Prevalence of Chlamydia trachomatis infection in Samoan women aged 18-29 and assessment of associated factors - a population based study

Report for NZAID

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Authorship note

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1. Executive Summary

This is the first study to assess the prevalence of genital *Chlamydia trachomatis* (CT) infection and associated factors for infection among women in Samoa. This project aimed to estimate the prevalence of CT in sexually active Samoan women aged between 18 and 29 years, and evaluate the association between CT infection and infertility and other risk factors. A population-based country-wide cross-sectional survey was conducted, using a two-stage cluster and random selection sampling technique, to describe the prevalence of CT infection and the patterns of sexual behaviour and fertility amongst sexually active Samoan women aged 18 to 29 years. Associations were explored for various possible risk factors.

Overall the prevalence of CT infection within the study population of 18-29 year old females living in Samoa was 36.0%. A higher prevalence of CT infection was observed within the 18-24 year age group compared with the 25-29 year age group. Those women who were single were more likely to be CT infected than those who were in an established partnership or marriage relationship (OR 1.92; 95% CI, 1.02-3.62). While younger age at first intercourse was not significantly associated with higher likelihood of CT infection, increasing numbers of sexual partners was: those with two or more (OR 2.89, 1.03-8.06) and those with three or more lifetime sexual partners (OR 3.07; 1.19-7.67) were at increased risk of CT infection. Of note, those women who reported only one sexual partner still had a CT infection prevalence of 27.6%, suggesting that male sexual behaviour is very important in Samoa with respect to CT infection. Those women who reported having a past pregnancy were significantly less likely than nulliparous women to have CT infection (OR 0.49; 0.27-0.87).

No significant associations were identified between CT infection and education level, alcohol consumption, and smoking.

The findings identify a high prevalence of CT infection in sexually active Samoan women aged 18-29 years, similar to that observed within the limited antenatal studies already undertaken in Samoa. In addition, the study has provided data on risk factors for CT infection in Samoa, which are similar to those found elsewhere.

2. Recommendations

The following are preliminary recommendations for stakeholders arising from this report:

1. Considering that *Chlamydia* infection can be treated with a single dose of Azithromycin, and with such high rates of infection in Samoa, we recommend that a meeting is organised of national stakeholders and international experts to consider options for intervention. Potential interventions could include a mass treatment campaign, but this would need considerable thought before implementation and would need rigorous planning and monitoring.

2. The results of this study should be used to provide bases for other public health interventions to prevent Sexually Transmitted Diseases in Samoa.

3. Further studies should be considered in the following groups:

    a. Males, noting that the findings of this study indicate male sexual behaviour is, as one would expect, a significant factor in female risk.

    b. Other age groups, to obtain a full understanding of age-specific rates of *Chlamydia* infection.

4. The results of this study could contribute to an integrated understanding of, and approach to, Sexually Transmitted Diseases in Samoa, including the threat of HIV.

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3. Aims

This project aimed to estimate the prevalence of CT, sub-fertility and infertility in Samoan women aged between 18 and 29, and evaluate the association between CT infection and infertility and other risk factors. The specific objectives were to:

1. Use a population-based cross-sectional survey to describe the prevalence of CT infection amongst sexually active Samoan women aged 18 to 29 years.

2. Investigate the possible association between CT infection and sub-fertility and other risk factors in sexually active Samoan women aged 18 to 29 years.

4. Introduction

Genital *Chlamydia trachomatis* (CT) infections are the most common bacterial sexually transmitted diseases in the world [1]. Every year, approximately 101 million new cases of genital CT infection are diagnosed world-wide [1]. Sexually transmitted infections (STI) place a large burden on healthcare resources both directly, through individuals seeking treatment and care, and indirectly, from the management of the complications of untreated disease [2]. In addition, sexually transmitted infections, such as that due to CT infection, are the main preventable cause of female reproductive sequelae [3, 4] and there is widespread concern as to the influence that untreated CT infection may be having on rates of female infertility [5].

Despite advances in detection and treatment, many CT infections will go undetected and untreated simply due to a large proportion of infected individuals being asymptomatic and thus potentially not seeking medical intervention. Left untreated, the infection may ascend into the upper genital tract in females and cause pelvic inflammatory disease (PID) resulting in severe reproductive health sequelae such as an increased risk of ectopic pregnancy (EP) or tubal factor infertility (TFI). Untreated CT infection has been reported as the leading preventable cause of PID [4], with one World Health Organisation study documenting that world-wide, between 18-20% of infertile women are infected with CT [8]. In addition, untreated infections act as co-factors in the transmission of the human immunodeficiency virus (HIV) [6] and vertical transmission from mother to baby can result in health complications for the child including neonatal conjunctivitis and pneumonia [7].

Knowledge on the epidemiology of CT infections and reproductive health of women in Samoa and the Pacific region in general is very limited. Understanding the epidemiology of infection and associated reproductive health sequelae will allow targeted interventions to be established that aid in reducing the prevalence of CT infection. Targeted maternal health interventions will support the prevention of pelvic inflammatory disease, decreasing the maternal death toll related to EP, which without medical intervention can be fatal.

5. Systematic Reviews

5.1 Systematic review: prevalence of genital Chlamydia trachomatis infection both globally and within the Pacific

5.1.1 Background

Although CT is considered the most prevalent bacterial sexually transmitted infection worldwide, the true incidence and prevalence is unknown [9]. The World Health Organisation estimates that 101 million new CT infections occur worldwide each year [1]. Despite this, the majority of women with lower genital tract CT infections remain asymptomatic and therefore remain undiagnosed thus making accurate estimates difficult [9].

It is thought that the true prevalence of CT infection within a population is greater than that indicated by either clinic or laboratory data. This is true due to the asymptomatic nature of many infections. An exception exists where routine population based screening for CT has been established. The most reliable estimates of CT prevalence come from the numerous adhoc studies that have assessed prevalence within a defined population of a city or state within a country. A search of the literature reveals many studies where the prevalence of CT infection among females of reproductive age has been published. However, many are limited to small sample sizes or of high risk groups such as sex workers or from STI clinics, which would not be representative of the entire population. Very few countrywide prevalence studies exist outside of countries where surveillance and screening of CT infections has been established.

5.1.2 Objectives

To review the prevalence of CT infection both within the Pacific and globally through identifying country specific studies that have reported an estimate of CT prevalence among females of reproductive age and where the study setting is not a high risk population.

5.1.3 Selection criteria for inclusion of studies in the review

All cross-sectional studies were considered for review that reported a CT prevalence estimate, where the study setting was not of a high risk population, for example an STI clinic or of known drug users, and had a minimum sample size of 450 participants. Studies did not have to consist of a nationwide sample. All studies where a CT test was undertaken were included, including self collected mail-in specimens. Studies involving participants reporting a previous diagnosis without an actual test being undertaken within the study were excluded. The inclusion of antenatal based studies, although considered low risk for an STI, allowed a comparison of the prevalence of CT with that in the female population of Samoa where it was previously known that no population based studies have been undertaken.

5.1.4 Search strategy

EMBASE database 2000 – present and Ovid MEDLINE (R) 2000 – present were searched to identify cross-sectional studies that reported a prevalence of CT infection among females of reproductive age (15-45). The following search terms were used in varying combinations to achieve maximum sensitivity: "Chlamydia", "Chlamydia trachomatis", "prevalence", "cross sectional", "population", "population based", "antenatal", "random selection".

5.1.5 Methods

Abstracts and titles were first screened for the sample size, the age range of the study population, the study setting and whether a test for CT was undertaken. All those that met the reviews inclusion criteria were then placed into one of the following regions, Asia, the Americas, Oceania, Europe and the United Kingdom, or the Pacific Islands, according to the country the study was set in. Two studies were randomly chosen from within each region to report on within the review. An exception was made if the randomly selected study reported prevalence from two or more countries within its region. If this occurred then only one study was selected from within that region. A further exception was made within the Oceania region where an additional

study was selected to gauge a more accurate estimate of the local rates within this region. All prevalence results, excluding the Pacific Islands, are outlined in Table 1. The prevalence data from the Pacific and Samoa is reported in section 5.1.8.

5.1.6 Prevalence estimates

The overall prevalence of CT varied widely within all regions examined. Prevalence estimates from all regions are summarised in Table 1.

Oceania: Within New Zealand, one study was identified that aimed to assess the prevalence of CT infection in pregnant women. The study, undertaken by Lawton, et al [10] obtained data for women registered with a maternity care provider between 1999 and 2002 and matched this data with a community laboratory database for those that underwent a CT test. Overall, 2,482 CT tests were performed on antenatal mothers at the clinics, with those aged under 25 years having a CT prevalence of 12.2% and those aged 25 years or older having a prevalence of 2.3%. Lawton, et al. also measured the prevalence according to ethnicity, 12.5% of Pacific Island mothers within the study tested positive for CT.

One population and one antenatal based study were indentified that estimated the prevalence of CT in Australian women. Hocking, et al. [11] aimed to estimate the prevalence of CT infection in young women using mailed urine specimens for testing using PCR. Overall, 657 women provided a urine specimen. Among sexually active women aged 18 to 24 years, the prevalence of CT was 3.7% (95% CI: 1.2%-8.4%) and 0.2% (95% CI: 0.0%-1.1%) among 25 - 35 year olds. A further antenatal study carried out by Chen, et al. [12] estimated the prevalence of CT in 987 women aged between 16 and 25 years that attended four major public antenatal clinics across Melbourne. The prevalence of CT within the participants was 3.2% (95% CI: 1.8-5.9).

The Americas: Pinto, et al. [13] conducted a national cross-sectional study of parturient women aged 15 to 24 attending public hospitals in Brazil in 2009. A first void urine specimen was collected and screened for CT using PCR. A total of 2071 women provided a urine specimen with a CT prevalence of 9.8% (95% CI: 8.5-11.1). The study concluded that CT was high among young pregnant women in Brazil.

Beydoun, et al. [14] undertook a secondary analysis of the 1999-2006 USA National Health and Nutrition Examination Survey data which included laboratory data for urine tests for CT infection among those aged 20 to 39. The prevalence of CT within those aged 20 to 39 was 1.7%, with a higher prevalence observed in those aged less than 25 years (2.8%) compared with those aged 25 years or older (1.3%).

Africa: Within sub-Saharan Africa, Buve, et al. [15] compared the epidemiology of CT infection in Cameroon, Kenya and Zambia in females aged 15 to 49. Within four cities, two within Cameroon and one each in Kenya and Zambia, a random sample of approximately 1000 females was taken and urine samples provided for testing via PCR. Females aged 15 to 29 had the highest prevalence across all three countries examined with Cameroon having the highest (7.5%), followed by Kenya (7.0%), and Zambia (4.2%). However, within those aged 15 to 49 years, Cameroon had the highest overall rate of 5.4%, followed by Kenya (4.5%), and Zambia (2.9%).

Asia: Chen, et al. [16] undertook a cross-sectional study of CT prevalence among 502 pregnant females attending an antenatal clinic in Fuzhou, China. Vaginal and cervical swabs were taken and PCR undertaken to detect CT infection. Overall, 10.2% returned a positive CT result with those aged 25 years or under having a prevalence of 18.1% (95% CI: 13.3-24.2). Within those aged over 25 years, the prevalence of CT infection was 5.2% (95% CI: 3.2-8.2).

Joyee, et al. [17] undertook the first study to estimate the prevalence of CT infection within the general population of India . A cluster survey was undertaken of three districts within the state of Tamil Nadu that aimed to recruit females aged between 15 to 45 years. Urine samples were collected and tested using PCR. Overall, 841 females provided urine samples with the prevalence of CT infection among the group of 1.1% (95% CI: 0.5-1.7). With those aged 25 years or less, the prevalence of CT was 0.7% and 1.3% in those aged older than 25 years.

