Estimation of Coital Frequency and Condom Use from Cross-Sectional Survey Data

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Declaration

I, Emma Slaymaker, confirm that the work presented in this thesis is my own.

Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

Coital frequency is an important theoretical determinant of the rate at which an STI can spread through a population. Differences in frequency of sex may bias measures of condom use based on survey data because survey respondents who have infrequent sex and those who have frequent sex contribute equally to commonly used measures of condom use. Data on sexual behaviour are widely available from surveys but detailed information on coital frequency is seldom collected. This thesis examines the available information, examines the utility of a method to make the most use of existing data and investigates whether condom use measures are biased by differences in coital frequency using, for the most part, data from Australia and Tanzania.

The existing data and literature show a lack of information on coital frequency for men and for unmarried people. Certain factors are correlated with coital frequency but there are no stable patterns of variation between different populations. Data from Australia and Tanzania show that condom use and coital frequency both vary according to the types of partnership for which they are reported. Further analysis of commonly used measures of condom use shows that these measure are influenced by differences in coital frequency and demonstrates that additional measures, describing the proportion of sex acts protected by condoms, provide complementary information. The scarcity of data on coital frequency is unlikely to be resolved by using the more widely available information on time since most recent sex. Although it is theoretically possible to work backwards from this to the number of sex acts in a given time period, this does not work in practice. Recommendations are made for improved methods to collect coital frequency information in large-scale surveys of the general population.

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List of Abbreviations

AIC	Aikaike's Information Criterion
AIDS	Acquired Immune Deficiency Syndrome
ASHR	Australian Study of Health and Relationships
CSW	Commercial Sex Worker
DHS	Demographic and Health Surveys
GPA	Global Programme on AIDS
HIV	Human Immunodeficiency Virus
LSHTM	London School of Hygiene and Tropical Medicine
MeSH	Medical Subject Headings
MICS	Multiple Indicator Cluster Surveys
NSA	National Surveys of Adolescents
PSI	Population Services International
STI	Sexually Transmitted infection
TCR	Total Coitus Ratio
TSFS	Time Since First Sex
TSLS	Time Since Last Sex
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNICEF	United Nations Children's Fund
WFS	World Fertility Survey

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Chapter 1 Introduction

1.1 Background

Sexual behaviour is studied for a variety of reasons using a range of qualitative and quantitative methods. Quantitative data are collected on a large scale principally to elucidate the epidemiology of sexually transmitted infections (STIs) including HIV and to understand fertility patterns. Many countries have conducted nationally representative surveys of the general population that have included questions, or entire modules, on sexual behaviour. A smaller number of countries have conducted one or more surveys specifically on sexual behaviour/sexual health. In addition, there have been many studies with a smaller scope restricted either to specific groups (e.g. young people, sex workers, men who have sex with men (MSM)) or with a focus on particular aspects of behaviour (e.g. contraceptive use).

Before the advent of HIV there was little standardisation between surveys, most of which were conducted in the developed world. A notable exception were the World Fertility Surveys conducted in selected developing countries during the late 1970s and early 1980s and which were the forerunner of the Demographic and Health Surveys (www.measuredhs.com). Although these were standardised their focus was limited to fertility and little was asked about sexual behaviour more generally. Most enquiries were limited to married women.

The HIV epidemic provoked greater interest in sexual behaviour. The need to mobilise governments and communities and to motivate and measure progress in HIV prevention has led to the development of standard measures of sexual behaviour and recommendations about the aspects of behaviour that should be monitored over time. In low income countries much of the data used to monitor progress come from the Demographic and Health Surveys and UNICEF's Multiple Indicators Cluster Surveys (MICS www.unicef.org/statistics/index_24302.html) and the survey instruments used by these organisations have become the de facto standard approach. The establishment of the Millennium Development Goals (MDGs) has generated more demand for these data.

Many developed countries also collect detailed sexual behaviour data. Some, such as the UK, field regular surveys solely on sexual health/behaviour (e.g. Natsal) and consequently tend to have access to detailed information. Other countries are less systematic in their approaches. Data are less comparable between countries due to differences in survey instruments and methods. There are gaps in the data and some difficulties in accessing data.

Despite there being a range of surveys from nearly 100 countries spread over the past 25 years remarkably little is known about some aspects of sexual behaviour. An area of particular ignorance is coital frequency. Early work on contraceptive efficacy and from the World Fertility Surveys provided some data, and a few later studies have filled in some gaps but most of the major data collection efforts in the last 20 years have overlooked this topic.

Coital frequency, the number of sex acts during a given period of time, is a key theoretical determinant of STI spread. It is directly relevant to condom use, and planning for the adequate provision of condoms. Differences in coital frequency may confound associations between STI incidence and other measures of sexual behaviour such as sexual partner numbers. Without information on coital frequency there is no way to tell whether someone with two partners is having more sex than somebody with only one partner. Somebody who has two partners rather than one has twice the risk that one partner will introduce an infection. However, if sex is infrequent with both partners the actual exposure may be no higher than the person with only one partner. It is therefore important to measure coital frequency and to understand any differences.

