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Population attributable risk for chlamydia in young international travelers (backpackers) and residents in Australia

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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 behavior and other potential risk factors on chlamydia positivity in young heterosexual international travellers (backpackers) and Australian residents aged <30 years 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:0.56,0.71) in backpackers compared to 50% (95%CI:0.41,0.56) in non-backpackers and the *PAR* associated with reporting 2 or more female sexual partners in the past 3 months was similar between male backpackers and non-backpackers; 33% (95%CI:28-40%) and 36% (95%CI:32-41%), respectively. In females, the *PAR* associated with inconsistent condom use in the past 3 months was 51% (95%CI: 42-59%) in backpackers compared to 41% (95%CI:31-51%) in non-backpackers, and the *PAR* associated with reporting 2 or more male sexual partners in the past 3 months was 14% (95%CI:11-18%) in backpackers compared to 30% (95%CI:25-37) 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 should be included in health promotion strategies.

Introduction

Australia remains a popular destination among young international travelers (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. Similar minorities of each group reported consistent condom use in the previous 3 months, though backpackers were more likely to be diagnosed with chlamydia [2].

Like many resource-rich countries, Australia has seen increasing notifications of *Chlamydia trachomatis* infection: more than doubling between 2002 and 2009, with the greatest burden ~~of~~ among young people aged 15-29 years [3,4]. Surveys have found that 35%-40% of sexually active young people report multiple sexual partners in the past year and 30% report inconsistent condom use with casual partners [5,6]. In response, there have been social marketing campaigns aimed at raising awareness about condom use and chlamydia screening among young people [7-9], including with more targeted campaigns for travelers.

Understanding the risk associated with various sexual behaviours and other factors are important to ensure health promotion strategies are evidence-based and appropriately targeted. Although odds ratios (ORs) may be well suited to the assessment of causality, 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 OR 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 (2007) [15] and Wand (2009) [16] that adjusts for the effects of other variables.

METHODS

Study population

The study population consisted of 12,958 young heterosexual men and women aged 18-30 years who visited the Sydney Sexual Health Centre (SSHC) for the first time during the period of 1998 – 2006 [2].

A patient registration form which captures demographic and behavioural data; including alcohol and drug use, sex work, sex overseas, sexual behaviour and the reason for attending. These data are entered into a computerised medical records system. All new patients were offered a test for *C trachomatis* by PCR.

Definitions

Heterosexual was defined as sex with the opposite sex only in the past 12 months. Backpacker was defined as having been born outside of Australia, lived outside of Australia for most of the last 5 years and been in Australia for less than 2 years; or to self identify as a 'traveler'. Non-backpackers included all other patients who were less than 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 [17]. The following participants were excluded from both groups; current sex workers, students and men reporting sex with men in the past year [2].

<u>Statistical analysis</u>

Chlamydia positivity was calculated by 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.

<u>Population attributable risk</u>

We adapted the method described by Spiegelman [15] and Wand [16] to estimate the PAR. Briefly, PAR quantifies the potential impact of a risk factor on disease incidence in the population. 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. The PAR adjusts for the effects of other variables and assumes non-modifiable risk factors are unchanged (e.g. age, sex).

We estimated the *PAR* for each risk factor and combinations of risk factors. As the logistic regression model assumes a multiplicative effect on the odds ratio, the *PAR* for the combination of two or more risk factors will usually be less than the sum of the *PARs* for each risk factor.

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

RESULTS

There were 12,958 heterosexuals aged 18-30 years who attended SSHC for the first time during the period 1998-2006; 5,702 (44%) were backpackers and this proportion increased steadily over time from 36% in 1998 to 52% in 2006 (p<0.001).

Prevalence of risk factors

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 (58% vs 42%), never married (94% vs 85%), unemployed (27% vs 13%), a current smoker (39% vs 34%), reported excess alcohol consumption (17% vs 5%), reported

3 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 diagnoses (15% vs 10%) and the reason for presenting to the clinic was for a STI/HIV screen (41% vs 36%) (Table 1). The same proportion of male backpackers and non-backpackers reported inconsistent condom use in the past three months (69%)[2].

<u>Females:</u>

Compared to female non-backpackers, a significantly ($p<0.001$) higher proportion of female backpackers were aged ≤ 25 years (63% vs 52%), never married (92% vs 81%), unemployed (26% vs 13%), a current smoker (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 diagnoses (13% vs 9%) and the reason for presenting to the clinic was for a STI/HIV screen (24% vs 32%) (Table 1). A significantly lower proportion of female backpackers reported inconsistent condom use in the past three months (69%) compared to female non-backpackers (72%, $p=0.006$)[2].

<u>Risk factors for chlamydia</u>

Among 12,958 young heterosexuals, 731 chlamydia tests were positive, equating to an overall chlamydia positivity of 6% (95% Confidence Interval (CI):5 %-6%); 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%-7%) in 1998 to 12% (95% CI: 10%-14%) in 2006 ($p<0.001$) and also in non-backpackers; from 3% (95%CI: 2%-4%) in 1998 to 8% (95%CI: 6%-10%) in 2006 ($p<0.001$). Increasing trends were seen for both males and females ($p<0.001$) (data not shown).

Tables 2 and 3provide 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:1.12-1.89), excess alcohol intake (AOR]=1.65, 95%CI:1.04-2.61), inconsistent condom use (AOR=1.94, 95%CI:1.38-2.74), reporting 2 (AOR) or 3 or more sexual partners in the past 3 months (AOR=3.03, 95%CI:2.20,4.18); known sexually transmissible infection (STI) contact (AOR=3.69, 95%CI:2.42-5.65), and a past chlamydia diagnosis (AOR=1.50, 95%CI:1.03-2.18). Male backpackers had the same independent predictors of chlamydia positivity, though past chlamydia diagnosis was not significant on multivariate analysis (Table 2).