Europe and the United Kingdom: Within the United Kingdom, Macleod, et al. [18] undertook a cross-sectional study of randomly selected people aged 16 to 39 from general practice registers to assess the prevalence of CT infection. Self collection urine testing kits were mailed out, with 2,801 urine samples returned by female

participants for NAAT testing. Overall the prevalence of CT in females was 3.6% (95% CI: 3.1-4.9). Among females aged younger than 25 years, the prevalence of CT was 6.2% (95% CI: 5.2-7.8).

Within Europe, Goulet, et al. [19] undertook a population based survey in France to estimate the prevalence of CT infection among 18 to 44 year olds. A random sample of sexually experienced people were invited to participate through home sampling of urine samples for PCR analysis for CT infection. Overall, 1445 females returned urine specimens with the prevalence of CT infection being 1.6% (95% CI: 1.0-2.5). CT prevalence among the 18 to 29 year age group was 3.2% (95% CI: 2.0-5.3) and 0.5% (95% CI: 0.2-1.1) among the 30 to 44 year age group.

5.1.7 Discussion of global prevalence data

Ultimately, how representative the limited cross-sectional studies with an adequate sample size are of the actual prevalence rates within a country is difficult to ascertain. What is common across all studies, is the highest rates of CT infection in females is generally found during their most sexually active years, that is, between the ages of 15 and 35, with women becoming infected at a younger age than men [20].

Overall, the prevalence of CT infection varies widely between countries and age groups with the prevalence of infection predominantly higher within the young reproductive age range of 15 – 35. Despite enhanced methods to detect and treat CT infection, much of the worldwide burden of CT is observed in the less developed countries particularly Africa along with parts of Asia [6, 20], where diagnosis is difficult due to inadequate laboratory infrastructure to perform sensitive diagnostic tests [13]. Although developing countries harbour much of the burden, it is generally agreed that rates are increasing globally, including within developed countries [3, 21]. A proportion of the increase in the prevalence of infection is likely due to the increased usage and availability of more sensitive and non-invasive testing procedures, such as NAAT, improved sensitivity of diagnostic testing equipment, and screening programmes [22]. However, factors including changes in and an increase in risky sexual behaviour amongst young people, point to the likelihood of a true increase in the prevalence of CT infection [23] but this still remains unclear.

Table1: Summarised results of CT prevalence from eleven countries.

	Study setting	Age range	Sample size	Positive CT (Prevalence %)
New Zealand [10]	Antenatal	< 25	608	12.2
		≥ 25	1874	2.3
		Total	2482	4.8
Australia [11, 12]	Population	18 – 24	135	3.7
		25 – 35	489	0.2
	Antenatal	16 – 25	987	3.2
Brazil [13]	Antenatal	15 – 24	2071	9.8
Cameroon [15]	Population	15 – 29	*	7.5
		30 – 49	*	2.1
		15 – 49	1983	2.9
China [16]	Antenatal	≤ 25	193	18.1
		> 25	309	5.2
		Total	502	10.2
England [18]	Population	16 – 24	2132	6.1
		16 – 39	2801	3.6
France [19]	Population	18 – 24	106	3.6
		25 – 29	361	2.7
		30 – 34	140	0.6
		35 – 44	130	0.4
		18 – 44	1445	1.6
		18 – 29	737	3.2
India [17]	Population	15 – 20	106	*
		21 – 25	176	1.1
		26 – 30	206	1.5
		31 – 35	156	1.9
		36 – 40	111	0.9
		41 – 45	86	*

		15 – 45	841	1.1
Kenya [15]	Population	15 – 29	*	7.0
		30 – 49	*	0.5
		15 – 49	871	4.5
USA [14]	Population	< 25	853	2.8
		≥ 25	2311	1.3
		20 – 39	3164	1.7
Zambia[15]	Population	15 – 29	*	4.2
		30 – 49	*	0.5
		15 – 49	911	2.9

* Not reported in paper or able to be calculated from data in paper

5.1.8 Samoa and Pacific Island estimates of the prevalence of Chlamydial infection in females – including unpublished data

The Pacific: Estimates of the prevalence of CT infection in the Pacific have been limited to routine screening of antenatal women, along with hospital and clinic based antenatal studies. The most accurate estimate of the prevalence of CT infection in the Pacific comes from an antenatal surveillance survey commissioned by the Secretariat of the Pacific Community and the World Health Organisation between 2004 and 2005 [24]. The survey assessed the prevalence of CT infection, along with other sexually transmitted infections, in six Pacific Island countries namely Fiji, Kiribati, Samoa, Solomon Islands, Tonga, and Vanuatu. For each country, between 200 and 350 pregnant women aged between 15 and 44 that were attending antenatal clinics in each of the six countries, were recruited into the project. To test for STIs participants were asked to provide 10 to 15 mL of first catch urine which was then frozen and sent to the Royal Melbourne Hospital in Melbourne, Australia, for testing via NAAT. Of the 1678 pregnant women enrolled into the study throughout the Pacific, the most prevalent sexually transmitted infection was CT, with an overall prevalence of 26.1% in women aged under 25 and 11.9% in those women aged 25 and over [24]. Country specific rates of CT infection are shown in Table 2.

Table 2: CT infection given in percentage by Age Category of Pregnant Women in 6 Pacific Island countries 2004-2005 [24]

	<25 Years Old	≥25 Years Old	Total
Fiji	34.0	23.4	29.0
Kiribati	20.0	8.5	13.0
Samoa	40.7	17.5	26.8
Solomon Islands	7.3	5.7	6.4
Tonga	27.5	8.3	14.5
Vanuatu	19.7	7.3	13.2
Total	26.1	11.9	18.0

Samoa: The first study to assess rates of STIs in Samoa was carried out by the World Health Organisation between 1999 and 2000 [25]. The project relied on voluntary enrolment of women attending the antenatal clinic at the main hospital in Apia. Those that consented to enrolment were asked to provide a tampon swab that was later sent to Australia to test for CT infection. A total of 472 pregnant women were consecutively recruited into the Samoan study during the six month study period between October 1999 to April 2000. Of the total enrolled participants, 427 completed sample collection. Overall, 29.7% (95% CI: 25.4-34.1) of those providing a sample tested positive for CT infection. The highest prevalence was observed in those aged less than 25 with 42.9% returning a positive CT test. Age specific percentages of those testing positive for CT are shown in Table 3.

Table 3: Prevalence of CT by five year age group among pregnant women in Samoa between October 1999 and April 2000.

	Study Population size by age group	Number Positive CT	% positive of total age Group population
15-19	66	26	39.4
20-24	139	62	44.6
25-29	107	30	28.0
30-34	66	6	9.1
35-39	37	2	5.4
≥ 40	12	1	8.3
Total	427	127	29.7

The results of the Second Generation Antenatal Study undertaken in Samoa between 2004 and 2005 showed similar results to those observed during the 1999 to 2000 study. In total, 299 pregnant women attending their first routine antenatal visit at the Antenatal clinic at the main hospital in Apia were enrolled into the 2004 to 2005 study. CT infection in those aged under 25 was 40.7%, and 17.5% in those aged 25 and older. Overall, the prevalence of CT infection in pregnant mothers in Samoa was 26.8%. This prevalence in antenatal mothers in Samoa was second highest only to Fiji. In those aged under 25, the prevalence was highest in Samoa when compared with all other Pacific Island countries within the study. Traditionally, pregnant mothers are seen as a low risk population for contracting an STI [26]. The sample size in Samoa and demographics of those enrolled would suggest it may be largely representative of the entire population. With over one in four returning a positive result for CT infection in Samoa, this is of some concern for STI control in Samoa. The project concluded that CT infection is hyperendemic in pregnant women living in Samoa [27].

In 2009, local testing for sexually transmitted infections using NAAT became available in Samoa increasing the capacity for STI detection and treatment. Hospitals in both

Upolu and Savai'i along with local STI and private clinics were able to have samples processed within Samoa. Between July and December 2011, 2,739 total tests on females were undertaken for CT infection. Overall, 31.5% returned a positive CT result [28] Furthermore, 1,758 tests were undertaken in females aged between 15 and 29 with 38.6% testing positive for CT. Of the 2,739 tests performed between July and December 2011, 80% were from hospital patients and antenatal mothers with the remainder from private clinics and STI clinics. Table 4 displays the prevalence for females by five year age group of all CT tests performed at the main hospital in Apia between July and December 2011.

Table 4: Prevalence of CT in females by five year age group from all CT tests in Samoa between July and December 2011 [28].

Age Group	Total Tests	Number +CT	% Positive
15-19	351	165	47.0
20-24	785	321	40.9
25-29	622	192	30.9
30-34	404	74	18.3
35+	341	58	17.0
Unknown	236	52	22.0
Total	2739	862	31.5

With the availability of local testing, routine screening for CT was established, of all women attending the antenatal clinic at the main hospital in Apia and the hospital in Savai'i. Between July and December 2011, 1667 tests were performed on antenatal women with 33.3% returning a positive CT test [28]. Table 5 displays the prevalence for females by five year age group of antenatal CT tests between July and December 2011.

Table 5: Prevalence of CT in females by five year age group of all antenatal tests undertaken in Samoa between July and December 2011 [28].

Age Group	Total Tests	Number +CT	% +CT
15-19	210	105	50.0
20-24	523	208	39.8
25-29	387	147	38.0
30-34	251	45	17.9
35+	233	28	12.0
Unknown	258	21	36.2
Total	1662	555	33.4

5.2 Systematic Review - Risk factors for *Chlamydial* infection in females

5.2.1 Background

Risk factors for contracting genital CT infection in females are generally considered to be the same as per other bacterial and viral STIs. High risk sexual behaviour, such as multiple sexual partners and infrequent condom use are the major risk factors for STIs [6]. In addition, age at first intercourse, previous diagnosis of another STI, being unmarried and early age of smoking and drinking initiation have also been shown to be associated with contracting an STI [6]. Despite risk factors for CT infection being similar for other STIs, some studies may report risk factors for CT infection specifically for females.

5.2.2 Objectives

To review the literature for risk factors and associated odds ratios or risk estimates specifically associated with CT infection among females from non high risk study populations.

5.2.3 Selection criteria for inclusion of studies in the review

All population based cross-sectional studies were considered for review that reported risk factors for CT among females, along with associated odds ratios or risk estimates, and where the study setting was not of a high risk population, for example sex workers, prison populations, or of known drug users, and had an minimum sample size of 2000 participants. Studies did not have to consist of a nationwide sample. All studies where a CT test was undertaken were included, including self collected mail in specimens, along with self reporting of a previous CT diagnosis. Studies that did not report specific risk factors for females within the study population were excluded. Due to the large number of potential studies, results were limited to those published from 2010 to present. In addition, a separate search was undertaken for studies from the Pacific that reported risk factors for CT infection.

5.2.4 Search strategy

EMBASE database 2010 – present and Ovid MEDLINE (R) 2010 – present were searched to identify cross-sectional studies that reported risk factors for infection among females of reproductive age (15-45). The following search terms were used in varying combinations to achieve maximum sensitivity: "Chlamydia", "Chlamydia trachomatis", "risk factor", "cross sectional", "population", "population based", "odds ratio", "relative risk", "Female" and "Pacific".

5.2.5 Methods

Abstracts and titles were first screened for the study sample size, the age range of the study population, the study setting, and whether a test for CT was undertaken and risk estimates associated with CT infection were reported. Only risk factors that reached or nearly reached statistical significance were reported in the review.

5.2.6 Risk factors for Chlamydia trachomatis infection among females

Overall three studies were identified that reported risk factors for female participants within the respective study populations. The study by Pinto, et al. reported on a national cross-sectional study of 2,071 parturient women aged 15 to 24 in Brazil [13]. Goulet, at al. reported on a national population-based survey in France of 2,580 women aged 18 to 44 years [19]. Finally, the study by Faber, et al. reported on 68,448

women in four Nordic countries [29]. In addition to the above, one study was identified that was outside of the specific years assessed. However, this study reported risk factors for CT infection within six Pacific island countries, namely Fiji, Kiribati, Samoa, Solomon Islands, Tonga and Vanuatu. Due to its local relevance, this study was also included in the results for the review [30].