1.2 Objectives

This thesis aims to review the information and data available on coital frequency, to analyse more recently collected data on coital frequency with reference to the literature and HIV risk, to demonstrate how differences in coital frequency can bias condom use measurements and finally to make recommendations for the collection of coital frequency data in surveys and cohort studies. Specifically, to:

1) Review the literature on coital frequency in the general population
2) Locate, review and summarise previously unpublished, publicly available data on coital frequency in the general population.
3) Describe methods for estimating coital frequency from cross-sectional survey data.
4) Try out a method for estimating coital frequency from data on time elapsed since most recent sex.
5) Analyse two recent sources of data on coital frequency from different populations including regression analysis of correlates of coital frequency:
    a) Tanzania: data from one round of the Kisesa cohort study on HIV in North Western Tanzania
    b) Australia: data from a national survey on sexual behaviour
6) Illustrate how condom use analyses might be biased if coital frequency is not taken into account
7) Recommend methods for the collection of coital frequency data in survey and cohort study settings.

1.3 Conceptual Framework

Two conceptual frameworks are shown. Figure 1 illustrates the processes leading to sexual acquisition of infection and Figure 2 illustrates the processes that lead to onwards sexual transmission of infection.

Acquisition

The processes that lead to an uninfected person acquiring HIV infection were derived from the proximate determinants framework[1] but have a more specific focus on sexual behaviour. In the proximate determinants framework the three components of the basic reproduction rate for an infection (effective contact between a susceptible and an infectious individual, duration of infectivity and probability of transmission)[2] are described as the biological determinants and are more proximate than the sexual behaviour factors listed. In this framework describing the acquisition of infection, two of those components are listed as separate stages: contact between a susceptible and an infected person and the probability of transmission, which is the more proximate since the latter is conditional on the contact between susceptible and infected partners. Duration of infectivity is not explicitly described as such in this framework but it features in two places: the HIV prevalence among potential partners and the viral load of the infected partner.

The different stages in the process of acquiring infection are listed at the top of Figure 1. Underneath each stage are listed, in boxes, the major factors and within each box are shown characteristics or behaviours that define or modify the main factors. The processes are illustrated as a straight line of causation from the most distal to the most proximate. However feedbacks are thought to exist and those most relevant for this thesis have been indicated on the diagram in grey arrows. The lists of factors are not exhaustive: those chosen are the most relevant to the sexual behaviour measures discussed in the thesis. Other potential feedbacks are not shown on the diagram, for example the acquisition of a new partner could lead to a change in residence, SES, marital status and these factors in turn also influence the opportunity to meet new partners.

Social and personal circumstances shape sexual behaviour and modify HIV risk. The time and location of sexual behaviour determines the HIV prevalence among sexual partners which is the primary determinant of HIV risk. For example, having unprotected sex in

KwaZulu Natal in South Africa in the early 1990s was less likely to lead to an HIV infection than nowadays, but in Uganda the risk was probably higher in the 1990s compared to today. Year of birth and geographical location are clearly determinants of the HIV prevalence amongst the pool of potential sexual partners available to an individual. However, more immediate factors may have an equally important influence. Timing of first sex can influence later sexual behaviour: individuals from otherwise similar backgrounds may have different sexual lifestyles that result from the manner in which they begin their sexual activity. Time since first sex also describes much about the circumstances of an individual's sex life, something that is influenced by more personal factors. Social status, wealth, mobility, education and HIV awareness all contribute towards the ability of a person to form, or refuse, sexual relationships. Marital history and marital status also affect these decisions. Personal preference underlies all of these factors and governs not only motivations for sexual behaviour but also the degree to which the individual is prepared to deviate from socially acceptable conduct with regard to sexual behaviour.

Exposure to an infected partner is a prerequisite for infection and this exposure can happen in two ways. An existing sexual partner can become infected or an individual can acquire a new partner who is already infected. When the partner acquisition rate is low for a sub-group of individuals their existing partners may provide the majority of infectious partners.

Infection of an existing partner is likely to lead to an exposure to a person who is highly infectious (because recent infection implies high viral load). The chance that an existing partner seroconverts depends on the nature of the partnership. For seroconversion an outside exposure to HIV infection is required. This may be via parenteral exposure but, where sexual transmission dominates, the likelihood of HIV being introduced to one of a hitherto concordant negative couple depends on whether it is the type of partnership in which mutual monogamy is the (ideal) norm or conversely a partnership where one or both partners are permitted to have other partners. An individual who has a lot of partners increases their own chance of having one of their partners seroconvert during their relationship. Longer duration of partnerships may also increase the chances of seroconversion taking place during the partnership because of longer exposure. However it could equally well suppress the risk of the partner acquiring HIV infection because longer

term partnerships are more likely to be mutually monogamous than partnerships of short duration.

The rate at which an individual acquires new partners dictates the rate at which they may become exposed to an HIV infected partner. This risk is heavily modified by the selection process for new partners. The age and sex of the partner, the type of relationship, when the partnership starts and its duration are all connected to the likelihood that the partner already has HIV infection.

If an individual is sexually exposed to an HIV infected partner, a number of factors then affect the risk that HIV infection is acquired from that partner. The viral load of the infected partner is an important determinant. Other STIs in one or both partners, male circumcision and condom use all influence the chances of transmission of infection. Number of sexual acts determines the number of opportunities for infection to occur.

Transmission

The processes governing the onwards sexual transmission of infection are not identical to those governing acquisition. The personal influences listed are similar but in this framework the individual's knowledge of their own HIV status, and consequent ill health or treatment are likely to profoundly influence the motivation and opportunity for sexual activity (in contrast to the acquisition model, where knowledge of the partner's status would be the corresponding determinant). Exposure to an uninfected partner is essential for onwards transmission of infection. This is affected by the number of partners, whether they have other partners (who may infect them and render them insusceptible) and duration of relationship. Partnerships of longer duration may be more efficient for onwards transmission of infection because they present more opportunities for transmission. Acquisition of new partners presents more opportunities for transmission, characteristics of the new partner influence the chance that they have previously acquired infection elsewhere.