Females

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

Population attributable risk

The partial PARs by gender and backpacker status are shown in Table 4. In males, inconsistent condom use was associated with the highest PAR, with 65% (95% CI: 0.56-0.71) of the chlamydia cases attributed to this risk factor among backpackers and 48% (95%CI: 0.41-0.56) of the cases in non-backpackers. In females, inconsistent condom use was attributed to 51% (95%CI:0.42-0.59) of the chlamydia cases among backpackers and 41% (95%CI:0.31-0.51) of the cases in non-backpackers.

Two or more sexual partners in the past 3 months had the second highest PAR, with an estimated 33% (95%CI:0.28-0.40) of the chlamydia cases among male backpackers and 36% (95% CI: 0.32-0.41) in male non-backpackers attributable to this risk factor. In females, 2 or more sexual partners in the past 3 months was attributed with an estimated 14% (95%CI: 0.11-0.18) of the chlamydia cases among backpackers and 30% (95%CI:25-37) of cases in non-backpackers.

When two factors were combined (inconsistent condom use and having 3 or more partners in the past 3 months) the estimated PAR was 81% (95% CI: 0.73, 0.86) in male backpackers and 71% (95% CI: 0.65, 0.77) in non-backpackers. In females, the estimated *PAR* for these two combined risk factors was 66% (95% CI: 0.54, 0.76) and 63% (95% CI: 0.53, 0.73) among female backpackers and non-backpackers, respectively.

When all four factors were combined (inconsistent condom use in the past 3 months, having 3 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

PARs that illustrate 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 at the majority of chlamydia cases in our clinical 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 3 or more male sexual partners in the past 3 months was associated with a greater PAR in non-backpackers.

Notably, while both a known STI contact and a past chlamydia diagnosis were associated with a current chlamydial infection they only contributed PARs of 2% to 12% because they were relatively uncommon risk factors.

The PAR findings suggest that the largest number of chlamydia infections could be avoided by increasing consistent condom use. In Australia there have been numerous health promotion strategies involving social marketing in the past ten 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 [18,19]. Internationally, most mass media interventions have no effect of condom use [20-22]. Our analysis also showed that multiple partners in the past 3 months was a frequently reported risk behavior 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 increasing testing and treatment. With widespread use of the internet and mobile phone, electronic-based health promotion may be more effective at changing sexual and health-care seeking behavior. Lim and colleagues [23] recently demonstrated in a randomized trial that sending health promotion messages via SMS increased self-reported condom use and STI testing rates compared to the control group. Also websites that enable young people to assess their individual risk of STIs based on the OR of a range of risk factors should be considered.

If a health department is considering spending money on controlling chlamydia, 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 diagnoses was significantly associated with chlamydia positivity, it's impact at a population level was about 5% due to 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 clinic attendees who are not representative of the general community. Sexual health clinic attendees are likely to include young people who are more at risk of chlamydia. Also, most of the risk factors examined were based on self-reported data and may be subject to recall and measurement bias, particularly a past chlamydia diagnosis Finally, it is likely that many of the chlamydia infections were acquired prior to 3 months preceding the visit to SSHC [24].

To our knowledge, this is one of the first attempts at a comprehensive study of the population impacts 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 behavior. In addition, young people should be given information about the risk associated with multiple partners and new partners

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Table 1: Characteristics in young heterosexual patients by sex and travel status, 1998-2006 (n=12,958) **[previously published]**

		Young heterosexual males			Young heterosexual females		
Variable	Sub-category	Non-backpackers n=3,880 %	Backpackers n=2,765 %	p-value	Non-backpackers n=3,376 %	Backpackers n=2,937 %	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 countries	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
	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
	Currently smoker	34	39		36	42	
Hazardous alcohol[1]	Yes	5	17	<0.001	14	27	<0.001
	No	95	83		86	73	<0.001
Inconsistent 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)	None	13	10	<0.001	13	10	<0.001
	One	51	41		65	59	
	two	20	23		15	20	
	Three +	15	26		7	11	
Sex in Thailand last 12 months	Yes	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	

[1]Alcohol intake of average 280 grams for men and 140 grams for women

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

	Young male heterosexual backpackers n=2,765				Young male heterosexual non-backpackers n=3,880			
	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		-		1		1	
≤ 25 years	1.12 (0.87,1.46)	0.375			1.40 (1.09,1.81)	0.009	1.46 (1.12,1.89)	0.005
Marital status								
Other	1		-		1		-	
Never married	1.45 (0.75,2.80)	0.264			1.37 (0.92,2.04)	0.118		
Current cigarette smoker								
No	1		-		1		-	
Yes	1.13 (0.88,1.47)	0.346			1.53 (1.18,1.97)	0.001		
Excess alcohol[1]								
No	1		-		1		1	
Yes	1.35 (0.98,1.85)	0.063			2.03 (1.31,3.15)	0.002	1.65 (1.04,2.61)	0.033
Reason for presentation								
Other reasons	1		1		1		1	
HIV/STI test	0.95 (0.68,1.32)	0.760	0.91 (0.64,1.28)	0.579	0.67 (0.48,0.92)	0.014	0.62 (0.44,0.86)	0.005
Ano-genital symptoms	1.03 (0.74,1.43)	0.854	0.95 (0.68,1.33)	0.763	0.99 (0.73,1.33)	0.923	0.93 (0.68,1.26)	0.635
STI contact	3.10 (1.92,4.93)	<0.001	2.95 (1.82,4.77)	<0.001	3.24 (2.16,4.87)	<0.001	3.69 (2.42,5.65)	<0.001
Number of sex partners (past 3 months)								
0 or 1	1		1		1		1	
2	1.81 (1.31,2.51)	<0.001	1.69 (1.22,2.35)	0.002	2.09 (1.53,2.85)	<0.001	2.11 (1.53,2.91)	<0.001
3 or more	2.21 (1.63,3.00)	<0.001	2.06 (1.22,2.35)	<0.001	3.18 (2.34,4.31)	<0.001	3.03 (2.20,4.18)	<0.001
Condom use (past 3 months)								
Consistent (always)	1		1		1		1	
Inconsistent	3.17 (2.20,4.57)	<0.001	2.71 (1.87,3.93)	<0.001	2.37 (1.70,3.31)	<0.001	1.94 (1.38,2.74)	<0.001
Past chlamydia diagnosis								
No	1		-		1			
Yes	1.13 (0.80,1.59)	0.500			1.73 (1.21,2.48)	0.003	1.50 (1.03,2.18)	0.034