Faber, et al: This study was a large randomly sampled population based cross-sectional study of 68,448 women within four Nordic countries namely Denmark, Iceland, Norway and Sweden [29]. Overall, genital CT infection was strongly associated with women having greater than one lifetime sexual partner, with a correlation identified with increasing number of lifetime sexual partners. Compared with those with only one lifetime sexual partner, those with 2 to 4 lifetime sexual partners were 2.6 (OR 99% CI: 2.2-3.2) times more likely to have a CT infection, 5 to 9 partners were 6.7 (OR 99% CI: 5.6-8.0) times more likely, and those with greater than or equal to 10 were 14.9 (OR 99% CI: 12.5-17.7) more likely to have a CT infection. A correlation was also identified with a young age at first intercourse. Those with an age of first intercourse of 14 years or younger were 1.6 times more likely to have a CT infection than those that had first their sexual intercourse at 19 years or older. Those having an age of first intercourse between 15 to 16 were 1.5 (OR 99% CI: 1.3-1.7) times more likely to have a CT infection, and those aged 17 to 18 were 1.3 (OR 99% CI: 1.2-1.5) times more likely.

Level of education was also associated with CT infection, those with a high level of education were less likely to have a CT infection than those with a middle or low level of education (Middle - OR, 0.90; 99% CI: 0.84-0.96, High – OR, 0.75; 99% CI: 0.69-0.82). Furthermore, young age at the initiation of both smoking and drinking was associated with CT infection when comparing smoking and drinking initiation in those aged 15 years or less and those that have never smoked (smoking - OR, 1.21; 99% CI: 1.11-1.32, drinking – OR, 1.49; 99% CI: 1.15-1.94). Finally, those having a previous diagnosis of another STI were more than twice as likely to have a current CT infection than those with no prior STI history (OR, 2.1; 99% CI: 2.0-2.2). This study benefitted from the very large sample size which improved its precision.

Pinto, et al: This study was conducted among parturient women aged 15 to 24 attending public clinics in Brazil in 2009 [13]. Overall, 2071 females aged between 15 and 24 were recruited into the study. Overall, the study found similar results to that of Faber, et al. A multivariate analysis identified a young age at first sexual intercourse as nearly significantly associated with increased odds of CT infection (OR, 1.4; 95% CI: 1.0-6.2). In addition, having more than one lifetime sexual partner (OR, 1.6; 95% CI: 1.1-2.3) and having a pap smear longer than a year ago (OR, 1.5; 95% CI: 1.1-2.1) were both associated with CT infection.

Goulet, et al: This study was the first national population based survey to assess the prevalence of CT infection in France. Overall 2,580 sexually active females aged between 18 and 44 living in France between October 2005 and March 2006, were enrolled into the study. The study also reported on a separate analysis undertaken on a subset of 737, 18-29 year old females. Within the 18-44 age group analysis, CT infection was strongly associated with a low level of education (OR, 10; 95% CI:1.8-53.8), having greater than two or more sexual partners in the past year (OR, 3.3 95% CI:1.2-9.0).

Risk factors for CT infection among 18 – 29 year old females were having a low level of education (OR, 16.5; 95% CI 2.4-112.1), having greater than two sexual partners in the past year (OR, 3.5; 95% CI 1.1-11.6), and last sexual partner being a casual encounter (OR, 7.0; 95% CI 1.2-41.9). Despite the large sample size, this study was limited by lack of precision in its estimates with a lot of variability within the confidence intervals.

Cliffe et al: This study reported on the second generation surveillance of HIV infection and STIs among 1,618 pregnant women in six Pacific Island Countries and Territories. All data from the six Pacific Islands are combined and a risk factor analysis for CT infection was undertaken on the data within two groups, those aged less than 25 years old and those aged 25 years and older. A univariate analysis identified that among women aged less than 25 years, the odds of having a CT infection were higher among those that were educated beyond a primary level (Secondary - OR, 2.4; 95% CI: 1.4-4.3, Higher – OR, 3.0; 95% CI: 1.6-5.8). In addition, within both groups CT infection

was less common among multiparous women compared with nulliparous women (>25 - OR, 0.20; 95% CI 0.1-0.7, ≥25 - OR, 0.43; 95% CI 0.2-0.8).

Within a multivariate analysis of risk factors, women aged less than 25 years that were not married or living with someone, were more likely to have a CT infection (OR, 1.8; 95% CI 1.1-2.9) compared with single women. Within both age groups examined, the number of lifetime sexual partners was also strongly associated with having a CT infection. When comparing women with only one lifetime sexual partner, women aged less than 25 years with two lifetime sexual partners were 1.7 (OR 95% CI: 1.0-2.8) times more likely to have a CT infection, women with three lifetime sexual partners were 3.0 (OR 95% CI: 1.6-5.7) times more likely, and women with four or more were 2.5 (OR 95% CI: 1.4-4.7) times more likely. Within women aged 25 years and older, the same associations existed with increasing number of sexual partners. Women aged 25 years or older with two lifetime sexual partners were 2.0 (OR 95% CI: 1.1-3.4) times more likely to have a CT infection, women with three lifetime sexual partners were 2.7 (OR 95% CI: 1.3-5.4) times more likely, and women with 4 or more were 2.2 (OR 95% CI: 1.0-4.5) times more likely. Table 6 summarises the major risk factors for CT infection from all studies included in the review.

Table 6: Summary of main risk factors for CT infection.

Risk Factor	Comments	References
Age	Young age at first intercourse	[13, 29]
Sexual experience	Multiple sex partners, casual or previous sexual contact not partner	[19, 29, 30]
Lifestyle and sex education	Young age at start of smoking and drinking, use of hormonal contraceptives, regular pap smear	[13, 29]
STIs	Prior STIs	[29]
Social Economic Status	Level of education	[19, 29, 30]
Parity	Having not given birth	[30]
Marital Status	Not married or living with someone	[13, 30]

5.2.7 Discussion of risk factors

Overall, the results are very similar within all the studies reviewed and as expected are similar as to other STIs. The main risk factors for CT infection appear to be multiple sexual partners and other lifestyle choice characteristics. Overall, there is a lack of information within the literature on the risk factors for CT infection within the Pacific, specifically Samoa. The one study identified in the Pacific was limited to assessing risk factors within antenatal mothers. Although acceptance rates into the study by Cliffe, et al. were high, the sensitive nature of the subject area, may have resulted in some underestimation of these results, particularly when providing details of past and present sexual behaviour.

Overall, trends in STI prevalence and associated risk factors, suggest that major societal and behavioural determinants of STI transmission may be operating in tandem. For example, frequent movement of people from countries with high rates of infection, and the changing place of marriage may influence STI rates [31]. In addition, it has been suggested by Wilson, et al. [96] that women that take care of their own health have a greater chance of having infections diagnosed and treated earlier than women that do not seek healthcare. This could explain the association between CT infection and regular pap smears demonstrated in the Brazilian study, and those having a past pregnancy having an infection picked up when visiting the hospital for antenatal care.

When assessing STIs in developed countries, sexually transmitted infections are often more prevalent in less affluent populations. Within some areas of the USA, the incidence of a number of sexually transmitted infections, such as CT, are thirty times greater within some inner city minorities compared with middle class white Americans [6]. A study of CT infection among 15 – 35 year olds in the USA demonstrated that the risk of CT among black respondents was over eight times higher than that of non-black respondents [33]. In addition, the poorest people often are lacking access to effective treatment for curable infection and health education messages relating to STIs may be lost on those where the most pressing needs, such as food, take priority [6].

6. Methodology

Ethical approval for the study was granted by the National University of Samoa Research Ethics Committee in 2010, by the Oceania University of Medicine in Samoa on the 17th of March 2011, by the Samoan Ministry of Health on the 30th of August 2011 and the Lower South Regional Ethics Committee in New Zealand on the 15th of January 2011, with the amendments to the project design approved on the 15th Of April 2011.

Enrolled participants were required to provide both written and verbal consent. All enrolled participants were provided with an information sheet either in English or Samoan or both. The information sheet provided a basic background to the project, and details pertaining to the confidentiality of study data, serological samples and test results. Contact details for non-governmental organisations in Samoa that specialise in STIs and maternal health, counselling services and contact details for the lead investigators, should the participant wish to make contact with the project team, were also provided on the sheet.

An overall schematic showing project methodology from entry into village for data collection, through to dissemination of findings and the project end point is shown in Figure 1, in the appendices.

6.1 Calculation of village population estimates for 2011

The most recent estimates of the population of 18-29 year old females at a village level were from the 2006 population census. As these were four years old, a more accurate estimate of the eligible village populations was required. To overcome this we estimated the 2011 eligible village populations by applying census growth rates between 2001-2006 for the four census regions used by the Samoan Bureau of Statistics. Bennett, et al. [34] suggests that if allowances are made for known variations in population growth rates, then an out-dated census may be adequate, as relative size is more important than absolute size and bias is likely to be small [35]. The 2001-2006 regional growth rate estimates for the four regions from the 2006 Census are shown in Table 7.

Table 7: Regional Population Growth Rates for Samoa 2001-2006 [36]

Region	2001-2006 Growth Rate
Apia Urban Area	-0.6%
North West Upolu	1.3%
Rest of Upolu	0.6%
Savai'i	0.1%

6.2 Generation and random selection of clusters

Based on the regional growth rates applied to villages in the four regions, our estimate of the population of 18-29 year old women in Samoa in 2011 was 15,702. A cumulative list of the estimated 2011 eligible populations and associated with each village within the sub-districts was then used as the cluster sampling frame. Overall, 90 clusters were created from this list with each cluster containing a minimum of 125 potential participants. The minimum sub-district number of 125 participants was calculated from an eligible study population and the expectation that at least 30% would meet the inclusion/exclusion criteria and agree to enrol in the study. This yielded a target enrolment of 50 participants from each cluster and a 'cluster: participant' ratio of 16:50 to yield up to 800 study participants.

A 'sampling interval' was determined to systematically select 16 clusters from the sampling frame by dividing the eligible female population by the cluster number (15,702/16 = 981). The first cluster was chosen at random as a number between one and the sampling interval number (981) using a random number generator in Microsoft Office Excel. The next clusters were consecutively selected using the sampling interval. The 16 clusters (Figure 2) yielded a total of 51 villages, with clusters containing between 1 and 6 villages.

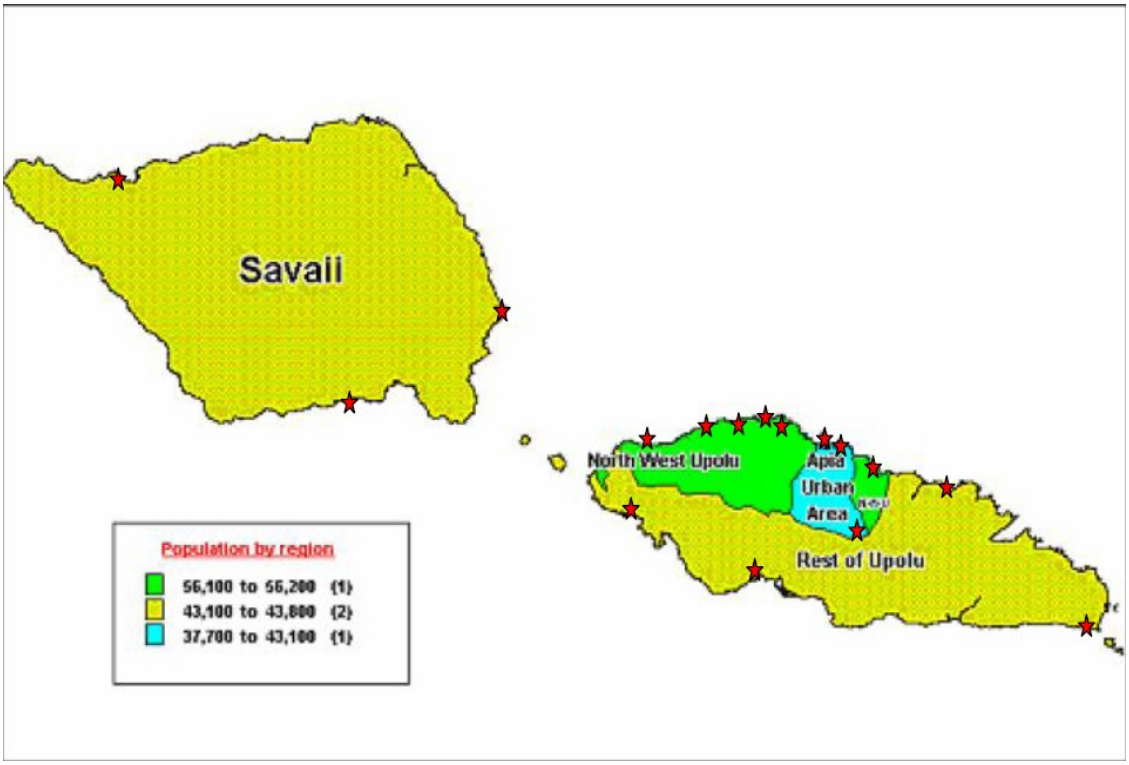

Figure 2: Four Regions of Samoa and distribution of study clusters. Red stars indicate the distribution of 16 Clusters/sub-districts, (51 villages). Map sourced from Samoan Bureau of Statistics.