Given contact with a susceptible partner, coital frequency dictates the number of opportunities for transmission. Condom use and male circumcision limit the potential for transmission. Other STIs increase the probability of transmission. High viral load increases

the risk of transmission. It is high in the very early and late stages of infection and substantially lowered by effective anti-retroviral treatment (ART).

Interactions and feedbacks

The factors shown in the conceptual framework are interdependent to some extent. These dependencies are not shown for simplicity. The grey arrows indicate those most relevant to this thesis. Having one or more sexual partners is likely to influence the acquisition of other partners. The social standing of the existing sexual partners will further influence this: an established partner such as a spouse may be more of a disincentive to acquire further partners than a more casual partner. Coital frequency may be determined by the duration of partnerships and may influence their continuation. It may also be related to the inception of new partnerships if an existing partnership does not fulfil either partner's sexual needs. Condom use may influence the coital frequency within a partnership, and desired coital frequency may influence the choice of contraceptive method.

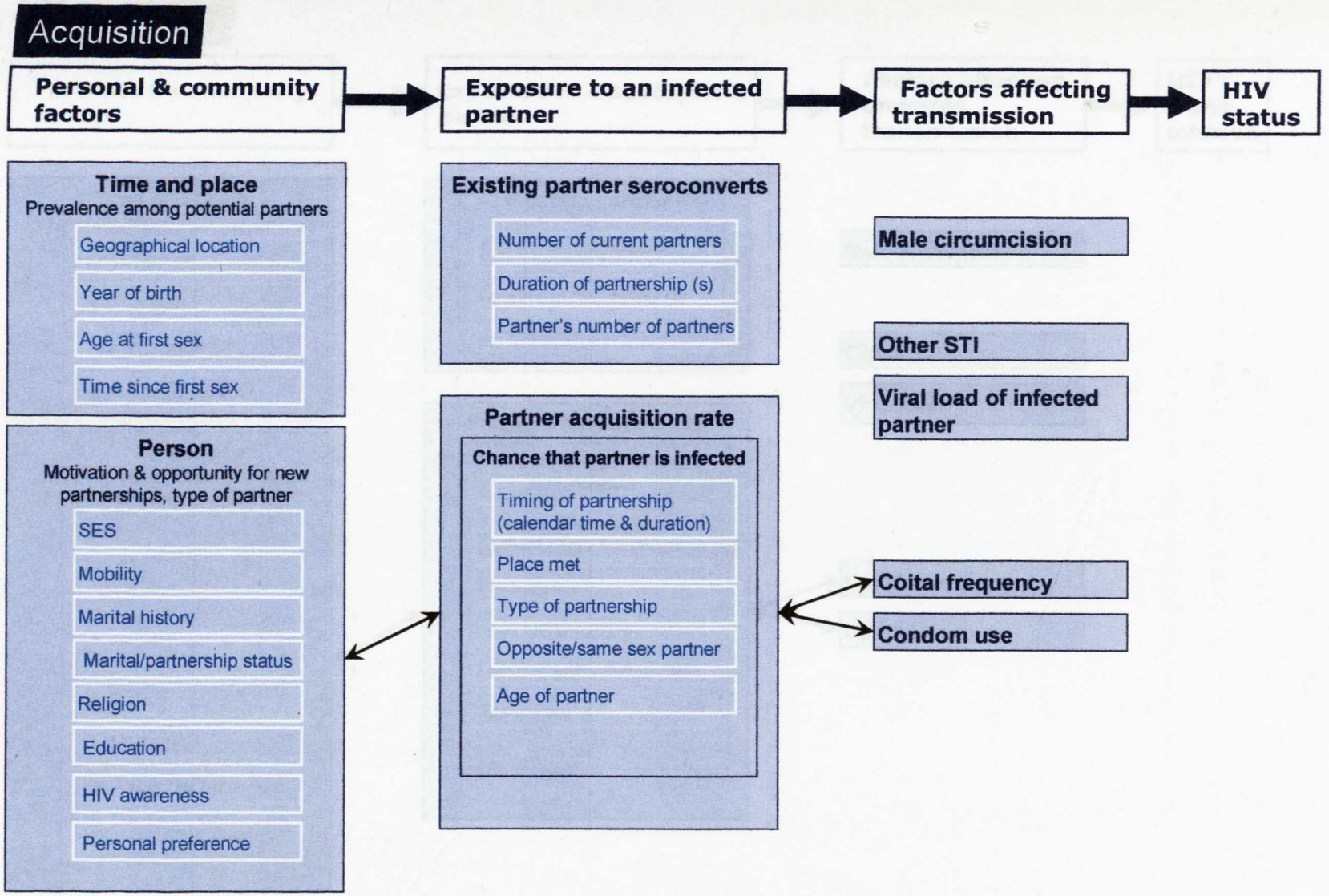


Figure 1: Conceptual framework for the role of sexual behaviour in the acquisition of HIV infection