[1]Alcohol intake of average 280 grams for men and 140 grams for women

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

	Young female heterosexual backpackers n=2,937				Young female heterosexual non-backpackers n=3,376			
	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				1			
≤ 25 years	1.30 (0.95,1.79)	0.106	-		1.37 (0.98,1.91)	0.065	-	
Marital status								
Other	1				1			
Never married	1.27 (0.70,2.32)	0.434	-		1.48 (0.92,2.36)	0.104	-	
Current cigarette smoker								
No	1				1		-	
Yes	1.17 (0.87,1.58)	0.304	-		1.39 (0.99,1.93)	0.0504		
Excess alcohol [1]								
No	1				1			
Yes	1.17 (0.85,1.62)	0.331	-		1.54 (1.01,2.34)	0.043	-	
Reason for presentation								
Other	1		1		1		1	
STI contact	2.54 (1.58,4.08)	<0.001	2.37 (1.47,3.82)	<0.001			3.54 (2.18,5.74)	<0.001
Number of sex partners (past 3 months)								
0 or 1	1		1		1		1	
2	1.25 (0.86,1.81)	0.243	1.17 (0.80,1.71)	0.413	1.57 (1.02,2.42)	0.004	1.48 (0.95,2.30)	0.079
3 or more	2.07 (1.38,3.11)	<0.001	1.89 (1.25,2.86)	0.003	3.05 (1.93,4.80)	<0.001	3.00 (1.89,4.77)	<0.001
Condom use (past 3 months)								
Consistent (always)	1		1		1		1	
Inconsistent	2.50 (1.68,3.72)	<0.001	2.33 (1.56,3.48)	-	2.00 (1.30,3.10)	0.002	1.78 (1.14,2.76)	0.011
Past chlamydia diagnosis								
No	1		-		1		-	
Yes	1.32 (0.87,1.99)	0.192		-	1.28 (0.75,2.18)	0.362		

[1]Alcohol intake of average 280 grams for men and 140 grams for women

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

Variable	**Backpacker**	**Non-backpacker**
	PAR% (95% CI)	**PAR% (95% CI)**
Males: all factors combined	**0.88 (0.81,0.93)**	**0.76 (0.70,0.82)**
Condom not used consistently, past 3 months	0.65 (0.56,0.71)	0.50 (0.41,0.56)
2 or more sexual partners, past 3 months	0.33 (0.28,0.40)	0.36 (0.32,0.41)
Known STI contact	0.08 (0.07,0.09)	0.10 (0.09,0.12)
Past chlamydia diagnosis	0.02 (0.01,0.03)	0.07 (0.06,0.08)
Females: all factors combined	**0.73 (0.67,0.79)**	**0.68 (0.58,0.76)**
Condom not used consistently, past 3 months	0.51 (0.42,0.59)	0.41 (0.31,0.51)
2 or more sexual partners, past 3 months	0.14 (0.11,0.18)	0.30 (0.25,0.37)
Known STI contact	0.08 (0.07,0.10)	0.12 (0.09,0.15)
Past chlamydia diagnosis	0.04 (0.03,0.05)	0.03 (0.02,0.04)

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Population attributable risk for chlamydia in young international ~~travelers~~travellers (backpackers) and residents in Australia

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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 behavior and other potential risk factors on chlamydia positivity in young heterosexual international travellers (backpackers) and Australian residents aged <30 years 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~~ not always using condom ~~use~~ in the past 3 months was 65% (95%CI:0.56,0.71) in backpackers compared to 50% (95%CI:0.41,0.56) in non-backpackers and the PAR associated with reporting 2 or more female sexual partners in the past 3 months was similar between male backpackers and non-backpackers; 33% (95%CI:28-40%) and 36% (95%CI:32-41%), respectively. In females, the PAR associated with not always using ~~inconsistent~~ condom ~~use~~ in the past 3 months was 51% (95%CI: 42-59%) in backpackers compared to 41% (95%CI:31-51%) in non-backpackers, and the PAR associated with reporting 2 or more male sexual partners in the past 3 months was 14% (95%CI:11-18%) in backpackers compared to 30% (95%CI:25-37) 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 should be included in health promotion strategies.

Article Summary

Article Focus:

- Risk factors for chlamydia infection were determined among young, heterosexual backpackers and Australian residences.
- A naval 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 with condom use regardless of the backpacker's status.
- Multiple sex partners in past 3 months was also determined to be a significant predictor and associated with high proportion of chlamydia infections at the population level.

Strengths and limitations

- This is the first study to investigate the impacts of sexual risk behaviors for chlamydia infection at the population level.
- Study population is the sexual health clinic attendees therefore they are likely to be at higher risk for chlamydia

infection compared to the general population.

Introduction

Australia remains a popular destination among young international ~~travelers~~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 minorities of each group reported ~~consistent~~ not always using condom ~~use~~ in the previous 3 months, though 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% report ~~inconsistent~~ not always using condom ~~use~~ with casual partners [5-7]. In response, there have been social marketing campaigns aimed at raising awareness about condom use and chlamydia screening among young people [7-9], including with more targeted campaigns for ~~travelers~~travellers.