6.3 Village contact and 18-29 year old list generation

Once the random selection of clusters and villages was completed, the Ministry of Women, Community and Social Development were approached to provide contact details for the Sui o le Malo (head of the village women's committee) for each of the 51 selected villages. For those villages that did not have Sui o le Malo, contact was made with the village Pulinu'u (mayor). Meetings were arranged with the Sui o le Malo or Pulinu'u (village representatives), where the project was explained and any questions could be answered. The village representatives were provided with templates to generate lists of all 18-29 year old females in their respective villages. The template was used to record the person's first name, surname and age. The Village representatives were provided with our estimate of the 18-29 year old female population within their respective villages and provided with enough printed templates to compile the lists. Representatives were compensated for transport cost in attending the meeting and provided with a small monetary gift (meaalofa) in

appreciation for assisting with the project. Meaalofa is an important component of fa'a Samoa which literally translates to 'the Samoan way'. The showing of respect is an important aspect of fa'a Samoa and meaalofa is often used as a form of showing such respect and money is commonly used as appreciation for good deeds and services, where one is not contracted or expected to have provided such service as part of one's employment or job.

The project team allowed a minimum of two weeks to complete the village lists. The village representatives were later contacted and a suitable time arranged to pick up the list or drop the list off to a project team member in Apia. Lists were deemed to be accurate if the number of names on the list was 80% or more of our estimated population. For those lists that failed to reach 80%, the village representatives were contacted and queried as to completeness of the list. Those lists that were incomplete were returned to the village representative if they indicated they could generate a more complete list if given more time.

6.4 Random selection within village lists

Once village lists were returned to the project team, the names and ages for each village were entered into Microsoft Excel. Each name was allocated a sixteen digit random number using the RAND function. The names were then placed in ascending numerical order according the output of the RAND function to generate a randomised list of names. Ten place holders were also randomly placed within the list of names to allow insertion of names of those that were not on the village list, but who happened to turn up on the day of collection.

6.5 Calculation of required enrolments per village

To ensure enrolments from each village within a cluster were proportional to the village population size, a calculation was made to determine the number of enrolled participants the project would aim to recruit from each village within an individual cluster. Within each cluster we aimed to recruit 55 participants including an oversample of five to adjust for clusters or villages that may not reach the required number of participants. To determine the number of enrolled participants required

from each village, we used the population totals from the village lists to calculate a percentage population of 18-29 year old females for each village from the total cluster population of 18-29 year olds. We then applied this to determine the proportion of the 55 participants required from each village within a cluster. An example cluster with recruitment proportions is shown in Table 8.

Table 8: Example cluster with village total and proportion of 55 enrolments according to village size.

	Village Name					
	Sapini	Luua	Malae	Salimu	Saasaai	Saipipi
Total village Population of 18-29 Females from lists	7	22	21	8	48	31
Aim to Recruit (Village population / cluster population)*55	3	9	8	3	19	12

6.6 Initial village visit

Prior to data collection, the project team visited each village to meet with the village representative and determine an appropriate location for the data collection to take place. For larger villages, the locations chosen were schools, churches and community halls. For smaller villages, the Sui o le Malo offered the use of their house or the local Women's Committee house. The locations chosen required that there be tables available, private toilet facilities for urine samples to be collected, enough room for segregation of those enrolled and those not to ensure confidentiality, and ideally be geographically central within the village. A date was arranged with the village representative for the 18-29 year old females of the village to meet at the selected location where the project team would meet the group and could recruit participants into the study and collect the required data.

6.7 Recruitment and data collection

6.7.1 Participant enrolment and consent

Recruitment and data collection took place in the late afternoon or evening within the villages. On arrival, the study was briefly explained to the participants as a group. An initial roll call, directly off the village list, of all those in attendance was taken and the additional attendees that were not on the village list were added. Names were then called out in order as they appeared on the randomly sorted village list. Participants approached a desk at the front of the venue where one of three project assistants was seated. The project assistant went through the inclusion and exclusion questions with the participant (Table 9) and completed the associated form. If the participant answered 'yes' to all the inclusion criteria, 'no' to all the exclusion criteria and indicated their age as between 18-29, they were directed to another team member in another area of the venue. Here the study was explained further to the participant, they were provided with an information sheet to read and any questions the participant may have had were answered by the assistant. The participant was then formally invited to enrol into the study. If the participant agreed to be enrolled, they were provided with a consent form to read and sign and the participant was then allocated a study number and provided with a questionnaire to complete. If after being provided with an information sheet and the participant refused enrolment into the project, the project assistant asked the reason for refusal and if the participant provided a response, this was noted on the participants inclusion/exclusion form.

If a participant answered 'no' to one or more inclusion criteria or 'yes' to one of more exclusion criteria, the participant was thanked for their time and the assistant moved onto the next name on the list. A schematic showing recruitment process at a village level is shown in Figure 3, in the appendices.

Table 9: Inclusion and exclusion criteria. Participants were required to answer 'yes' to the inclusion questions and 'no' to the exclusion questions.

Inclusion	• Are you aged between18-29? • Have you been living in the village for at least 1 year? • For over a year, have you been having sexual intercourse without using condoms, birth control pills or any other form of contraception?
Exclusion	• Do you have any medical condition or ever undergone a medical procedure that makes it impossible for you to become pregnant for example a surgical sterilisation?

Once an eligible participant had completed the consent process, they were allocated a unique project number. Their name and contact details were recorded alongside this number on a master sheet. The questionnaire, urine and blood samples were labelled with only the unique number. The master list was only consulted for contacting the participant in the case of a positive CT test or suspected fertility issues. Only the lead investigators had access to the master sheet. Following serological testing, the laboratory was provided with the village and age of the participant for their records. No names were provided to the laboratory. After those that were successfully enrolled completed the questionnaire, blood and urine samples were collected. A trained phlebotomist from the National Health Service Laboratory accompanied the project team to draw blood and provide instructions on collecting a urine sample.

6.7.2 Urine specimen collection

First-catch urine specimens were self-collected. Subjects were asked not to urinate at least 1 hour prior to collection, and approximately 20 mL of the initial urine stream were collected in a clean sterile container. All samples were placed within a cooler containing ice and transported directly by the study team to the main hospital laboratory in Apia if the collection was from Upolu, or Savai'i if from Savai'i.

6.7.3 Blood specimen collection

Approximately 8.5ml of blood was obtained from each participant using a standard venipuncture technique. Blood was drawn up into an 8.5ml serum separator vacutainer that was labelled with the participant's unique study code.

6.7.4 Participant and village representative appreciation

All those attending the village sessions on the day were provided with a bottle of water and a small snack. Those that were successfully enrolled were also provided with a five tala mobile phone top-up card. The village representative was provided with mealofa of two hundred tala for organising the meeting and for use of facilities within the village.

6.9 Laboratory procedures

All serological samples were transported to the laboratory at the main hospital in Apia within 24 hours of collection. Urine samples were placed in a fridge at 4°C for no longer than 48 hours and blood samples kept on ice for no longer than 24 hours prior to processing. Once urine samples reached the laboratory, urine was divided into aliquots and stored in the transport/preservative tubes provided by the NAAT manufacturer. Once in transport/preservative tubes, urine samples were processed within two weeks.

6.9.1 Separation of sera from blood samples and storage

Within 24 hours of collection, blood collection tubes were centrifuged at 2600 revolutions per minute for 10 minutes to allow the gel within the collection tube to form a barrier between the clot and the blood sera. Using a pipette, the sera was transferred to a 5 mL screw top serum tube and labelled with the study participants unique code. All blood serum was stored at -80°C until packaging and shipping to Australia.

6.9.2 Testing of urine samples

Urine samples were tested for both CT and NG. Prior to testing, approximately 4mL of urine was transferred to the appropriately labelled sample tube. Tubes were centrifuged at 2000 x g for 30 minutes prior to decanting the supernatant and the addition of 2 mL diluent. Samples were vortexed for 5 seconds to re-suspend the sediment in the diluent then placed in a lysing rack along with positive and negative controls. Samples were heated for 30 minutes in the lysing rack and then allowed to

cool at room temperature for at least 15 minutes. The priming plate was then prepared and 150 µL from each column of samples was aspirated into the priming microwells. Once all column samples had been transferred, the priming plate was covered and left at room temperature for a minimum 20 minutes.

Following the priming incubation period, the amplification plate was prepared. 100 µL was transferred from each sample column to the microwells on the amplification plate. Once all column samples had been transferred, the amplification plate was covered with the amplification sealer sheet. The amplification plate was then transferred to the BDProbeTec ET instrument and the run was initiated as per the user manual.

The BDProbeTec ET CT/NG Amplified Deoxyribonucleic Acid Assay uses fluorescent energy transfer as the detection method to test for the presence of CT/NG. All calculations are performed automatically by the instrument software. The presence or absence of CT/NG was determined by relating the BDProbeTec ET MOTA scores for the specimen to pre-determined cut-off values as defined by the manufacturer. The MOTA score is a metric used to assess the magnitude of signal generated as a result of the reaction. However, it should be noted that the magnitude of the MOTA score is not indicative of the level of organism in the specimen. The MOTA score used for identification of positive CT/NG is shown in Table 10. Positive and low positive were indicative of CT/NG infection and thus both classified as positive for the purposes of the study. However, only positive CT results were used in the final analysis.

Table 10: MOTA score and differentiation between positive and negative CT test results.

CT MOTA Score	Result	Report	Interpretation
≥ 10,000	Positive	CT plasmid DNA detected	Positive for CT. CT organism viability and/or infectivity cannot be inferred since target DNA may persist in the absence of viable organisms.
2,000-9,999	Low Positive	CT plasmid DNA detected	CT likely. Supplemental testing may be useful for verifying presence of CT
< 2,000	Negative	CT plasmid not detected	Presumed negative for CT. A negative result does not preclude CT infection because results are dependent on adequate specimen collection, absence of inhibitors, and sufficient DNA to be detected.

A dedicated book was provided to the laboratory to record the results of urine tests alongside the appropriate participant number. This book was cross-checked regularly against the original laboratory record of the test result to ensure accuracy.

6.10 Positive case contact tracing and treatment

The participant study number associated with all positive test results for CT or NG were provided to the lead investigators by the laboratory as soon as test results

became available. The participant numbers were then linked back to the individuals via the contact sheet. The individuals were contacted by a study nurse and advised of the result. Participants were given the option to either come to a local STI clinic, or if the study team were passing through their village, a time was arranged to meet the person within their village to provide treatment to both themselves and their partner. Often this coincided with the study team passing through on our way to another village for data collection. The individuals were met in a location they felt comfortable with and to not draw too much attention to themselves. One of the project nurses explained the test result to the individual, and provided them with 1000 mg of azithromycin for themselves and 1000 mg for their partner or recent sexual contacts. Treatment of the study participant was directly observed and advice was given on explaining the treatment to their partner. If they felt uncomfortable doing this, arrangements were made for a study nurse to meet the partner and the participant together to explain the treatment to the partner and provide treatment.