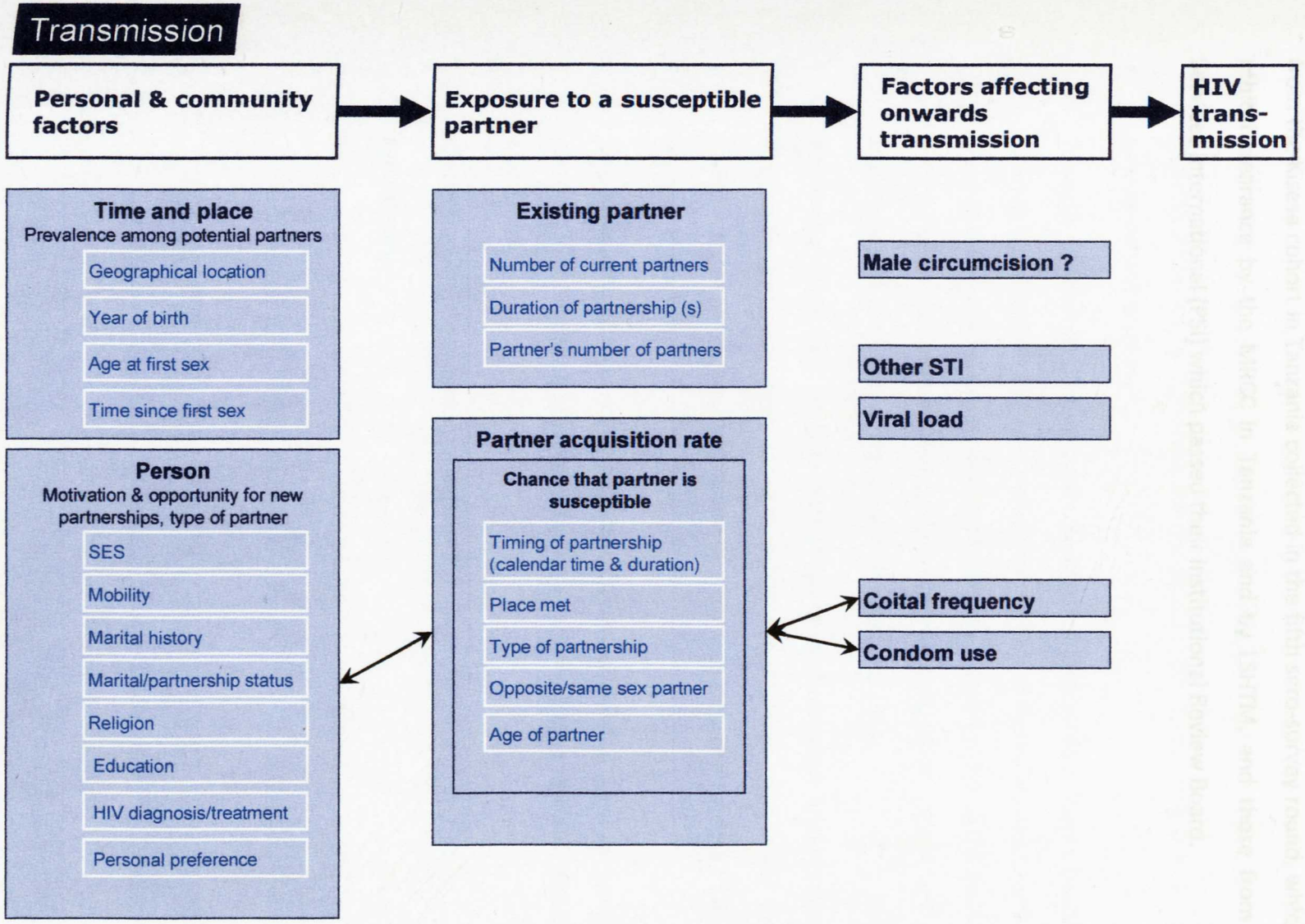


Figure 2: Conceptual framework for the role of sexual behaviour in the transmission of HIV infection

1.4 Ethics

This thesis is based entirely on the secondary analysis of data that had already been collected for other purposes. All these data had ethical clearance from an appropriate body and the majority are publicly available. The only datasets not publicly available are the data from the Kisesa cohort in Tanzania collected in the fifth sero-survey round, which was given ethical clearance by the MRCC in Tanzania and by LSHTM, and those from Population Services International (PSI) which passed their Institutional Review Board.

1.5 Structure of Thesis

2. **Literature Review**. This thesis starts with a review of the literature pertaining to coital frequency in the general population. The focus of this review was on the literature that provided estimates of this frequency.
3. **Data Review:** Analysis of unpublished survey data which contains information on coital frequency from the general population and review of the results.
4. **Statistical modelling:** Rationale and proposed method for using time since last sex to predict coital frequency.
5. **Analysis of ASHR data on coital frequency and time since last sex:** Descriptive analysis and negative binomial regression models of the correlates of coital frequency in national survey data from Australia. Application of the proposed method to derive coital frequency from reported time since last sex, and an assessment of the utility of this approach using real data.
6. **Analysis of coital frequency data from Tanzania:** Descriptive analysis and negative binomial regression models of the correlates of coital frequency in the population of Kisesa ward in North Western Tanzania using data from the Tazama Project's cohort study in this ward.
7. **How does coital frequency influence estimates of condom use?** An empirical illustration using data from Australia, Burkina Faso, Ghana, Malawi, Rwanda, Uganda and Zambia.
8. **Discussion and Recommendations**
9. **References**

Chapter 2 Literature review of coital frequency in the general population: estimates, correlates and variation.

A literature search was conducted using Web of Science and Medline. Search terms were "coital frequency" and "sexual behaviour", which is a MeSH term. Retrieved references (N 993) were examined to see if they contained information on coital frequency. 74 papers were retained and 24 used in this review. Excluded papers contained no new information, were not relevant to the general population or did not provide estimates of coital frequency. References in the selected papers were examined and any additional relevant papers were obtained. This search was first conducted in 2004 and subsequently updated, with the addition of one new paper[3], during final preparation of this thesis.