Understanding the risk associated with various sexual behaviours and other factors ~~are~~ is important to ensure health promotion strategies are evidence-based and appropriately targeted. Although odds ratios (ORs) ~~may be well suited to the assessment of causality, they~~ 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 OR 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 (2007) [~~15~~10] and Wand (2009) [~~16~~11] that adjusts for the effects of other variables.

METHODS

~~Study population~~

Setting

Sydney Sexual Health Clinic is a large urban public sexual health clinic in close proximity to the the city and beach areas of Sydney which are popular destinations for backpackers. ~~The study population consisted of 12,958 young heterosexual men and women aged 18-30 years who visited the Sydney Sexual Health Centre (SSHC) for the first time during the period of 1998 – 2006 [2]~~.

~~A patient registration form which captures d~~Demographic and behavioural data including alcohol and drug use, sex work, sex overseas, sexual behaviour and the reason for attending to the clinic~~.~~ ~~These data are~~ were entered into a computerised medical records system. All new attendees were offered a test for *C trachomatis* by PCR.

Definitions

Heterosexual was defined as sex with the opposite sex only in the past 12 months. Backpacker was defined as having been born outside of Australia, lived outside of Australia for most of the last 5 years and been in Australia for less than 2 years; or to self identify as a 'traveler'. Non-backpackers included all other attendees who were less than 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 [~~17~~12]. Current sex workers and students ~~The following participants were~~ were excluded from both groups. ~~; current sex workers, students and men reporting sex with men in the past year [2].~~

Statistical analysis

Chlamydia positivity was calculated by 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

~~We used the method described by Spiegelman [15] and Wand [16] to estimate the PAR. Briefly,~~ PAR quantifies the potential impact of a risk factor on disease occurrence in the population [10,11]. ~~We estimated the *PAR* for each risk factor and combinations of risk factors.~~ The PAR is formulated as a function of odds ratio (*OR*) (s) and the prevalence (*p*) (s) of the risk factor(s). When there is only one risk factor at two levels (1 versus 0)

$$\text{PAR} = \frac{p(OR-1)}{p(OR-1)+1} = 1 - \frac{1}{\sum_{s=1}^{2} p_s OR_s} \quad (1)$$

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 generalized to the multi-factorial setting when there are more than one risk factors at multiple levels, as

$$\text{PAR} = \frac{\sum_{s=1}^{S} p_s(OR_s - 1)}{1 + \sum_{s=1}^{S} p_s(OR_s - 1) + 1} = 1 - \frac{1}{\sum_{s=1}^{2} p_s OR_s} \qquad (2)$$

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 percent reduction expected in the number of HIV seroconversion if all the 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 interests. In an evaluation of a preventive intervention in a multifactorial disease setting, the interest is in the percent of cases associated with the exposures to be modified, when other risk factors, particularly non-modifiable, exist but do not change as a result of the intervention. Therefore we derived and used 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

$$\text{PAR} = \frac{\sum_{s=1}^{S}\sum_{t=1}^{T} p_{st} OR_{1s} OR_{2t} - \sum_{s=1}^{S}\sum_{t=1}^{T} p_{st} OR_{2t}}{\sum_{s=1}^{S}\sum_{t-1}^{T} p_{st} OR_{1s} OR_{2t}} = 1 - \frac{\sum_{t=1}^{T} p_{\bullet t} OR_{2t}}{\sum_{s=1}^{S}\sum_{t=1}^{T} p_{st} OR_{1s} OR_{2t}} \qquad (3)$$

where t denotes a stratum of unique combinations of levels of all background risk factors which are not modifiable and/or not under study, $t = \ ,\ldots,T$ and OR_{2t} is the odds ratio in combination t relative to the lowest risk level, where $OR_{2,1}$ =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, $s = \ ,\ldots,S$, and OR_{1s} is the relative risk 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 $p_{.t} = \Sigma_{s=}^{S} p_{st}$. 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 relative risk 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. The PAR adjusts for the effects of other variables and assumes non-modifiable risk factors are unchanged (e.g. age, sex).

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

RESULTS

There were 12,958 heterosexuals aged 18-30 years who attended SSHC for the first time during the period 1998-2006; 5,702 (44%) were backpackers and this proportion increased steadily over time from 36% in 1998 to 52% in 2006 ~~($p<0.001$)~~.

Prevalence of risk factors

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 (58% vs 42%), had never married (94% vs 85%), were unemployed (27% vs 13%), ~~a~~ were current smokers (39% vs 34%), reported excess alcohol consumption (17% vs 5%), reported 3 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 diagnoses (15% vs 10%) and stated that the reason for presenting to the clinic was for a STI/HIV screen (41% vs 36%) (Table 1). The same proportion of male backpackers and non-backpackers reported ~~inconsistent~~ not always using condom ~~use~~ in the past three months (69%)[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%), ~~a~~ 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 diagnoses (13% vs 9%) and stated that the reason for presenting to the clinic was for a STI/HIV screen (24% vs 32%) (Table 1). A significantly lower proportion of female backpackers reported ~~inconsistent~~ not always using condom ~~use~~ in the past three months (69%) compared to female non-backpackers (72%, 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% Confidence Interval (CI):~~5~~3.6%-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%-7%) in 1998 to 12% (95% CI: 10%-14%) in 2006 ($p<0.001$) and also in non-backpackers; from 3% (95%CI: 2%-4%) in 1998 to 8% (95%CI: 6%-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:1.12-1.89), excess alcohol intake (AOR~~]=~~ =1.65, 95%CI:1.04-2.61), ~~inconsistent~~ not always using condom ~~use~~ (AOR=1.94, 95%CI:1.38-2.74), reporting 2 (AOR=2.11, 95% CI:1.53-2.91) or 3 or more sexual partners in the past 3 months (AOR=3.03, 95%CI:2.20,4.18); known sexually transmissible infection (STI) contact (AOR=3.69, 95%CI:2.42-5.65), and a past chlamydia diagnosis (AOR=1.50, 95%CI:1.03-2.18). Male backpackers had the same independent predictors of chlamydia positivity except~~, though~~ age, excess alcohol intake and past chlamydia diagnosis ~~was not significant on multivariate analysis~~ (Table 2).