6.11 Data management and statistical analysis

All data were entered into SPSS and double checked for accuracy. All errors, incongruence and data duplication were corrected. Data were stratified for age, occupation, education, marital status, exercise frequency, weekly alcohol consumption, religion, age at first sexual intercourse, and number of sex partners both past 12 months and lifetime.

Data were transferred to STATA for analysis due to its ability to adjust for village clustering using a variance estimator option. Univariate logistic regression, adjusting for cluster, was first used to identify independent risk factors (odds ratios) for CT prevalence within the entire study population. Possible confounders for inclusion in multivariate models were chosen based on the change in estimate methodology[37], with variables found to have a 10% change in point estimate chosen for the final models.

7. Results

Overall, 41 (85.4%) of 48 selected villages across Samoa participated in the study and completed recruitmet. Fourteen of those were on the island of Savai'i and the other 27 were on the island of Upolu. From these villages, there was a 47% turnout of potential participants at village data collections, based on calculated estimates of the 18-29 year old village populations for 2011. The overall study population consisted of 239 consenting women aged 18-29 who fitted eligibility criteria. Slightly over half of the study population were aged between 18 to 24 years with a mean age within the study population of 24.6 years. Less than 20% of the study population were in paid employment, over 60% were educated to a high school level with less than 10% having tertiary qualifications. Approximately 70% of the study population were in a marital relationship that was not defined as being single.

The mean age of first sexual intercourse was 19.5 years, with over half having (55%) first intercourse at age 19 or younger. Just under a third (31%) of the population reported having two or more sexual partners in the previous 12 month period. Slightly more than half the study population (53%) reported having two or more lifetime sexual partners, with 17% reporting at least three lifetime sexual partners. Less than one quarter of the study population were current or former smokers and less than one fifth reported as consuming alcohol at least once every week. Almost two thirds (66%) of the study population did not undertake any form of weekly leisure exercise.

Slightly less than two thirds (63%) of the study population reported having a past pregnancy, with more than half of those reporting that the time trying to conceive before their first pregnancy was less than 12 months. Greater than two thirds of the study population were defined as either overweight or obese.

The overall prevalence of CT infection in the study population was 36.0% (95% CI 29.9-42.1). Demographic factors associated with infection are summarised in Table 11. There was a slightly higher prevalence observed within the 18-24 year age group (37.2) when compared with the 25-29 year age group (34%).

Rates of CT infection were higher among participants that identified their relationship status as being single (49.3%) compared with those of married, defacto or widowed participants (29.9%). A multivariate analysis identified single participants to be almost twice as likely to have a CT infection (OR 1.92; 95% CI, 1.02-3.62) than married, defacto or widowed participants with the association reaching statistical significance.

Participants that identified as having 'tertiary' qualifications had a lower prevalence of CT than those that identified their highest qualifications as being 'secondary' or 'primary or nil'. The prevalence of CT infection among those that identified as being in paid employment was similar to those that identified as not being in paid employment. Univariate and multivariate analyses identified no significant association between these groups and CT infection.

Sexual behaviour and lifestyle factors were considered for association with CT infection and are summarised in Table 12. Younger age at first intercourse was not significantly associated with a higher likelihood of having CT infection. The prevalence of CT in those with two or more lifetime sexual partners was 42.7 % compared with 32.9% in those with only one lifetime sexual partner. This difference was not significant on multivariate analysis (OR 1.78; 95% CI, 0.82-3.86). However there was statistically significant increasing likelihood of infection with increasing number of lifetime sexual partners. Comparing those with only one lifetime sexual partner, those with two lifetime sexual partners were 2.89 (95% CI, 1.03-8.06) times more likely to have a CT infection, and those with 3 or more lifetime sexual partners were 3.07 (95% CI, 1.19-7.67) times more likely to have a CT infection. Similarly, multivariate analysis identified those with two or more sexual partners in the previous twelve months as being more likely to have a CT infection compared with those with only one sexual partner (OR 3.02; 95% CI , 1.19-7.67), reaching statistical significance.

Participants that identified as consuming alcohol at least once per week, had a higher prevalence of CT infection (43.6%) compared with participants that did not consume alcohol at least once per week (34.5%). Participants that reported as engaging in non-regular exercise (reported as exercising 'sometimes' or 'never/rarely') had a higher prevalence of CT infection than those that reported as engaging in exercise 'often'.

The prevalence of CT infection among participants reporting as having never smoked (37.8%) was slightly higher than that of current or ex-smokers (29.4%). However neither alcohol consumption, exercise, or smoking were significantly associated with CT infection on multivariate analysis.

The associations of parity status with CT infection are summarised in Table 13. The prevalence of CT infection among participants reporting a past pregnancy (29.8%) was lower than those reporting as never being pregnant (46.6%). Within a multivariate analysis, participants reporting as having a previous pregnancy were significantly less likely to have a current CT infection (OR 0.49; 95% CI, 0.27-0.87). A sub-analysis of parity status comparing nulliparous, primiparous and multiparous participants showed that primiparous women were significantly less likely to have CT infection than Nulliparous women (OR 0.54; 95% CI, 0.30-0.99) and Multiparous women also were significantly less likely to have CT infection (OR 0.46; 95% CI 0.24-0.89).

With respect to time trying to conceive, those who conceived within 12 months were less likely to have CT infection than those who took 12 months or more, although this did not reach statistical significance.

Table 11: Overall prevalence of CT infection and associated demographic factors for infection

Variable	Positive	Prevalence % (95% CI)	OR (95% CI)	AOR (95% CI)	p-value for AOR
Overall	86	36.0 (29.9-42.1)	-	-	-
Age					
18-24	54	37.2 (29.3-45.2)	1.0	1.0	
25-29	32	34.0 (24.4-43.7)	0.87 (0.51-1.48)	1.45 (0.82-2.56)[1]	0.20
Highest Qual					
Tertiary	16	35.6 (21.3-49.8)	1.0	1.0	
Secondary	50	38.8 (30.3-47.2)	1.15 (0.57-2.33)	1.36 (0.66-2.83)[2]	0.41
Primary or nil	20	30.8 (19.4-42.1)	0.81 (0.29-2.27)	1.04 (0.34-3.15)[2]	0.95
Paid Employment					
No	71	36.2 (29.4-43.0)	1.0	1.0	
Yes	15	34.9 (20.4-49.4)	0.94 (0.56-1.59)	0.84 (0.53-1.34)[3]	0.47
Relationship Status					
Married/Defacto/					
Widowed	49	29.9 (22.8-36.9)	1.0	1.0	
Single	37	49.3 (37.9-60.8)	2.29 (1.35-3.88)	1.92 (1.02-3.62)[4]	0.04
Religion					
Methodist	10	32.3 (15.4-49.1)	1.0	1.0	
Catholic	19	38.8 (24.9-52.6)	1.33 (0.37-4.82)	1.44 (0.43-4.90)[5]	0.56
Congregational	28	33.7 (23.4-4.0)	1.07 (0.39-1.95)	1.19 (0.46-3.05)[5]	0.72
Latter Day Saints	14	40.0 (23.4-56.6)	1.40 (0.49-4.02)	1.54 (0.57-4.14)[5]	0.39
Other/No religion	15	36.6 (21.6-51.6)	1.21 (0.53-2.78)	1.41 (0.64-3.13)[5]	0.40

Factors controlled for in multivariate analysis: 1 Relationship status, past pregnancy; 2 Past pregnancy, weekly alcohol consumption; 3 Past pregnancy; 4 Past pregnancy; 5 Past pregnancy;

Table 12: Prevalence of CT infection and associated lifestyle and sexual behaviour factors for infection

Variable	Positive	Prevalence % (95% CI)	OR (95% CI)	AOR (95% CI)	p-value for AOR
Age at first intercourse					
≥20	36	33.3 (24.4-42.3)	1.0	1.0	
≤19	50	38.2 (29.8-46.6)	1.23 (0.75-2.04)	1.23 (0.75-2.04)[*]	0.41
Number of Sexual partners previous 12 months					
1	54	32.9 (25.7-40.2)	1.0	1.0	
≥2	32	42.7 (31.3-54.0)	1.52 (0.72-3.19)	1.78 (0.82-3.86)[1]	0.14
Number of sexual partners lifetime					
1	35	27.6 (19.7-35.4)	1.0	1.0	
2	33	45.8 (34.2-57.5)	2.22 (0.83-5.94)	2.89 (1.03-8.06)[2]	0.04
≥3	18	45.0 (29.3-60.7)	2.15 (1.01-4.57)	3.07 (1.17-8.00)[2]	0.02
Number of sexual partners lifetime					
1	35	27.6 (19.7-35.4)	1.0	1.0	
≥2	51	45.5 (36.2-54.8)	2.20 (0.94-5.1)	3.02 (1.19-7.67)[3]	0.02
Alcohol use (Weekly)					
Never/Rarely drinks	69	34.5 (27.9-41.1)	1.0	1.0	
≥ 1 sessions	17	43.6 (27.7-59.4)	1.47 (0.78-2.76)	1.69 (0.95-3.01)[4]	0.08
Exercise Frequency (Weekly)					
Often	13	27.7 (14.7-40.7)	1.0	1.0	
Sometimes	46	41.4 (32.2-50.7)	1.85 (1.05-3.27)	1.56 (0.87-2.83)[5]	0.14
Never/Rarely	27	33.3 (23.0-43.7)	1.31 (0.57-3.01)	1.17 (0.51-2.71)[5]	0.70
Smoking Status					
Current/ex smoker	15	29.4 (16.7-42.1)	1.0	1.0	
Never	71	37.8 (30.8-44.7)	1.46 (0.70-3.01)	1.95 (0.81-4.68)[6]	0.13

* Association not altered beyond 10% following multivariate analysis.Factors controlled for in multivariate analysis: 1 Past pregnancy, smoking status; 2 Past pregnancy, smoking status; 3 Past pregnancy, smoking status; 4 Smoking status; 5 Relationship status; 6 Lifetime number of sexual partners, weekly alcohol consumption

Table 13: Prevalence of CT infection and parity status associated with infection

Variable	Positive	Prevalence % (95% CI)	OR (95% CI)	AOR (95% CI)	p-value for AOR
Past pregnancy					
No	41	46.6 (36.1-57.1)	1.0		
Yes	45	29.8 (22.4-37.2)	0.49 (0.27-0.87)	0.49 (0.27-0.87)*	0.01
Parity					
Nulliparous	43	45.7 (35.6-55.9)	1.0	1.0	
Primiparous	22	31.4 (20.4-42.4)	0.54 (0.30-0.99)	0.54 (0.30-0.99)*	0.02
Multiparous	21	28.0 (17.7-38.3)	0.46 (0.24-0.89)	0.46 (0.24-0.89)*	0.02
Time trying to conceive before first pregnancy					
<12 months	19	25.7 (15.6-35.8)	1.0	1.0	
≥12 months	26	34.7 (23.7-45.6)	1.47 (0.66-3.31)	1.47 (0.55-3.31)*	0.33

* Association not altered beyond 10% following multivariate analysis.
Factors controlled for in multivariate analysis: nil

8. Discussion

Until the current study, the most recent published estimates of CT prevalence in Samoa came from the Second Generation Surveillance Survey commissioned by the Secretariat of the Pacific community in 2005 [24]. Within the 20-29 year age group within this study, the prevalence of CT was 34.7%. It is worth noting that the Second Generation study recruited antenatal mothers and was purely opportunistic. In addition, antenatal mothers are traditionally seen as a low risk population for acquiring an STI [30]. The prevalence of 36.0% in 18-29 year old females in this current study, is similar to the prevalence in antenatal mothers in the Second Generation Surveillanc Survey. One can also compare the findings from the current study to the CT antenatal surveillance data from the National Health Service Laboratory. Between July and December 2011, 39% of antenatal women aged between 20 and 29 years returned a positive CT test. Some of these women may have had a clinical indication for being tested.