An inventory of papers used in this review is given in Table 2 which describes the study population and main findings of each study. A summary of the estimates from each study (where applicable) are given by age in Table 7 and by marital duration/status in Table 11.

Datasets pertaining to the general population and with information on coital frequency were identified and analysed and these are discussed in the next chapter. Estimates from three papers which discuss DHS data[4-6] are not included in this chapter because each paper used a different selection of surveys and different summary measures and all the DHS data have been analysed in a comparable fashion in the next chapter.

Estimates from one paper[7] have not been reported because it seems likely that one of the non-response codes (88) was inadvertently included in the calculation of the means[8].

The Schneidewind-Skibbe paper is a[3] review of studies that report coital frequencies for women and was conducted between the initial writing of this chapter and the final preparation. There is a great deal of overlap in the studies presented here and in that paper but those authors also found a large number of papers in the psychology literature, mostly relating to the USA. The authors report the coital frequencies from each of these studies, as is done here, but do not draw together the results and many of the statements in the discussion are based on research in quite specific populations groups but this is not set in context. There are 20 studies in the Schneidewind-Skibbe paper that are not mentioned

here. Ten are from the USA and, given time and space constraints, were not further considered since the results do not add much to the other US studies already identified and reported here. The remainder were almost all studies in restricted populations- either based on unusual sample frames or specific groups such as older people and were also not included as they were not relevant to the general population.

2.1 Motivations for measuring coital frequency

Most of the research on coital frequency has focussed either on the role of coital frequency as a determinant of fecundability[4 9-11] or as an explanation for observed patterns of fertility[5 12-13]. Coital frequency may be of critical importance for the spread of HIV (and other STI). In this context it is inextricably linked with family planning choices and, in particular, condom use. Within a partnership where one person is infected with HIV and the other is uninfected the cumulative risk of HIV transmission probably increases each time they have sex without a condom[14] but this process has not been well described, due to a lack of data. Risk of HIV infection is thought to increase rapidly with the first few sex acts and may then plateau[14-15].

Recently, interest in the role of concurrent partnerships in the spread of HIV infection in generalised epidemics has stimulated interest in coital frequency[16].

2.2 Availability and quality of data and estimates

Coital frequency is difficult to measure because one must rely on respondents' reports and data quality is therefore dependent on their ability to accurately recall their activity and their willingness to give an accurate report to the interviewer. The most common method of data collection is to incorporate questions about the frequency of sex into surveys of fertility and reproductive behaviour. Potential advantages of this approach are that the survey population is likely to be the most sexually active segment of the population and the focus on fertility and family formation may encourage respondents to participate. Samples are usually nationally representative and provide high quality data on respondents other characteristics because many of these surveys are well established and carried out with good funding and technical support. Potential disadvantages are that the data rely on recalled behaviour, may not use reference periods that are appropriate to all respondents and the questions may be interpreted differently by different respondents but this may not be apparent to the analyst.

Respondents are typically asked to report the number of acts in a given period (e.g. four weeks or one month). In some surveys this specifically relates to a particular partner, one that has already been identified in the survey and questions may then be repeated for other partners where applicable. In other enquiries the total number of acts is sought. The precise definition of an act is rarely given. In the absence of a definition, some respondents may class two episodes of penetrative sex that occur close together in time as one act whilst others may report this as two acts. Figure 3 shows the questions used in the DHS round II surveys. In these surveys the questions followed after some general questions about marriage history. In later phases of the DHS the two direct questions about number of acts were dropped but the question on the time since last sex was retained and moved after some new questions about age at first sex and numbers of sexual partners. Surveys which collect the time since last sex ask the question in more or less the same way as the DHS example given here. Number of acts was used as reported for most surveys but transformed to the same reference period (e.g. four weeks) for comparison purposes.

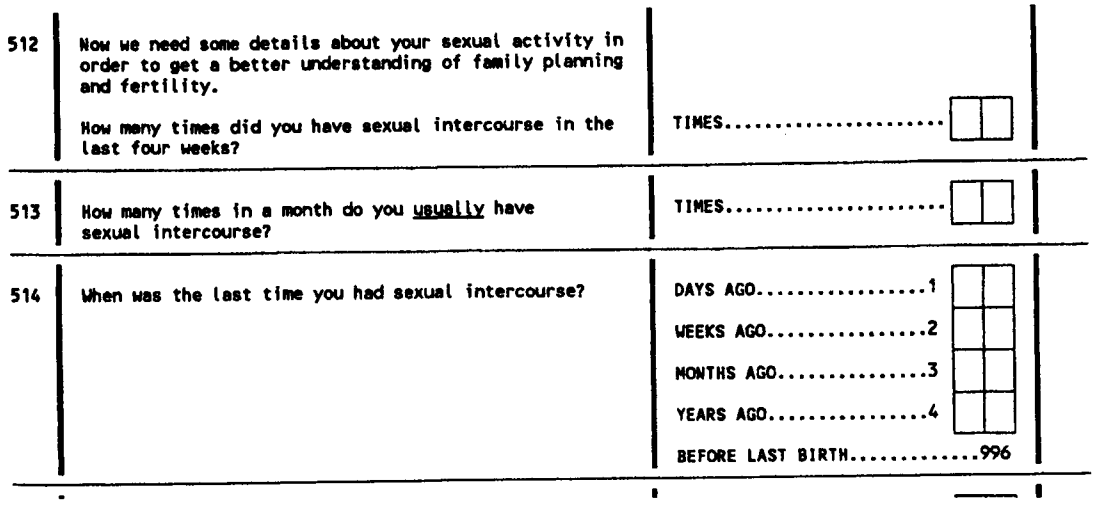


Figure 3: Excerpt from DHS phase II model questionnaire showing the questions used to collect data on coital frequency.