Females

In female non-backpackers, independent predictors of chlamydia positivity were not always using ~~inconsistent~~ condom ~~use~~ (AOR=1.78, 95%CI: 1.14-2.76); reporting 3 or more sexual partners in the past 3 months (AOR=3.00, 95%CI:1.89-4.77); and known STI contact (AOR=3.54, 95%CI:2.18-

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 ~~gender~~ sex and backpacker status are shown in Table 4. In males, not always using ~~inconsistent~~ condom ~~use~~ was associated with the highest PAR, with 65% (95% CI: 0.56-0.71) of the chlamydia cases attributed to this risk factor among backpackers and ~~48~~50% (95%CI: 0.41-0.56) of the cases in non-backpackers. In females, ~~inconsistent~~ not always using condom ~~use~~ was ~~attributed to~~associated with 51% (95%CI:0.42-0.59) of the chlamydia cases among backpackers and 41% (95%CI:0.31-0.51) of the cases in non-backpackers.

Two or more sexual partners in the past 3 months had the second highest PAR, with an estimated 33% (95%CI:0.28-0.40) of the chlamydia cases among male backpackers and 36% (95% CI: 0.32-0.41) in male non-backpackers attributable to this risk factor. In females, 2 or more sexual partners in the past 3 months was attributed with an estimated 14% (95%CI: 0.11-0.18) of the chlamydia cases among backpackers and 30% (95%CI:25-37) of cases in non-backpackers.

When two factors were combined (~~inconsistent~~ not always using condom ~~use~~ and having 3 or more partners in the past 3 months) the estimated PAR was 81% (95% CI: 0.73, 0.86) in male backpackers and 71% (95% CI: 0.65, 0.77) in non-backpackers. In females, the estimated PAR for these two combined risk factors was 66% (95% CI: 0.54, 0.76) and 63% (95% CI: 0.53, 0.73) among female backpackers and non-backpackers, respectively.

When all four factors were combined (~~inconsistent~~ not always using condom ~~use~~ in the past 3 months, having 3 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

PARs that illustrate the impact of risk factors for a disease at a population level ~~has~~ have important implications for prevention policy and practice. In this study we have shown that ~~at~~ the majority of chlamydia cases in our clinical population were attributable to ~~inconsistent~~ not always using condom ~~use~~ and multiple sexual partners in the past 3 months. In both males and females, ~~inconsistent~~ not always using condom ~~use~~ was associated with a greater PAR in backpackers compared to non-backpackers. Conversely in females, reporting 3 or more male sexual partners in the past 3 months was associated with a greater PAR in non-backpackers.

Notably, while both a known STI contact and a past chlamydia diagnosis were associated with a current chlamydial infection they only contributed PARs of 2% to 12% because they were relatively uncommon risk factors.

The PAR findings suggest that the largest number of chlamydia infections could be avoided by increasing ~~consistent~~ not always using condom ~~use~~. In Australia there have been numerous health promotion strategies involving social marketing in the past ten 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 [~~18~~13,~~19~~14]. Internationally, most mass media interventions have no effect ~~of~~ on condom use [~~20-22~~15-17]. Our analysis also showed that multiple partners in the past 3 months was a frequently reported risk behavior 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 increasing testing and treatment. With widespread use of the internet and mobile phone, electronic-based health promotion may be more effective at changing sexual and health-care seeking behavior. Lim and colleagues [~~23~~18] recently demonstrated in a ~~randomize~~randomised trial that sending health promotion messages via SMS increased self-reported condom use and STI testing rates compared to the control group. Also websites that enable young people to assess their individual risk of STIs based on the OR of a range of risk factors should be considered. In regards to travellers, approaches should be more targeted such as health promotion messages displayed in select pubs/clubs, backpacker hostels, domestic airport and in backpacker publications.

If a health department is considering spending money on controlling chlamydia, 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 ~~diagnoses~~ diagnosis was significantly associated with chlamydia positivity, it's impact at a population level was about 5% due to relatively low prevalence of this risk factor compared to a PAR of 60% for ~~inconsistent~~ not always using 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~~. Sexual health clinic attendees~~ and ~~are~~ likely to be ~~include young people who are~~ at more at 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%,8.4%), which is lower than 6% chlamydia positivity in our clinic-based sample [19]. A community-based study of British backpackers found 41% of backpackers reported not always using condom, which is also lower than the 69% reported in both males and females in our clinic sample [7]. ~~Also, m~~Most of the risk factors examined were based on self-reported data and may be subject to recall and measurement bias, particularly a past chlamydia diagnosis Finally, it is likely that many of the chlamydia infections were acquired prior to 3 months preceding the visit to SSHC. ~~[24].~~

Several epidemiological studies determined the sub-groups of the populations 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, ~~this~~ current study is one of the first attempts at a comprehensive study of the population impacts 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 behavior. In addition, young people should be given information about the risk associated with multiple partners and new partners.

Authors Contributions:

HW implemented the study, analysed the data and wrote the first draft. RG, BD and AM helped interpreting the data and finalizing the manuscript. All authors saw and approved the final manuscript.