The prevalence of CT infection in Samoa was higher than published prevalence data from other countries within the Pacific. The prevalence of CT in Samoa was higher than that observed in Fiji (aged <25, 34.0%), and Tonga (aged <25 27.5%). Nearly twice as high as that of Kiribati (aged <25, 20.0%) and Vanuatu (aged <25, 19.7%), and over four times higher than that of the Solomon Islands (aged <25, 7.3%). Within more developed countries in the Pacific, the prevalence of CT infection in Samoa was nearly three times that observed in New Zealand (aged <25, 12.2%) and over nine times that observed in Australia (aged 18-24, 3.7%).

Outside of the Pacific, the prevalence of CT infection in Samoa was much higher than published prevalence data from other developing countries. The prevalence of CT was nearly twice that observed in China (aged ≤ 25, 18.1%), nearly four times higher than Brazil (aged 15-24, 9.8%), five times higher than Kenya (aged 15-29, 7.0%) and Cameroon (aged 15-29, 7.5%), eight times higher than Zambia (aged 15-29, 4.2%) and over 25 times higher than India (aged 21-30, 1.3%).

Compared to more developed countries outside of the Pacific, the prevalence of CT infection in Samoa was markedly higher. The prevalence of CT was over five times higher than England (aged 16-24, 6.1%), nearly ten times higher than France (aged 18-29, 3.2%), and over twelve times higher than within the USA (aged <25, 2.8%).

This is the first study to report on risk factors for CT infection specifically within Samoa. However, the study by Cliffe, et al. [30] reported on a number of risk factors among antenatal mothers from six Pacific Islands in 2008. Overall, risk factors found to be strongly associated within the Cliffe, et al. study were also similar within the current study: participants that were not married or living with someone were over 50% more likely to have a CT infection that those that were married. Compared with the current study, single participants were 1.92 times more likely to have a CT infection than married, defacto or widowed participants. In addition, Cliffe, et al. reported an increasing likelihood of CT infection with increasing number of lifetime sexual partners and among nulliparious individuals. Both of these results were also observed and similar to the current study, where we found parity and number of sexual partners to be significantly associated with CT infection.

Many of the results observed within this Samoan based study are consistent with studies of risk factors for CT infection outside of the Pacific. Number of lifetime sexual partners has been shown to be strongly associated with CT infection in three studies with results varying. One study identified those having greater than one lifetime sexual partner being 1.6 times more likely to have a CT infection [13], those with 2-4 lifetime sexual partners being 2.6 times more likely to have a CT infection [29], and those with greater than two lifetime sexual partners being 3.5 times more likely to have a CT infection [19]. Within the current Samoan study, those having two lifetime sexual partners were nearly three times as likely to have a CT infection, and those with three or more lifetime sexual partners were more than three times as likely to have a CT infection, with both results reaching statistical significance. It is important to note that those women within only one sexual partner still had a CT infection prevalence of almost 28%, showing the importance of male sexual behaviour in Samoa and of conducting CT infection studies in males.

Young age at first intercourse has also been shown to be associated with CT infection in studies outside of the Pacific. Within the study by Faber, et al. those having their first intercourse at age 17-18 were 1.3 times more likely to have a CT infection than those having their first intercourse at age 19 [29]. From the results of the current study, those having their first intercourse at age 19 or younger were more likely to have a CT infection than those having their first intercourse at age 29 or older, although this result was not statistically significance.

Level of education has been shown to be associated with CT infection within at least one study, with lower/middle level educated individuals being more likely to have a CT infection than individuals with a higher level of education [19]. In contrast we did not find an association with level of education.

8.1 Role of bias and confounding

Sampling and Selection bias: Selection bias was minimised within the study through the use of a randomised cluster sample design along with the random selection of participants within the village. All sexually active females aged between 18-29 years living in Samoa had an equal chance of being selected into the study. This was achieved both from the cluster sample selection process and from the random selection from village lists. The study used strictly defined eligibility criteria for an individual to be eligible for enrolment (see methodology). In addition, from all those that attended the village sessions and were eligible for enrolment, we achieved 100% enrolment with no participant refusing enrolment.

Selection bias would be introduced into the study depending on the turnout of potential participants during our village session. Overall, the study achieved a 47% turnout of potential participants at village data collections, based on the calculated estimates of the 18-29 year old village populations for 2011. Explanations for the 53% that did not attend the village data collections are unknown. However, during the study it became evident that due to the large geographical size of a number of the villages within the study, it would be difficult for females living some distance away from where we were undertaking data collection to attend our data collections. In this instance, multiple data collections took place at two different locations within the village. Despite this, response rates were still at 47% and it is likely that many could not make it to the village sessions due to work, religious or family commitments, were not adequately informed about the session or simply did not want to attend. The village representative in charge of organising the village sessions was advised to simply advertise the session as “health researchers from the National University of Samoa wanting to talk about women’s health issues”. This allowed properly trained nurses to explain the true nature of the study to the participants, potentially leading to less loss of potential recruits simply due to the research being focussed on sexual health and not appealing to the more conservative individuals.

Measurement bias: The project was very fortunate to have access to the National Health Service BDProbeTec testing system for CT detection. NAAT is the most sensitive test available, having both high sensitivity and specificity [38] thus limiting false positive results. However, the accuracy of the test is only as good as the specimen provided by the subject. Subjects were advised clearly to collect a first catch urine specimen into the supplied collection jar. However, as there is no way to determine the difference between a first catch urine specimen and a midstream specimen once the specimen has been provided, we simply had to rely on the subjects collecting their specimen as we had instructed. A midstream collection is more likely to return a false negative result than a first catch specimen due to inadequate bacterial count [39].

Recall and reporting bias: Sexual history and sexual health is an extremely sensitive and provocative topic in Samoa. From observations during the village data collections, participants found it difficult to acknowledge that they were sexually active, which was included within the eligibility criteria for enrolment. Instead of asking the participant directly, particularly among those that were single, or if the participant simply answered "no" as to whether they were sexually active, the nurses undertaking recruitment would ask different questions such as "do you have a boyfriend?" if they answered "yes" the nurse would ask "do you live with your boyfriend?" or "do you sometimes stay overnight with your boyfriend?" Often responses were simply a raised eyebrow or a nod of the head which is interpreted as 'yes' in Samoa. Following these questions, the nurse would often then ask the 'sexual activity' question more directly and receive a different response than when asked at the outset of the recruitment process. However, it is likely that some participants simply refused to acknowledge they were sexually active. As a result, they were not recruited into the study. In addition, successful recruits found the questions asking about age at first intercourse, twelve month number of sexual partners, and lifetime number of sexual partners, difficult to answer due to the sensitive nature of the questions. In addition, the length of time the study was asking participants to remember may have added an element of recall bias if participants were unable to recall accurate responses. Finally, we cannot rule out the possibility that individuals may have simply provided socially acceptable replies thus resulting in biased results.

Interviewer bias: Interviewer bias was minimised through the use of only three trained interviewers throughout the duration of the project with the questionnaires/interviews being conducted in a language of the participants choosing, either English or Samoan.

The questionnaire administered by the interviewers was adapted to the Samoan setting and the specific requirements of this project from that already validated by Bhattacharya, et al. [40]. Once finalised in English, the questionnaire was translated into Samoan, back translated into English to check for accuracy, and then piloted within a village on females within the appropriate age range. The village selected for the pilot was one that was not selected for the study proper. Adjustments were made to the questionnaire following the pilot, prior to the commencement of the study proper.

Chance and confounding: Cross-sectional studies are not ideal for determining risk factors as this study type has limited ability to determine causal relationships. However, they do provide a mechanism to estimate the susceptibility of a population to infection, or the complications associated with infection.

The study was limited by its small sample size and in particular small sample size within some stratified groups. This limited the ability of the study to control for potential confounding and its ability to detect statistically significant results.

Socio-demographic status has been shown to be a risk factor for CT infection. The only measurement of this within this study was through education level and employment status. A measure of overall socio-demographic status was not measured and therefore not controlled for within this study.

Health seeking behaviour and pap-smears have been shown to be factors associated with CT infection. No information on the health seeking behaviour of individuals was gathered and therefore was unable to be controlled for within the analysis.

9. Conclusion

This study has presented the findings of the first population based study to assess the prevalence of CT infection and associated factors for infection in women aged 18-29 living in Samoa. The findings identify a high prevalence of CT infection in Samoan women similar to that observed within the limited antenatal studies already undertaken in Samoa. In addition, the study has provided data on risk factors for CT infection in Samoa, which are similar to those found elsewhere.

Many of the risk factors for acquiring a CT infection are similar for other more serious STIs such as HIV. In addition, those infected with another STI are at an increased risk of contracting HIV. With risky sexual behaviour already present within the population, such as multiple sexual partners, along with the high prevalence of CT infection, HIV has an opportunity to become established. All that is lacking in Samoa is a reservoir of HIV infection. At present reported cases of HIV in Samoa are low. However, one only needs to look within the Pacific for evidence of how a high prevalence of bacterial STIs is a catalyst for the emergence of HIV [41, 42].

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Appendix I: Questionnaires: English and Samoan versions

STRICTLY CONFIDENTIAL

Please answer the questions or ☑ the box which applies to you.

Background Questions

1. In which year were you born? 1 | 9 | | |

2. Please state which village you live in?

3. How long have you lived in the above village?
   - Less than 1 year ☐
   - Between 1-2 years ☐
   - Between 2-5 years ☐
   - More than 5 years ☐

4. Do you do paid work outside the home?
   - Yes ☐
   - No ☐

   If 'yes', what is your present or usual occupation?
   - Clerical/Office work ☐
   - Hospitality/Tourism ☐
   - Retail/Sales Assistant ☐
   - Health care worker ☐
   - Government worker ☐
   - Police/Military ☐
   - Farmer ☐
   - Labouring ☐
   - Professional (eg doctor, lawyer, CEO) ☐
   - Market/street sales ☐
   - Teacher ☐
   - Other ☐

5. What is your marital status?
   - Married ☐
   - Living with Partner ☐
   - Defacto/Stable Union ☐
   - Single ☐

6. How long have you been in this partnership?

   years | months

1

7. Is your partner in paid employment?

Yes ☐
No ☐

If yes, what is your partner's present or usual occupation?

Clerical/Office work ☐
Hospitality/Tourism ☐
Retail/Sales Assistant ☐
Health care worker ☐
Government worker ☐
Police/Military ☐
Farmer ☐
Construction/labouring ☐
Professional (eg doctor, lawyer, CEO) ☐
Market/street sales ☐
Transport worker (eg bus or taxi driver) ☐
Fisherman ☐
Factory worker ☐
Teacher ☐
Other ☐

8. Do you have any of the following qualifications?

(Please tick highest achieved)

University Degree ☐
Tertiary level Diploma ☐
Tertiary level Certificate ☐
High School Certificates (School C; UE; NCEA; etc) ☐
None ☐

9. What is your religious affiliation?

Methodist ☐
Catholic ☐
Congregational Christian ☐
The Church of Jesus Christ of Latter Day Saints ☐
Assemblies of God ☐
Seventh Day Adventist ☐
Baha'i ☐
Jehovah's Witness ☐
Other ☐
No religion ☐

Health Questions

10. What is your height?

ft. ☐ ins. ☐ or metres ☐

11. What is your weight?

St. ☐ lbs. ☐ or kg ☐

12. Have you experienced any of the following?

(tick all which apply)

- Tubal Surgery ☐
- Appendectomy ☐
- Pelvic Surgery ☐
- Endometriosis ☐
- Chemotherapy ☐
- Chlamydia Infection ☐
- Gonorrhea Infection ☐
- Other pelvic infection ☐
- HIV/AIDs ☐

13. Have you ever used the IUD (Intrauterine Device), Coil or Mirena?

- Yes ☐
- No ☐

14. Have you been surgically sterilised?

- Yes ☐
- No ☐

If you have a partner, has he had a vasectomy/ been sterilised?