2.2.1 Bias and measurement errors

Survey data of any sort are intended to capture the distribution of characteristics in the populations they represent. They may fail to do this adequately for a number of reasons which relate to the design and implementation of the survey.

Problems with the sample frame, or the sampling method chosen, can introduce selection biases whereby certain groups of people become more likely than others to be invited to

take part. The information used in this thesis comes from studies based on formal samples designed to represent the general population. Some of these may have suffered from selection biases due to incomplete or inaccurate sample frames or errors in the implementation but unfortunately such problems are likely to be inapparent to end users of the data. Restriction of data sources to those with formal and rigorous samples should have ensured that such errors are unusual.

Certain types of eligible participants may be more likely to take part in particular surveys, both for reasons extrinsic to the survey, such as time limitations, or intrinsic reasons, such as being unwilling to discuss sexual behaviour with a stranger. Problems germane to most household surveys, such as the difficulty in interviewing working people, can be apparent from response rates disaggregated by age and sex. Men in their twenties are notoriously hard to enumerate fully and in some countries response is also low among young women. More context specific participation biases are harder to anticipate and therefore detect, especially when conducting a cross country analysis without detailed knowledge of each studied population. Consequently, subtle differences in participation in particular surveys may well have gone undetected. However there is no reason to think that there are similarities with respect to sexual behaviour people who did not participate across all the different surveys. This is even the case for people who did not want to participate because of the nature of the survey. One can speculate that people who did not wish to discuss their sexual behaviour were more sexually active than average (and thus concerned that their behaviour was not socially desirable), or equally that they were less active (young, relatively inexperienced and equally concerned about the social desirability of their behaviour). Furthermore, many of the surveys reported in this thesis had a broader remit than just sexual behaviour, which may have improved response compared to surveys soley on sexual behaviour. It does not seem likely that non-participation in surveys would have led to systematic differences in the data collected across all the surveys. It might well have led to certain surveys being poorly representative of the population studied, and this might explain why some countries appear to be unlike others, or why some sections of the population appear different. However, using only the survey data it is impossible to assess whether this is the cause of any observed differences.

Another bias, reporting bias, is more troubling because it is much harder to identify or quantify. There is essentially no way to determine the validity of the sexual behaviour data provided in a quantitative survey setting. Cross check questions, when the same information is collected in two different ways during the survey, can help uncover inconsistencies in reporting. However, if these are only revealed at the analysis stage they do not help the end user establish the correct answer. If the inconsistency is flagged up during the interview, the respondent may feel judged or confused, and not reveal the correct answer. If a respondent is consistent, but incorrect, there is no way to determine this. Response errors may arise because of genuine difficulties recalling and reporting a behaviour. They may also arise because the respondent wishes to conceal the truth and present instead a version that they believe to be more socially acceptable.

Concern about the quality of the sexual behaviour data collected in surveys is as old as the surveys themselves and a variety of studies have tried to establish the degree to which these data are reliable and accurate[17].

The possibility of using biomarkers, such as prostate specific antigen, to detect sexual activity provides some external validity check on self reported data[18]. It is limited because the biomarker data can only detect errors where a repsondent reports no sex, or sex only with a condom. Other differences, such as type of partner, cannot be revealed.

Another possible means of validation is the comparison of couple reports. On the whole couples agree with each other but the accuracy of recall diminshes with increasing time since the event of interest [19-20]. However, Bangladeshi couples were found to have quite different reporting of the use of coitus dependent contraceptive methods, perhaps because there was no set pattern of use which made recall difficult [21]. Therefore the extent of recall errors may vary between different items within a questionnaire rendering some behavioural measures more accurate than others even within the same setting.

An alternative validation can be obtained by re-interviewing survey participants at a later date, although this may increase the possibility of recall bias at the later interview. Using this approach with a Swiss phone survey, the authors[22] found good agreement on aggregate measures.

The accuracy of recall can also be assessed by comparing prospective and retrospective measures of the same behaviour. Comparing a retrospective survey with a prospective diary of sexual activity, Hornsby [23] found the retrospective reports were higher than the prospective and suggests that participants didn't take into account, illness, temporary separations, menstruation, and thus overestimated their coital frequency. The degree of overestimation was in the same direction and of similar size for all participants and therefore, they suggest, of little concern. Inclusion in this the study was based on having very high reported coital frequency at enrollment. Perhaps potential participants may have agreed that this was their level of coital frequency when hoping to join the study, perhaps without thinking too hard about it, only to have a lower level revealed during the study.

In Uganda the pilot phase of the GPA survey involved triangulation with in-depth interviews, key informant interviews and the structured questionnaire. They found reasonable consistency for most of the questionnaire with the exception of high risk behaviours which were underreported [24].

Methods to improve reporting have been tried in an attempt to include data quality. Comparisons between methods reveal the impact of the method of data collection on the disclosure of particular behaviours. In a Zimbabwe cohort study a secret voting method is used [25] which found the effects of reporting method on disclosure differed by item and the degree of change between the two methods was not consistent between items or over time. Similar results were obtained with a comparison of face to face and ACASI in Kenya [26]. Here the authors leant towards ACASI as the more truthful version owing to more disclosure of circumscribed behaviours/experiences using this method.