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Table 1: Characteristics in young heterosexual patients by sex and travel status, 1998-2006 (n=12,958)

		Young heterosexual males			Young heterosexual females		
Variable	Sub-category	Non-backpackers n=3,880 %	Backpackers n=2,765 %	p-value	Non-backpackers n=3,376 %	Backpackers n=2,937 %	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 countries	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
	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
	Currently smoker	34	39		36	42	
Hazardous alcohol[1]	Yes	5	17	<0.001	14	27	<0.001
	No	95	83		86	73	<0.001
~~Inconsistent~~ ~~C~~condom use (past 3 months)	~~Yes~~Always	69	69	0.889	72	69	0.006
	Not always	31	31		28	31	
Number of sex partners (past 3 months)	None	13	10	<0.001	13	10	<0.001
	One	51	41		65	59	
	two	20	23		15	20	
	Three +	15	26		7	11	
Sex ~~in Thailand~~overseas in last 12 months	~~Yes~~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	

[1]Alcohol intake of average 280 grams for men and 140 grams for women

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

	Young male heterosexual backpackers n=2,765				Young male heterosexual non-backpackers n=3,880			
	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		-		1		1	
≤ 25 years	1.12 (0.87,1.46)	0.375			1.40 (1.09,1.81)	0.009	1.46 (1.12,1.89)	0.005
Marital status								
Other	1		-		1		-	
Never married	1.45 (0.75,2.80)	0.264			1.37 (0.92,2.04)	0.118		
Current cigarette smoker								
No	1		-		1		-	
Yes	1.13 (0.88,1.47)	0.346			1.53 (1.18,1.97)	0.001		
Excess alcohol[1]								
No	1		-		1		1	
Yes	1.35 (0.98,1.85)	0.063			2.03 (1.31,3.15)	0.002	1.65 (1.04,2.61)	0.033
Reason for presentation								
Other reasons	1		1		1		1	
HIV/STI test	0.95 (0.68,1.32)	0.760	0.91 (0.64,1.28)	0.579	0.67 (0.48,0.92)	0.014	0.62 (0.44,0.86)	0.005
Ano-genital symptoms	1.03 (0.74,1.43)	0.854	0.95 (0.68,1.33)	0.763	0.99 (0.73,1.33)	0.923	0.93 (0.68,1.26)	0.635
STI contact	3.10 (1.92,4.93)	<0.001	2.95 (1.82,4.77)	<0.001	3.24 (2.16,4.87)	<0.001	3.69 (2.42,5.65)	<0.001
Number of sex partners (past 3 months)								
0 or 1	1		1		1		1	
2	1.81 (1.31,2.51)	<0.001	1.69 (1.22,2.35)	0.002	2.09 (1.53,2.85)	<0.001	2.11 (1.53,2.91)	<0.001
3 or more	2.21 (1.63,3.00)	<0.001	2.06 (1.22,2.35)	<0.001	3.18 (2.34,4.31)	<0.001	3.03 (2.20,4.18)	<0.001
Condom use (past 3 months)								
~~Consistent (~~ Aalways~~)~~	1		1		1		1	
~~Inconsistent~~Not always	3.17 (2.20,4.57)	<0.001	2.71 (1.87,3.93)	<0.001	2.37 (1.70,3.31)	<0.001	1.94 (1.38,2.74)	<0.001
Past chlamydia diagnosis								
No	1		-		1			
Yes	1.13 (0.80,1.59)	0.500			1.73 (1.21,2.48)	0.003	1.50 (1.03,2.18)	0.034

[1]Alcohol intake of average 280 grams for men and 140 grams for women

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

	Young female heterosexual backpackers n=2,937				Young female heterosexual non-backpackers n=3,376			
	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				1			
≤ 25 years	1.30 (0.95,1.79)	0.106	-		1.37 (0.98,1.91)	0.065	-	
Marital status								
Other	1				1			
Never married	1.27 (0.70,2.32)	0.434	-		1.48 (0.92,2.36)	0.104	-	
Current cigarette smoker								
No	1				1		-	
Yes	1.17 (0.87,1.58)	0.304	-		1.39 (0.99,1.93)	0.0504		
Excess alcohol [1]								
No	1				1			
Yes	1.17 (0.85,1.62)	0.331	-		1.54 (1.01,2.34)	0.043	-	
Reason for presentation								
Other	1		1		1		1	
STI contact	2.54 (1.58,4.08)	<0.001	2.37 (1.47,3.82)	<0.001			3.54 (2.18,5.74)	<0.001
Number of sex partners (past 3 months)								
0 or 1	1		1		1		1	
2	1.25 (0.86,1.81)	0.243	1.17 (0.80,1.71)	0.413	1.57 (1.02,2.42)	0.004	1.48 (0.95,2.30)	0.079
3 or more	2.07 (1.38,3.11)	<0.001	1.89 (1.25,2.86)	0.003	3.05 (1.93,4.80)	<0.001	3.00 (1.89,4.77)	<0.001
Condom use (past 3 months)								
~~Consistent (~~ always~~)~~	1		1		1		1	
~~Inconsistent~~Not always	2.50 (1.68,3.72)	<0.001	2.33 (1.56,3.48)	-	2.00 (1.30,3.10)	0.002	1.78 (1.14,2.76)	0.011
Past chlamydia diagnosis								
No	1		-		1		-	
Yes	1.32 (0.87,1.99)	0.192		-	1.28 (0.75,2.18)	0.362		

[1]Alcohol intake of average 280 grams for men and 140 grams for women

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

Variable	Backpacker	Non-backpacker
	PAR% (95% CI)	**PAR% (95% CI)**
Males: all factors combined	**0.88 (0.81,0.93)**	**0.76 (0.70,0.82)**
Condom not used ~~consistently~~always, past 3 months	0.65 (0.56,0.71)	0.50 (0.41,0.56)
2 or more sexual partners, past 3 months	0.33 (0.28,0.40)	0.36 (0.32,0.41)
Known STI contact	0.08 (0.07,0.09)	0.10 (0.09,0.12)
Past chlamydia diagnosis	0.02 (0.01,0.03)	0.07 (0.06,0.08)
Females: all factors combined	**0.73 (0.67,0.79)**	**0.68 (0.58,0.76)**
Condom not used ~~consistently~~always, past 3 months	0.51 (0.42,0.59)	0.41 (0.31,0.51)
2 or more sexual partners, past 3 months	0.14 (0.11,0.18)	0.30 (0.25,0.37)
Known STI contact	0.08 (0.07,0.10)	0.12 (0.09,0.15)
Past chlamydia diagnosis	0.04 (0.03,0.05)	0.03 (0.02,0.04)

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Population attributable risk for chlamydia in young international travellers (backpackers) and residents in Australia

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

- This is the first study to investigate the potential impact of sexual risk behaviors for chlamydia infection at the population level.

