cases among backpackers and 41% (95% CI 31% to 51%) of the cases in non-backpackers.

Table 1 Characteristics of young heterosexual patients by sex and backpacker status, 1998–2006 (n=12 958)

		Young heterosexual males			Young heterosexual females		
Variable	**Sub-category**	**Non-backpackers (n=3880), %**	**Backpackers (n=2765), %**	**p Value**	**Non-backpackers (n=3376), %**	**Backpackers (n=2937), %**	**p Value**
Age group (years)	26–30 years	58	44	<0.001	48	37	<0.001
	≤25 years	42	56		52	63	
Country of birth	Australia	62	–	–	61	–	–
	England	5	47		4	45	–
	Other	33	55		34	55	
Marital status	Married/partner	9	4	<0.001	12	5	<0.001
	Never married	85	94		81	92	
	Other	5	2		4	1	
Employment status	Employed	80	59	<0.001	78	61	<0.001
	Unemployed	13	27		13	26	
	Other	7	14		10	13	
Reason for presentation	STI/HIV screen	36	41	<0.001	32	34	0.043
	Known STI contact	5	4	0.105	5	5	0.680
	Ano-genital symptoms	51	49	0.104	42	42	0.997
	Genital herpes or warts	3	3	0.974	3	3	0.311
Cigarette smoking status	Not/past smoker	66	61	<0.001	64	58	<0.001
	Current smoker	34	39		36	42	
Hazardous alcohol use*	Yes	5	17	<0.001	14	27	<0.001
	No	95	83		86	73	<0.001
Consistent condom use (past 3 months)	Yes	69	69	0.889	72	69	0.006
	No	31	31		28	31	
Number of sex partners (past 3 months)	0	13	10	<0.001	13	10	<0.001
	1	51	41		65	59	
	2	20	23		15	20	
	3+	15	26		7	11	
Sex overseas in last 12 months (and country)	Thailand	9	22	<0.001	4	7	<0.001
	Sex in another country	17	41		17	45	
	No sex overseas	74	38		79	48	
Past chlamydia diagnosis (self-report)	Yes	10	15	<0.001	9	13	<0.001
	No	90	85		91	87	

*Average alcohol intake of 280 g for men and 140 g for women.
STI, sexually transmissible infection.

Table 2 Predictors of chlamydia in young heterosexual male backpackers and non-backpackers

	Young male heterosexual backpackers, n=2765				Young male heterosexual non-backpackers, n=3880			
	Univariate		Multivariate		Univariate		Multivariate	
	OR (95% CI)	p Value	OR (95% CI)	p Value	OR (95% CI)	p Value	OR (95% CI)	p Value
Age group (years)								
26–30	1	0.375	–		1		1	
≤25 years	1.12 (0.87 to 1.46)				1.40 (1.09 to 1.81)	0.009	1.46 (1.12 to 1.89)	0.005
Marital status								
Other	1	0.264	–		1		–	
Never married	1.45 (0.75 to 2.80)				1.37 (0.92 to 2.04)	0.118		
Current cigarette smoker								
No	1	0.346	–		1		–	
Yes	1.13 (0.88 to 1.47)				1.53 (1.18 to 1.97)	0.001		
Excess alcohol*								
No	1	0.063	–		1		1	
Yes	1.35 (0.98 to 1.85)				2.03 (1.31 to 3.15)	0.002	1.65 (1.04 to 2.61)	0.033
Reason for presentation								
Other reasons	1		1		1		1	
STI/ HIV test	0.95 (0.68 to 1.32)	0.760	0.91 (0.64 to 1.28)	0.579	0.67 (0.48 to 0.92)	0.014	0.62 (0.44 to 0.86)	0.005
Ano-genital symptoms	1.03 (0.74 to 1.43)	0.854	0.95 (0.68 to 1.33)	0.763	0.99 (0.73 to 1.33)	0.923	0.93 (0.68 to 1.26)	0.635
Known STI contact	3.10 (1.92 to 4.93)	<0.001	2.95 (1.82 to 4.77)	<0.001	3.24 (2.16 to 4.87)	<0.001	3.69 (2.42 to 5.65)	<0.001
Number of sex partners (past 3 months)								
0 or 1	1		1		1		1	
2	1.81 (1.31 to 2.51)	<0.001	1.69 (1.22 to 2.35)	0.002	2.09 (1.53 to 2.85)	<0.001	2.11 (1.53 to 2.91)	<0.001
3 or more	2.21 (1.63 to 3.00)	<0.001	2.06 (1.22 to 2.35)	<0.001	3.18 (2.34 to 4.31)	<0.001	3.03 (2.20 to 4.18)	<0.001
Consistent condom use (past 3 months)								
Yes	1	<0.001	1		1		1	
No	3.17 (2.20 to 4.57)		2.71 (1.87 to 3.93)	<0.001	2.37 (1.70 to 3.31)	<0.001	1.94 (1.38 to 2.74)	<0.001
Past chlamydia diagnosis								
No	1	0.500	–		1			
Yes	1.13 (0.80 to 1.59)				1.73 (1.21 to 2.48)	0.003	1.50 (1.03 to 2.18)	0.034

*Average alcohol intake of 280 g for men and 140 g for women.
STI, sexually transmissible infection.