Similar findings were obtained from a phone survey amongs the Chinese speaking population in Hong Kong, comparing interviewer only and combined interviewer and computerised data capture. There was greater disclosure of risky/less desirably behaviours in the computerised data capture group. One form of reporting difference was that women were more likely to describe their sexual partners as husbands rather than boyfriends in the interviewer administered questionnaire compared to the computer assisted version[27].

This more subtle form of reporting bias was evident in data collected in a face to face survey in Tanzania[28]. Differences between men and women were largely explained by the different

descriptions of sexual partners given by men and women. Another study of young people in this population found poor quality of reports in survey data compared to other methods of data collection including in-depth interviews and biomarker data [18]. Young people in this population did not consistently reveal risk behaviours in the survey setting.

However, an assessment of data quality from repeated cross sectional surveys of adults in three African HIV cohorts found that, although there was considerable inaccuracy in the reporting of age at events (first sex and first marriage) these differences were not directional. Inconsistency in reporting age at first sex on different occasions was therefore a source of noise in the data but not a source of bias. However, in some birth cohorts there was a suggestion that over time a later age at first sex was reported, perhaps indicative of a reporting bias in response to campaigns to delay sexual debut. These campaigns may have changed ideas about what age was socially desirable during the study period (10 years in one site) [29] highlighting an additional problem of reporting bias when looking at trends over time.

Change between surveys in 1990 and 2000 in the reported prevalence of certain behaviours (such as homosexual partners) in the Natsal studies in Britain[30] could have been due to greater disclosure of such behaviours in the later survey. This could have been because computer assisted interviewing was used in the later survey. Equally, reported attitudes towards homosexual partnerships are more favourable in the later survey: this could have created an environment that facilitated disclosure of such behaviour or could have been a product of an increase in the prevalence (or prominence) of homosexual partnerships.

A commonly reported problem with sexual behaviour data are the differences in the numbers of partners reported by men and women (for example [31-32]) and these differences may be taken to indicate overall poor data quality or an extensive difference in reporting bias between men and women. However, these are likely to be simplistic explanations. In most populations there are age differences between men and women. In surveys which restrict participants to a certain age range the sexual partners of the youngest men and oldest women may well be excluded. Failing to survey both sides of the couple is an obvious cause of asymmetry in the reports from each sex. Differences in participation (often under-representation of young men in household surveys), failure to capture female sex workers

with large numbers of partners (where applicable) and differential reporting by men and women are all likely to play a part in the observed differences [32].

The data used in this thesis could suffer from selection, participation and reporting bias. In fact this thesis makes use of many of the datasets on which the papers discussed above were based. These biases are unlikely to affect all studies equally, the nature and extent of the bias probably varies between surveys and between items in the same survey. The implications of this are firstly, to exercise caution when interpreting findings that include absolute numbers and to be sceptical of differences and trends that cannot be corroborated from elsewhere. Triangulation of data, where possible, is likely to be helpful [33]. In multivariate analysis, the influence of reporting bias can be minimised, although not corrected, by controlling for factors which could affect reporting, including the survey when making comparisons over time. Nonetheless the existence of bias does not invalidate the data – no method of measurement is without error and there is no consensus that the direction or extent of reporting bias is such that it undermines what can be concluded from survey data on sexual behaviour.

The quality of sexual behaviour variables, including coital frequency, reported in Demographic and Health Surveys (DHS) was assessed by Blanc and Rutenberg and found to give a reasonable picture at the aggregate level[4]. Some inconsistency was evident in the responses of individuals and 'heaping' was evident in some responses, for example, respondents were more likely to report certain coital frequencies than would be expected. This was also evident in the WHO Global Programme on AIDS surveys carried out in the early 1990s but was not thought to invalidate the data collected[34]. Heaping of responses to questions about time elapsed since the last event, or the frequency with which something occurs may be brought about by the way in which questions are phrased or they way in which responses are recorded by interviewers[4]. It may also show a level of imprecision in respondents' memories of the events or in their summary of that information, akin to giving the time to the nearest five minutes when asked.

Some authors have expressed concern that retrospectively reported frequencies are too high because respondents tend not to account for disruptions to what they perceive as their normal pattern of sex- so menstruation, temporary absence of the partner, illness and so on are not taken into account.

The accuracy in recalled reports of coital frequency is assessed by Hornsby and Wilcox[23]. Using data from a study of hormonal levels in women who were not pregnant nor using any hormonal contraception they found that retrospective reports were, on average, much higher than would have been expected from the subsequent prospective data. The results were not from the same time period so the individual reports are of little use. The difference between the average reported frequencies may be vulnerable to confounding if other factors that determine coital frequency differed between the two estimates.

Steiner et al[35] also tackled this problem using data from 221 US women who were participating in a contraceptive efficacy trial for a female condom. To be eligible for the study the women had to be aged between 18 and 40, report an average of 2 sex acts a week and be in a mutually monogamous heterosexual relationship. By comparing the data from the enrolment interview with that collected prospectively during the course of the study, the authors found that the retrospective frequencies tended to be higher than the prospective estimates. This study ran for longer and the sample size was larger and so corroborates the findings of Hornsby and Wilcox. This was a sample of very active women – the prospective mean frequency was 11.8 acts per month, compared to 12.6 acts reported retrospectively. The authors don't give any measure of significance of the difference, or whether the frequencies reported by some women were consistently different from the baseline estimate and thus represent a real change in frequency.