- The study population was sexual health clinic attendees and 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, though 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 (2007) [10] and Wand (2009) [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 to the clinic are collected and entered into a computerised medical records system. All new attendees are offered a test for *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 of Australia, lived outside of Australia for most of the last 5 years and been in Australia for less than 2 years; or to self identify as a 'traveler'. 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.

Statistical analysis

Chlamydia positivity was calculated by 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) (s) and the prevalence (p) (s) of the risk factor(s). When there is only one risk factor at two levels (1 versus 0)

$$\text{PAR} = \frac{p(OR-1)}{p(OR-1)+1} = 1 - \frac{1}{\sum_{s=1}^{2} p_s OR_s} \qquad (1)$$

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 generalized to the multi-factorial setting when there are more than one risk factors at multiple levels, as

$$\text{PAR} = \frac{\sum_{s=1}^{S} p_s(OR_s-1)}{1+\sum_{s=1}^{S} p_s(OR_s-1)} = 1 - \frac{1}{\sum_{s=1}^{2} p_s OR_s} \qquad (2)$$

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 percent reduction expected in the number of HIV seroconversion if all the 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 interests. In an evaluation of a preventive intervention in a multifactorial disease setting, the interest is in the percent of cases associated with the exposures to be modified, when other risk factors, particularly non-modifiable, exist but do not change as a result of the intervention. Therefore we derived and used 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

$$\text{PAR} = \frac{\sum_{s=1}^{S}\sum_{t=1}^{T} p_{st}OR_{1s}OR_{2t} - \sum_{s=1}^{S}\sum_{t=1}^{T} p_{st}OR_{2t}}{\sum_{s=1}^{S}\sum_{t-1}^{T} p_{st}OR_{1s}OR_{2t}} = 1 - \frac{\sum_{t=1}^{T} p_{\bullet t}OR_{2t}}{\sum_{s=1}^{S}\sum_{t=1}^{T} p_{st}OR_{1s}OR_{2t}} \qquad (3)$$

where t denotes a stratum of unique combinations of levels of all background risk factors which are not modifiable and/or not under study, $t = \ ,\dots,T$ and OR_{2t} is the odds ratio in combination t relative to the lowest risk level, where $OR_{2,1}$ =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, $s = \ ,\dots,S$, and OR_{1s} is the relative risk 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 $p_{.t} = \Sigma_{S=}^{S} \ p_{st}$. 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 relative risk 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, version 9 (SAS Institute Inc, Cary, NC). Ethical approval for the study was obtained from the South Eastern Sydney and Illawarra Area Health Service Human Research Ethics Committee.

RESULTS

There were 12,958 heterosexuals aged 18-30 years who attended SSHC for the first time during the period 1998-2006; 5,702 (44%) were backpackers and this proportion increased steadily over time from 36% in 1998 to 52% in 2006.

Prevalence of risk factors

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 smoker s (39% vs 34%), reported excess alcohol consumption (17% vs 5%), reported 3 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 STI/HIV screen (41%

vs 36%) (Table 1). The same proportion of male backpackers and non-backpackers inconsistent condom in the past three months (69%)[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 a STI/HIV screen (34% vs 32%) (Table 1). A significantly lower proportion of female backpackers reported inconsistent condom use in the past three months (69%) compared to female non-backpackers (72%, 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% Confidence Interval (CI):3.6 %-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%-7%) in 1998 to 12% (95% CI: 10%-14%) in 2006 (p<0.001) and also in non-backpackers; from 3% (95%CI: 2%-4%) in 1998 to 8% (95%CI: 6%-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:1.12-1.89), excess alcohol intake (AOR =1.65, 95%CI:1.04-2.61), inconsistent condom use (AOR=1.94, 95%CI:1.38-2.74), reporting 2 (AOR=2.11, 95% CI:1.53-2.91) or 3 or more sexual partners in the past 3 months (AOR=3.03, 95%CI:2.20,4.18); known sexually transmissible infection (STI) contact (AOR=3.69, 95%CI:2.42-5.65), and a past chlamydia diagnosis (AOR=1.50, 95%CI:1.03-2.18). 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: 1.14-2.76); reporting 3 or more sexual partners in the past 3 months (AOR=3.00, 95%CI:1.89-4.77); and known STI contact (AOR=3.54, 95%CI:2.18-5.74). 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: 56-71%) of the chlamydia cases attributed to this risk factor among backpackers and 50% (95%CI: 41-56%) of the cases in non-backpackers. In females, inconsistent condom use was associated with 51% (95%CI: 42-59%) of the chlamydia cases among backpackers and 41% (95%CI: 31-51%) of the cases in non-backpackers.

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

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

When all four factors were combined (inconsistent condom use, having 3 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, measures through - PAR has important implications for prevention policy and practice. In this study we have shown that the majority of chlamydia cases in our clinical 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 3 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 a STI was associated with a current chlamydia diagnosis they only contributed a PAR of 2% because it was 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 ten 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 behavior 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 increasing testing and treatment. With widespread use of the internet and mobile phone, electronic-based health promotion may be more effective at changing sexual and health-care seeking behavior. 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 the 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. In regards to travellers, approaches should be targeted and include health promotion messages displayed in select pubs/clubs, backpacker hostels, domestic airport and in backpacker publications.