- Yes ☐
- No ☐
- Not applicable ☐

15. Do you have any long term physical health problems?

- Yes ☐
- No ☐

If 'yes', please describe.

16. Do you have any long term mental health problems?

- Yes ☐
- No ☐

If 'yes', please describe.

Sexual Behaviour Questions

17. How old were you when you first had sexual intercourse? ☐

18. How many sexual partners have you had in the past 12 months? ☐

19. How many sexual partners have you ever had? ☐

Drinking Questions

20. How often do you drink wine, beer or spirits?

	WINE	BEER	SPIRITS
Never			
Less than once/ week			
Once or twice/ week			
More than twice/ week			

21. When you drink wine, beer or spirits, how many drinks do you usually have at a sitting?

(Tick one box in each column)

	WINE	BEER	SPIRITS
None			
One or two drinks			
Three or four drinks			
Five or more drinks			

Exercise Questions

22. Considering a 7 day period (a week), how many times on average do you do the following kinds of exercise for more than 15 minutes during your free time?

(Write in each box the appropriate number.)

(a) STRENUOUS EXERCISE (HEART BEATS RAPIDLY) ☐

(i.e. running, jogging, basketball, vigorous dancing, judo, vigorous canoeing, vigorous swimming, vigorous long distance cycling, etc.)

(b) MODERATE EXERCISE (NOT EXHAUSTING) ☐

(i.e. fast walking, tennis, easy cycling, volleyball, badminton, easy swimming, and easy dancing, etc.)

(c) MILD EXERCISE (MINIMAL EFFORT) ☐

(i.e. yoga, archery, fishing, bowling, golf, easy walking easy swimming, etc.)

23. Considering a 7 day period (a week), during your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

Often ☐ Sometimes ☐ never/ rarely ☐

Smoking Questions

24. Please indicate your smoking status.

Current smoker ☐
Ex-smoker ☐
Never smoker ☐

If currently smoking, how many per day? ☐

Fertility Questions

If you have never been pregnant, please answer Section A only.

If you have ever been pregnant, please answer Section B only.

By pregnancy, we mean any births, miscarriages, terminations and ectopic pregnancies

Section A ONLY ANSWER IF YOU HAVE NEVER BEEN PREGNANT.

25. Have you ever tried to become pregnant?

Yes ☐
No ☐

If yes

How long did you try to become pregnant?
(Tick one box only)

less than 1 year ☐
1 – 2 years ☐
Over 2 years ☐
Don't know ☐

26. Have you ever had regular intercourse without preventing a pregnancy (ie. not using contraception)?

Yes ☐
No ☐

If no, go to question 28

If yes,
How long did you not prevent a pregnancy?
(tick one box only)

< 1 year ☐
1-2 years ☐
> 2 years ☐
Don't know ☐

5

27. Have you ever seen a doctor (GP, hospital or specialist) or traditional birth attendant (faatosaga) about why you have not become pregnant?

- Yes – GP or hospital doctor ☐
- Yes – medical specialist ☐
- Yes – faatosaga ☐
- None ☐

If yes, please indicate if you were given any of the diagnoses listed below:

(tick all which apply)

- Ovulation problems ☐
- Sperm quality problems ☐
- Blocked fallopian tubes ☐
- Unexplained infertility ☐
- Endometriosis ☐
- Other ☐
- No diagnosis ☐

If 'other', please describe below

28. Do you expect to become pregnant in future?

(Tick one box only)

- Yes, definitely ☐
- Yes, possibly ☐
- Unsure ☐
- Probably not ☐
- Definitely not ☐
- Other ☐

If 'other', please give reasons below.

29. If in future, you felt you were having problems becoming pregnant, would you consider seeking medical advice?

- Yes ☐
- No ☐

If 'yes', when would you consider it appropriate?
After trying for:

(Tick one box only)

- up to 6 months ☐
- 7 months – 1 year ☐
- 13 months – 2 years ☐
- 25 months – 3 years ☐
- Over 3 years ☐

If 'no' would you consider seeking the advice of a traditional birth attendants or faatosaga?

- Yes ☐
- No ☐

If 'yes', when would you consider it appropriate?
After trying for:

(Tick one box only)

- up to 6 months ☐
- 7 months – 1 year ☐
- 13 months – 2 years ☐
- 25 months – 3 years ☐
- Over 3 years ☐

Section B ONLY ANSWER IF YOU HAVE EVER BEEN PREGNANT

30. How many times have you been pregnant? ☐

31. How many children have you had? ☐

32. Please fill in each column below as best as you can for all the times you have become pregnant even if pregnancy did not result in a live birth. If you are unsure how to complete the table please ask for help from a study assistant.

Pregnancy number	Year of pregnancy	Outcome of pregnancy (i.e. currently pregnant, live birth, stillbirth, miscarriage, abortion, or ectopic).	Any difficulties in becoming pregnant? (Yes/ No)	Consulted a doctor about these difficulties? (Yes/ No)	How long did it take you to become pregnant?
1					
2					
3					
4					
5					
6					

33. Did you ever try for another child after your last pregnancy?

Yes ☐
No ☐

34. Do you regard your family as complete?

Yes ☐
No ☐
Unsure ☐

If no

(a) Do you intend to become pregnant again?

(Tick one box only)

Yes, not preventing pregnancy now ☐
Yes, in the future ☐
No ☐
Don't know ☐

(b) If 'not preventing now', for how long have you been doing so?

(Tick one box only)

Less than 1 year ☐
1-2 years ☐
Over 2 years ☐
Don't know ☐

35. Have you ever seen your GP or hospital doctor about any difficulty in becoming pregnant?

Yes ☐
No ☐

If 'no', please go to question 36.

If yes, please indicate if you were given any of the diagnoses listed below:

(tick all which apply)

Ovulation problems ☐
Sperm quality problems ☐
Blocked fallopian tubes ☐
Unexplained infertility ☐
Endometriosis ☐
Other ☐
No diagnosis ☐

If 'other', please describe below

36. Have you ever seen a traditional birth attendant or faatosaga about any difficulty in becoming pregnant?

Yes ☐
No ☐

37. If in the future, you felt that you were having problems becoming pregnant, would you consider seeking medical advice?

Yes ☐
No ☐

If 'yes', when would you consider appropriate?

(Tick one box only)

6 months ☐
7 months – 1 year ☐
13 months – 2 years ☐
25 months – 3 years ☐
Over 3 years ☐

38. If in future, you felt that you were having problems becoming pregnant, would you consider seeking the advice of a traditional birth attendant or faatosaga?

Yes ☐
No ☐

If 'yes', when would you consider appropriate?

(Tick one box only)

6 months ☐
7 months – 1 year ☐
13 months – 2 years ☐
25 months – 3 years ☐
Over 3 years ☐

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE.
PLEASE CHECK THAT YOU HAVE ANSWERED ALL QUESTIONS THAT APPLY TO YOU.

PLEASE TURN OVER FOR QUESTIONS FROM THE MINISTRY OF WOMEN, COMMUNITY AND SOCIAL DEVELOPMENT

Participant Number | U | O | O | - | | | |

FAAAUTAMAINA I SAMOA

E talosagaina lau susuga mo ni au faamatalaga faamaoni i ou silafia maua mai taimi na e to ai, poo ni taimi foi na e saili fofo ai mo se to. O faamatalaga tuuina mai, e matua teu malu e le mafai ona faailoaina i se tasi vagana le auga o lenei suesuega. Ona o le tulaga faaaloalogia o faamatalaga, e le mafai ai ona faailoa pe tuliloaina oe, vagana lava ua manaomia nisi faamatalaga e te fesoasoani atili ai i lenei suesuega.

Afai o le a iai ni atugaluga e tulai mai lenei pepa o faamatalaga, ma e finagalo e talanoa (faalilolilo) mai ai, poo se tasi lava fomai e ese mai ia'i matou, o le a utagia lelei lea tulaga.

Sui o le su'esu'ega i Samoa:	**Telefoni**
Dr Tamasailau Suaalii-Sauni	00685-7278059
Ms Eseta Faafeu-Hope	00685-7610281
Faumuina Ms Siuomatautu Tapelu	00685-7751983
Ms Liai Iosefa	00685-7758770
Michael Walsh	00685-7291074
Lupe Isaia	00685-21212
Vaomalo Kini	00685-7566651
Manū Taialofa Naseri	00685-28888
Dr Maria Kerslake	00685-7762430
Dr Monalisa Punivalu	00685-7580678
Toleafoa Dr Viali Lameko	00685-27343

Alii Foma'i Faapitoa (Independent Obstetrician):

Le Mamea Dr Emosi Puni	00685-26519

MATUA MALU PUIPUIA TALI

Faamolemole tali le fesili pe ☑ faasa'o le pusa talafeagai mo oe

Fesili faatatau i le tala'aga

1. O le a le tausaga na e soifua mai ai? 1 | 9 | |

2. Faamolemole ta'u mai le nuu loo e alaala ai?

3. O le a le 'umi talu ona e alaala i le nuu e pei ona ta'ua i luga?

- Lalo ifo o le tausaga ☐
- 1-2 tausaga ☐
- 2-5 tausaga ☐
- Silia ma le 5 tausaga ☐

4. E te faigaluega?

- Ioe ☐
- Leai ☐

Afai e 'ioe', o le a lau galuega o faia nei.

- Galuega faaofisa ☐
- Galuega faa turisi ma fale tumatafaga mo tafaoga ☐
- Faatauoloa ☐
- Galuega faa-soifua maloloina pei o fomai ma tausi-soifua ☐
- Galuega a le Malo ☐
- Leoleo ☐
- Faifaatoaga ☐
- Faiauala, palama, inisinia ☐
- Fom ai, loia poo nisi galuega maualuluga ☐
- Faatauoloa I maketi ma autafa o auala ☐
- Faiaoga ☐
- Ninis it ☐

5. O le a lou tulaga tau faito'alua?

- Faaipoipo ☐
- Nonofo ma le paaga ☐
- Nonofo eseese/Tete'a/Maliu ☐
- Le'i faito'alua ☐

Afai e leai se paaga, alu sa'o i le fesili 10

6. O le a le umi talu ona lua mafuta ma lau paaga?

tausaga	masina

7. E faigaluega totogi lau paaga?

Ioe ☐
Leai ☐

Afai e ioe, o le a lana galuega?