Table 3 Predictors of chlamydia in young heterosexual female backpackers and non-backpackers

	Young female heterosexual backpackers, n=2937				Young female heterosexual non-backpackers, n=3376			
	Univariate		Multivariate		Univariate		Multivariate	
	OR (95% CI)	p Value	OR (95% CI)	p Value	OR (95% CI)	p Value	OR (95% CI)	p Value
Age group (years)								
26–30	1	0.106			1	0.065		
≤25	1.30 (0.95 to 1.79)		–		1.37 (0.98 to 1.91)		–	
Marital status								
Other	1	0.434			1	0.104		
Never married	1.27 (0.70 to 2.32)		–		1.48 (0.92 to 2.36)		–	
Current cigarette smoker								
No	1	0.304			1	0.0504	–	
Yes	1.17 (0.87 to 1.58)		–		1.39 (0.99 to 1.93)			
Excess alcohol*								
No	1	0.331			1	0.043		
Yes	1.17 (0.85 to 1.62)		–		1.54 (1.01 to 2.34)		–	
Reason for presentation								
Other	1	<0.001	1	<0.001	1		1	<0.001
Known STI contact	2.54 (1.58 to 4.08)		2.37 (1.47 to 3.82)				3.54 (2.18 to 5.74)	
Number of sex partners (past 3 months)								
0 or 1	1		1		1		1	
2	1.25 (0.86 to 1.81)	0.243	1.17 (0.80 to 1.71)	0.413	1.57 (1.02 to 2.42)	0.004	1.48 (0.95 to 2.30)	0.079
3 or more	2.07 (1.38 to 3.11)	<0.001	1.89 (1.25 to 2.86)	0.003	3.05 (1.93 to 4.80)	<0.001	3.00 (1.89 to 4.77)	<0.001
Consistent condom use (past 3 months)								
Yes	1	<0.001	1		1	0.002	1	0.011
No	2.50 (1.68 to 3.72)		2.33 (1.56 to 3.48)	<0.001	2.00 (1.30 to 3.10)		1.78 (1.14 to 2.76)	
Past chlamydia diagnosis								
No	1	0.192	–		1	0.362	–	
Yes	1.32 (0.87 to 1.99)			–	1.28 (0.75 to 2.18)			

*Alcohol intake of average 280 g for men and 140 g for women.
STI, sexually transmissible infection.

Table 4 PAR% (95% CI) for genital chlamydia infection in young heterosexuals by backpacker status

Variable	Backpacker PAR% (95% CI)	Non-backpacker PAR% (95% CI)
Males		
All factors combined	0.88 (0.81 to 0.93)	0.76 (0.70 to 0.82)
Inconsistent condom use, past 3 months	0.65 (0.56 to 0.71)	0.50 (0.41 to 0.56)
3 or more sexual partners, past 3 months	0.33 (0.28 to 0.40)	0.36 (0.32 to 0.41)
Known STI contact	0.08 (0.07 to 0.09)	0.10 (0.09 to 0.12)
Past chlamydia diagnosis	0.02 (0.01 to 0.03)	0.07 (0.06 to 0.08)
Females		
All factors combined	0.73 (0.67 to 0.79)	0.68 (0.58 to 0.76)
Inconsistent condom use, past 3 months	0.51 (0.42 to 0.59)	0.41 (0.31 to 0.51)
3 or more sexual partners, past 3 months	0.14 (0.11 to 0.18)	0.30 (0.25 to 0.37)
Known STI contact	0.08 (0.07 to 0.10)	0.12 (0.09 to 0.15)
Past chlamydia diagnosis	0.04 (0.03 to 0.05)	0.03 (0.02 to 0.04)

PAR, population attributable risk; STI, sexually transmissible infection.

Two or more sexual partners in the past 3 months had the second highest PAR, with an estimated 33% (95% CI 28% to 40%) of the chlamydia cases among male backpackers and 36% (95% CI 32% to 41%) in male non-backpackers attributable to this risk factor. In females, three or more sexual partners in the past 3 months was attributed with an estimated 14% (95% CI 11% to 18%) of the chlamydia cases among backpackers and 30% (95% CI 25% to 37%) of cases in non-backpackers.