If a health department is considering spending money on controlling chlamydia, 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, it's impact at a population level was about 5% due to 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 more at 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: 1.2-8.4%), which is lower than 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 a past chlamydia diagnosis Finally, it is likely that many of the chlamydia infections were acquired prior to 3 months preceding the visit to SSHC. Several epidemiological studies determined the sub-groups of the populations 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 behavior. In addition, young people should be given information about the risk associated with multiple partners and new partners.

Authors Contributions:

HW implemented the study, analysed the data and wrote the first draft. RG, BD and AM helped interpreting the data and finalizing the manuscript. All authors saw and approved the final manuscript.

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Table 1: Characteristics in 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=3,880 %	Backpackers n=2,765 %	p-value	Non-backpackers n=3,376 %	Backpackers n=2,937 %	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[1]	Yes	5	17	<0.001	14	27	<0.001
	No	95	83		86	73	<0.001
Condom use (past 3 months)	Always	69	69	0.889	72	69	0.006
	Inconsistent	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	

[1]Alcohol intake of average 280 grams for men and 140 grams for women

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

	Young male heterosexual backpackers n=2,765				Young male heterosexual non-backpackers n=3,880			
	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		-		1		1	
≤ 25 years	1.12 (0.87,1.46)	0.375			1.40 (1.09,1.81)	0.009	1.46 (1.12,1.89)	0.005
Marital status								
Other	1		-		1		-	
Never married	1.45 (0.75,2.80)	0.264			1.37 (0.92,2.04)	0.118		
Current cigarette smoker								
No	1		-		1		-	
Yes	1.13 (0.88,1.47)	0.346			1.53 (1.18,1.97)	0.001		
Excess alcohol[1]								
No	1		-		1		1	
Yes	1.35 (0.98,1.85)	0.063			2.03 (1.31,3.15)	0.002	1.65 (1.04,2.61)	0.033
Reason for presentation								
Other reasons	1		1		1		1	
HIV/STI test	0.95 (0.68,1.32)	0.760	0.91 (0.64,1.28)	0.579	0.67 (0.48,0.92)	0.014	0.62 (0.44,0.86)	0.005
Ano-genital symptoms	1.03 (0.74,1.43)	0.854	0.95 (0.68,1.33)	0.763	0.99 (0.73,1.33)	0.923	0.93 (0.68,1.26)	0.635
Known STI contact	3.10 (1.92,4.93)	<0.001	2.95 (1.82,4.77)	<0.001	3.24 (2.16,4.87)	<0.001	3.69 (2.42,5.65)	<0.001
Number of sex partners (past 3 months)								
0 or 1	1		1		1		1	
2	1.81 (1.31,2.51)	<0.001	1.69 (1.22,2.35)	0.002	2.09 (1.53,2.85)	<0.001	2.11 (1.53,2.91)	<0.001
3 or more	2.21 (1.63,3.00)	<0.001	2.06 (1.22,2.35)	<0.001	3.18 (2.34,4.31)	<0.001	3.03 (2.20,4.18)	<0.001
Condom use (past 3 months)								
Always	1		1		1		1	
Inconsistent	3.17 (2.20,4.57)	<0.001	2.71 (1.87,3.93)	<0.001	2.37 (1.70,3.31)	<0.001	1.94 (1.38,2.74)	<0.001
Past chlamydia diagnosis								
No	1		-		1			
Yes	1.13 (0.80,1.59)	0.500			1.73 (1.21,2.48)	0.003	1.50 (1.03,2.18)	0.034

[1]Alcohol intake of average 280 grams for men and 140 grams for women

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

	Young female heterosexual backpackers n=2,937				Young female heterosexual non-backpackers n=3,376			
	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				1			
≤ 25 years	1.30 (0.95,1.79)	0.106	-		1.37 (0.98,1.91)	0.065	-	
Marital status								
Other	1				1			
Never married	1.27 (0.70,2.32)	0.434	-		1.48 (0.92,2.36)	0.104	-	
Current cigarette smoker								
No	1				1		-	
Yes	1.17 (0.87,1.58)	0.304	-		1.39 (0.99,1.93)	0.0504		
Excess alcohol [1]								
No	1				1			
Yes	1.17 (0.85,1.62)	0.331	-		1.54 (1.01,2.34)	0.043	-	
Reason for presentation								
Other	1		1		1		1	
Known STI contact	2.54 (1.58,4.08)	<0.001	2.37 (1.47,3.82)	<0.001			3.54 (2.18,5.74)	<0.001
Number of sex partners (past 3 months)								
0 or 1	1		1		1		1	
2	1.25 (0.86,1.81)	0.243	1.17 (0.80,1.71)	0.413	1.57 (1.02,2.42)	0.004	1.48 (0.95,2.30)	0.079
3 or more	2.07 (1.38,3.11)	<0.001	1.89 (1.25,2.86)	0.003	3.05 (1.93,4.80)	<0.001	3.00 (1.89,4.77)	<0.001
Condom use (past 3 months)								
Always	1		1		1		1	
Not consistent	2.50 (1.68,3.72)	<0.001	2.33 (1.56,3.48)	<0.001	2.00 (1.30,3.10)	0.002	1.78 (1.14,2.76)	0.011
Past chlamydia diagnosis								
No	1		-		1		-	
Yes	1.32 (0.87,1.99)	0.192		-	1.28 (0.75,2.18)	0.362		

[1]Alcohol intake of average 280 grams for men and 140 grams for women

Table 4: PAR% [95% confidence interval (CI)] for **genital chlamydia infection** in young heterosexuals by backpacker status

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