Galuega faaofisa ☐
Turisi ☐
Faatauoloa ☐
Soifua Maloloina ☐
Galuega a le Malo ☐
Leoleo ☐
Faifaatoaga ☐
Faiauala, inisinia, palama ☐
Loia, Fomai ☐
Faatauoloa I maketi ma autafa o auala ave taavale, ave pasi, ave loli ☐
Fagota ma faifaiva ☐
Falegaosimea ma kamupani ☐
Faiaoga ☐
Nisi ☐

8. E i ai ni ou faailoga e pei ona ta'ua i lalo?

(Faamolemole faasa'o mai le faailoga maualuga ua 'uasia)

Tikeri mai se Iunivesite ☐
Faailoga Tipiloma ☐
Faailoga Tusipasi ☐
Faailoga tusipasi a'oga maualuga (School C, PSSC, ma isi) ☐
Leai se faailoga ☐

9. O le a le Ekalesia o loo e 'auai?

Metotisi ☐
Katoliko ☐
LMS ☐
Mamona ☐
Lotu Patipati ☐
Aso Fitu ☐
Baha'i ☐
Molimau a Ieova ☐
Isi ☐
Le lotu ☐

Fesili faatatau i le soifua maloloina

10. O le a lou 'umi? futu inisi mita

11. O le a lou mamafa? Maa pauna kilokalama

12. Sa e aafiai se tasi o tulaga e pei ona ta'ua?

(faasa'o uma vaega talafeagai)

- Ta'otoga o le faaautama (Tubal surgery)
- Ta'otoga e ave'ese le pitoga'au (Appendectomy)
- Ta'otoga o le faaautagata (Pelvic Surgery)
- Pala o le toala fanau (Endometriosis)
- Togafitiga o le kanesa (Chemotherapy)
- Ma'i afi (Chlamydia Infection)
- Ma'i afi (Gonorrhea Infection)
- O isi ma'i faaautagata (Other pelvic infection)
- HIV/AIDs

13. Ua e faaaogaina le aiga fuafuaina o le lupo?
- Ioe
- Leai

14. Ua fai sou ta'otoga e te le toe fanau ai?
- Ioe
- Leai

Pe afai e iai sau paaga, ua fai sona ta'otoga e le toe fanau ai?
- Ioe
- Leai
- Le talafeagai

15. S iai ni ou faafitauli faaumiumi i le soifua maloloina o lou tino?
- Ioe
- Leai

Afai e 'ioe', faamolemole faamatala

16. E i ai sou mai tumau o le tino?
- Ioe
- Leai

Afai e 'ioe', faamolemole faamatala

Fesili faatatau i feusuaiga

17. O le fia o outausaga na e faia muamua ai se feusuaiga? ☐

18. Ua fia nei ni aupaaga feusuai talu le 12 masina talu ai? Ta'u mai le aofa'i. ☐

19. Ua fia ni aupaaga feusuai talu mai ona e faia lea tu? ☐

Fesili faatatau i le taumafa 'ava malosi

20. E faafia ona e taumafa i le uaina, pia, poo le 'ava malosi?

	UAINA	PIA	'AVA MALOSI
E le inu ava			
Lalo ifo o le faatasi i le vaiaso			
Faatasi pe faalua i le vaiaso			
Sili atu i le faalua i le vaiaso			

21. A e inu uaina, pia, poo 'ava malosi, o le a le malosi e oo iai lau inu?

(Tick one box per column)

	UAINA	PIA	'AVA MALOSI
E le inu ava			
Lalo ifo o le faatasi i le vaiaso			
Faatasi pe faalua i le vaiaso			
Sili atu i le faalua i le vaiaso			

Fesili faatatau i le faamalosi tino

22. Pe a fua i le 7 aso o le vaiaso, e fia ni taimi e te faia ai ni ituaiga faamalosi tino mo le sili atu i le 15 minute I ou taimi avanoa?

(Tusi i le pusa le tali talafeagai)

(a) FAAMALOSI TINO MAMAFA(E TELEVAVE AI LE TATA O LE FATU) ☐

(i.e. tamo'e, mo'emo'e, netipolo, siva tele, judo, alovaa malosi, 'a'au malosi, vili uila malosi i se aualaumi, ma isi)

(e) FAAMALOSI TINO FEOLOLO (E LE FAAVAIVAI TINO) ☐

(i.e. savali televave, tenisi, vili uila feololo, volipolo, badminton, 'au'au feololo i le sami, sivasiva, ma isi)

(i) SINA FAAMALOSI TINO VAIVAI (TAUMAFAIGA LAITITI) ☐

(i.e. yoga, fanafana au, fagota, faataavale polo, ta polo, savalivali lemu, 'au'aulemu, ma isi)

23. Pe a fua i le 7 aso o le vaiaso, i ou taimi avanoa, e faafia ona e faia ni galuega 'u'umi e faaafu ai lou tino (e tata vave ai lou fatu)?

Tele o taimi	Nisi o taimi	Seāseā/Leai se taimi
☐	☐	☐

Fesili faatatau i le taumafa tapaa

24. Faamolemole, faailoa mai le tulaga o lau taumafa tapaa

O loo ulaula nei	☐
Sa ulaula	☐
E le ulaula	☐

Afai o loo ulaula i le taimi nei, e fia sikareti e ula i le aso? ☐

Fesili faatatau i le faatamataina

Afai e te le'i to muamua, faamolemole tali na o le vaega "**A**".

Afai sa e to muamua, faamolemole tali na o le vaega "**B**".

O le to, e faatatau i soo se fanauga, to fafano, to ŋa faamutaina, ma to i totonu o faaautama.

Vaega "A": TALI MAI PE AFAI E TE LE'I TO MUAMUA

25. Sa e naunau e te to?

Ioe	☐
Leai	☐

Afai e 'ioe'

O le a le 'umi na e taumafai ai? (faasa'ona o le pusa e tasi)

Lalo ifo o le tausaga	☐
1 – 2 tausaga	☐
Sili atu ma le 2 tausaga	☐
Le iloa	☐

26. Sa e faia ni feusuaiga e aunoa ma se aiga fuafuaina?

Ioe	☐
Leai	☐

Afai e leai, alu sa'o i le fesili 28

Afai e 'ioe', o le a le umi sa le puipuia ai oe?
(faasa'ona o le pusa e tasi)

Lalo ifo o le tausaga	☐
1 – 2 tausaga	☐
Sili atu ma le 2 tausaga	☐
Le iloa	☐

27. Sa e vaaia se foma'i, po o se faatosaga i le mafuaga o loulo to?

Ioe – Foma'i falema'i ☐
Ioe – Foma'i faapitoa ☐
Ioe - Faatosaga ☐
Leai ☐

Afai e 'ioe', faamolemole faailoa mai pe sa tuuina atu ia te oe se tasi o faafitauli e pei ona lisiina atu:

(faasa'o uma mai pusa e talafeagai)

Faafitauli tau faaautamaina (Ovulation problems) ☐
Faafitauli tau sua fanau (Sperm quality problems) ☐
Faafitauli tau puni faasautama (Blocked fallopian tubes) ☐
Ua le iloa (Unexplained infertility) ☐
Faafitauli tau pala toala fanau (Endometriosis) ☐
Nisi faafitauli ☐
Leai se faamatalaga (No diagnosis) ☐

Afai o se isi faafitauli, faamolemole faamatala mai i lalo:

28. O e faamoemoe e te to i le lumana'i? (Faasa'o le pusa e tasi)

Ioe, mautinoa lava ☐
Ioe, masalo lava ☐
Le mautinoa ☐
Ailoga ☐
Mautinoa e leai ☐
Nisi ☐

Afai o seisi mea ese mai, faamolemole aumai mafuaaga i lalo :

29. Afai e te fia to i le lumana'i, faamata e te saili i se fautuaga faafoma'i?

Ioe ☐
Leai ☐

Afai e 'ioe', o le a se taimi talafeagai mo lea faamoemoe? (Faasa'o le pusa e tasi)

Pe a uma le:

6 masina ☐
7 masina – 1 tausaga ☐
13 masina – 2 tausaga ☐
25 masina – 3 tausaga ☐
Sili atu ma le 3 tausaga ☐

Afai e 'leai', e te mafaufau e sa'ili se fautuaga mai se faatosaga?

Ioe ☐
Leai ☐

Afai e 'ioe', o le a se taimi tala feagai mo lea faamoemoe? (Faasa'o le pusa e tasi)

Pe a uma le:

6 masina	☐
7 masina – 1 tausaga	☐
13 masina – 2 tausaga	☐
25 masina – 3 tausaga	☐
Sili atu ma le 3 tausaga	☐

Vaega "B": TALI MAI PE AFAI SA E TO MUAMUA

30. Ua faafia ona e to? ☐

31. Ua to'afia lau fanau? ☐

32. Faamolemole, faatumu mai le avanoa i lalo ifo mo au to uma, tusa lava pe na fanaule au. Afai e te faaletonu i le faatumuga o le pepa faamoemole fesili mo se fesoasoani.

Aofaiga o to	Tausaga na to ai	Tulaga na oo iai o loo to, fanau ola, fanau mai oti, fafano, faamutaina, poo le to i le faaautama)	Sa iai ni faafitauli i le taumafaiga e te to ? (Ioe/Leai)	Sa vaai se foma'i e uiga i ia faafiatuli? (Ioe/Leai)	O le a le umi o ou taumafaiga ae to loa?
To muamua [1]					
To lona lua [2]					
To lona tolu [3]					
To lona fa [4]					
To lona lima [5]					
To lona ono [6]					

33. Sa e toe taumafai mo se isi tamaititi talu lau to mulimuli?

Ioe	☐
Leai	☐

34. Ua lava iina lau fanau?

Ioe ☐
Leai ☐
Le mautinoa ☐

Afai e leai

(a) e te toe fia to? (faasa'o le pusa e tasi)

Ioe, e le o puipuia le to i le taimi nei ☐
Ioe, i le lumana'i ☐
Leai ☐
Le iloa ☐

(e) afai e le o puipuia nei, o le a le umi talu ona le puipuia? (faasa'o le pusa e tasi)

Lalo ifo o le tausaga ☐
1-2 tausaga ☐
Sili atu ma le 2 tausaga ☐
Le iloa ☐

35. Sa e alu e vaai le falema'i, poo se foma'i, i lou le to?

Ioe ☐
Leai ☐

Afai e leai, faamolemole alu sa'o i le fesili 36

Afai e ioe, faamolemole faailoa mai pe sa tuuina atuia te oe se faamatalaga e pei ona lisiina atu i lalo:

(faasa'o uma mai pusa e talafeagai)

Faafitauli tau faaautama (Ovulation problems) ☐
Faafitauli tau i sua fanau (Sperm quality problems) ☐
Faafitauli tau puni faaautama (Blocked fallopian tubes) ☐
Le iloa (Unexplained infertility) ☐
Faafitauli tau i le pala o le toala fanau (Endometriosis) ☐
Nisi o faafitauli (Other) ☐
Leai se faamatalaga (No diagnosis) ☐

Afai o nisi faafitauli, faamolemole faamatala mai:

36. Sa e vaai se faatosaga e faatatau u lou le to?

Ioe ☐
Leai ☐

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37. Afai i le lumana'i ua e lagona o loo iai ni faafitauli i lou taumafai e te to, e te mafaufau e sa'ili se fautuaga faafoma'i?

Ioe ☐
Leai ☐

Afai e ioe, o le a tonu le taimi e te mafaufau e tatau ai? (faasa'o le pusa e tasi)

6 masina ☐
7masina – 1 tausaga ☐
13 masina – 2 tausaga ☐
25 masina– 3 tausaga ☐
Sili atu ma le 3 tausaga ☐

38. Afai e te fia to i le lumana'i faamata e te saili i se fautuaga faa-faatosaga?

Ioe ☐
Leai ☐

Afai e ioe, o le a se taimi tala feagai mo lea faamoemoe? (faasa'o le pusa e tasi)

6 masina ☐
7 masina – 1 tausaga ☐
13 masina – 2 tausaga ☐
25 masina– 3 tausaga ☐
Sili atu ma le 3 tausaga ☐

FAAFETAI TELE MO LE FAATUMUINA O LENEI PEPA FESILI! FAAMOLEMOLE, SIAKI PE UA TALI UMA FESILI E AGAVAA MA OE, ONA FAAFO'I MAI LEA.

SUSUE I LE ISI ITU O LE PEPA MO FESILI A LE MATAGALUEGA O TINA MA TAMAITAI

Fesili Faaopopo:

MATAGALUEGA O TINA MA TAMAITAI MA AGA FESOOTAI

O nei fesili e fesootai ma le lotoifale, o taito'alua ma sauaga faafeusuaiga. O tulaga o nei fesili e le fesootai ma le pepa o fesili o loo i luma lea sa e faaturnuina. O au tali o nei fesili e tuusao atu ile Matagaluega o Tina ma Tamaitai e latou te iloiloina. E leai se fesootaiga ma le autu olenei galuega pei ona iai le matou sailiga.

1) Na fasi oe e se isi ile lua tausaga talu ai?

Ioe ☐
Leai ☐

2) Na faamalosi oe e se isi e fai se faiga aiga i le lua tausaga talu ai

Ioe ☐
Leai ☐

Schematic showing recruitment process at a village level