When two factors were combined (inconsistent condom use and having three or more partners in the past 3 months), the estimated PAR was 81% (95% CI 73% to 86%) in male backpackers and 71% (95% CI 65% and 77%) in non-backpackers. In females, the estimated PAR for these two combined risk factors was 66% (95% CI 54% to 76%) and 63% (95% CI 53% to 73%) among female backpackers and non-backpackers, respectively.

When all four factors were combined (inconsistent condom use, having three or more sexual partners in the past 3 months, known STI contact and previous history of chlamydia), the PAR was 88%, 73%, 76% and 68% among male-backpackers, female-backpackers, male non-backpackers and female non-backpackers, respectively.

DISCUSSION

The impact of risk factors for a disease at a population level has important implications for prevention policy and practice. In this study we have shown that the majority of chlamydia cases in our clinic population were attributable to inconsistent condom use and multiple sexual partners in the past 3 months. In both males and females, inconsistent condom use was associated with a greater PAR in backpackers compared to non-backpackers. Conversely in females, reporting three or more male sexual partners in the past 3 months was associated with a greater PAR in non-backpackers.

Notably, while sexual contact with a person known to have an STI was associated with a current chlamydia diagnosis, this only contributed a PAR of 2% because it was a relatively uncommon risk factor.

The PAR findings suggest that the largest number of chlamydia infections could be avoided by increasing condom use. In Australia there have been numerous health promotion strategies involving social marketing in the past 10 years which have focused on increasing condom use, but there is little evidence that they changed behaviour, and no evidence that they have led to a reduction in chlamydia transmission.[13 14] Internationally, most mass media interventions have no effect on condom use.[15–17] Our analysis also showed that multiple partners in the past 3 months was a frequently reported risk behaviour and a significant risk factor for chlamydia positivity, thus netting a substantial PAR. Although not specifically measured, multiple partners in a short period is likely to reflect sex with new partners or concurrent partnerships that are established risk factors for chlamydia.

Health promotion and other prevention strategies targeting young people need to be more innovative than just social marketing and include information about the various risk factors for chlamydia, which in turn may then lead to increased testing and treatment. With widespread use of the internet and mobile phones, electronic-based health promotion may be more effective at changing sexual and healthcare seeking behaviour. Lim and colleagues[18] recently demonstrated in a randomised trial that sending health promotion messages via SMS increased self-reported condom use and STI testing rates compared to a control group. Also websites that enable young people to assess their individual risk of STIs based on the odds ratio of a range of risk factors should be considered. Regarding travellers, approaches should be targeted and include health promotion messages displayed in selected pubs/clubs, backpacker hostels, domestic airports and backpacker publications.

If a health department is considering spending money on controlling chlamydia, calculating the PAR makes it

possible to estimate the potential population-level impact of the strategy and weigh this up against the available budget. For example, in young male Australian residents (non-backpackers) although a past chlamydia diagnosis was significantly associated with chlamydia positivity, its impact at a population level was about 5% due to the relatively low prevalence of this risk factor compared to a PAR of 60% for inconsistent condom use. This means that strategies that target men with a history of past chlamydia infection would need to cost 12 times less to be more cost effective.

Our study has some limitations. The sample was based on sexual health clinic attendees who are not representative of the general community and are likely to be at higher risk of chlamydia. A community-based study of young sexually active women aged 18–25 years found a chlamydia prevalence of 3.7% (95% CI 1.2% to 8.4%), which is lower than the 6% chlamydia positivity in our clinic-based sample.[19] A community-based study of British backpackers in Australia found 41% of backpackers reported inconsistent condom use, which is also lower than the 69% reported in both males and females in our clinic sample.[7] Most of the risk factors examined were based on self-reported data and may be subject to recall and measurement bias, particularly regarding a past chlamydia diagnosis. Finally, it is likely that many of the chlamydia infections were acquired before the 3 months preceding the visit to SSHC. Several epidemiological studies determined the population sub-groups, such as certain ethnic groups[20–24] and females,[25] which have substantially elevated risks for chlamydia infection using standard statistical and epidemiological methods. To our knowledge, our current study is one of the first attempts at determining the population impact of risk factors for chlamydia infection. Our results confirm that innovative health promotion strategies aimed at increasing condom use should be a priority considering the high PAR associated with this behaviour. In addition, young people should be given information about the risk associated with multiple partners and new partners.

Competing interests None.

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