Problems with retrospectively reported frequencies and with estimates of "usual" frequency, have meant that many surveys do not ask respondents to provide these estimates but rely instead on the number of days elapsed since the last sex as a proxy measure of frequency. This has the advantage of being more easily recalled and reported by the respondent. Respondents may be less likely to give a normative response since the purpose of the question may not be clear to them, unlike a direct question regarding the frequency of sex.

2.3 Underlying models of coital frequency

Collection of data on coital frequency is likely to be more successful if the data collection instruments are designed around a theory about the process which generates the true coital frequency in the population. None of the papers discussed in this chapter explicitly

mentions this but three studies used existing data to explore such models of underlying coital frequency.

Leridon[36] used data from a French national survey conducted in 1992 to describe the relationship between number of acts in a given period and time since last sex. His interest was primarily in determining which was the more reliable measure.

He defined the open-interval, which is the time elapsed between the most recent sex and date of interview, as a function of the closed interval that occurs between two sex acts. He used the reported number of sex acts in the four weeks before the survey to estimate the average length of the closed intervals between two acts using two different distributions: the exponential and log-normal. He compared these estimated times since last sex with that reported by the respondents, as a measure of the quality of the reporting of the number of sex acts.

He found that there was a good correspondence between the time since last sex based on respondents' reports and that derived from the reported number of sex acts in 4 weeks. Both the mean and the variance calculated based on an exponential model (i.e. a constant hazard) showed good correspondence with the reported estimates. This analysis was, necessarily, restricted to respondents who had had sex at least once in the 4 weeks before the survey.

This approach rests on the assumption that there is no within-person variation in the chance of sex occurring. Leridon looked at day of last sex and showed that these were fairly well spread across the week which demonstrated that day of the week did not influence the chances of sex occurring but noted that this does not preclude the existence of other factors which cause individuals to vary from a constant hazard.

Therefore he then calculated time since last sex allowing for between person variation in the length of the closed intervals between sex acts. He used the log-normal distribution to model this variance. This analysis was restricted to people aged 25 to 45, for whom the average estimated time since last sex was larger than the reported average. Although the visual correspondence was good, the results of Chi-squared tests found that there were significant differences between the estimates. Leridon ascribes this to, firstly, the large sample size making the test very stringent and, secondly, to slightly inflated reports of the

number of sex acts that arise due to respondents rounding up their reports of the number of acts. He concluded that the combination of the exponential distribution for within-person variance and the log-normal for between person variance gave satisfactory results for people aged 25 to 45 and that the congruence between the reported and estimated times since last sex showed that the reported number of sex acts was reliable in these data.

Barrett suggested that the hazard of sex on a given day for a couple is not constant (as assumed under a Poisson process)[37]. Barrett used prospective diary data from the Catholic Marriage Advisory Service concerning 241 married Catholic couples to investigate whether the probability of having sex on any given day was affected by whether the couple had had sex the day before. He found it was, that there were significant differences between couples in their patterns of sexual activity but no significant differences within couples over the study period. These patterns caused the probability of sex to deviate quite sharply from that expected under a constant hazard assumption. However the couples he studied were seeking advice on the rhythm method and were therefore presumably trying to have sex only on days when the woman was not likely to conceive. The data are based on several months of observation, for a period of 6 days at a time in the cycle when the woman was least likely to conceive. Barrett observed two patterns of activity in this group; in some couples having sex the day before increased the chance of sex the next day (a "persisting" pattern) whilst in others having had sex the day before decreased the chance (an "alternating" pattern).

In populations where the majority of couples are likely to be either trying to conceive or to have access to a modern method of contraception the pattern of intercourse may be different. Even if these patterns are evident in most populations this may not invalidate the use of regression models based on the Poisson distribution as proposed by Leridon. Barrett's study population fell into three equal sized groups: chance of sex unaffected by sex the previous day, chance of sex increased by sex the previous day and chance of sex decreased by sex the preceding day. Therefore, unless the pattern followed is dependent on other characteristics of the couple, and related to overall coital frequency, this departure from the constant hazard assumption should even out at the population level so that aggregate estimates derived on the basis of a constant hazard should be reasonably accurate.

Ruzicka and Bhatia collected information in time since last sex and also a monthly coital frequency amongst a non-random sample of married women from the Matlab demographic surveillance system in 1978. The sample was not randomly selected because the fieldworkers were not entirely comfortable with fielding a survey on coital frequency and felt it could only work if they did not have to interview certain women. The sample is therefore biased though perhaps not with respect to coital frequency, unless the more approachable women had a different frequency to women who were not deemed approachable by the fieldworkers. The authors found that contraceptive users were over-represented in their sample and that the women interviewed were younger and more educated than would have been expected from a representative sample.

Ruzicka and Bhatia were interested in the internal consistency of the data and present, in their first table, the data shown in Figure 4 which relate only to women who had sex at least once in the month before the interview. The figure shows that there is a non-linear decline in time since last sex as frequency of sex increases. Figure 4 also shows the relationship that would be expected if the observed frequencies were the product of a Poisson process. There is not a close correspondence, which suggests that these results concur more with Barrett's findings than with Leridon's. The difference between the observed and expected implies the assumption of a constant hazard for sex within groups of individuals who share the same coital frequency is not tenable in this population. However, since the correspondence is better at higher coital frequencies, the relationship suggested by Leridon may be at least partially correct and much of the difference in this example could be due to the exclusion of women who had not had sex in the month before the survey.

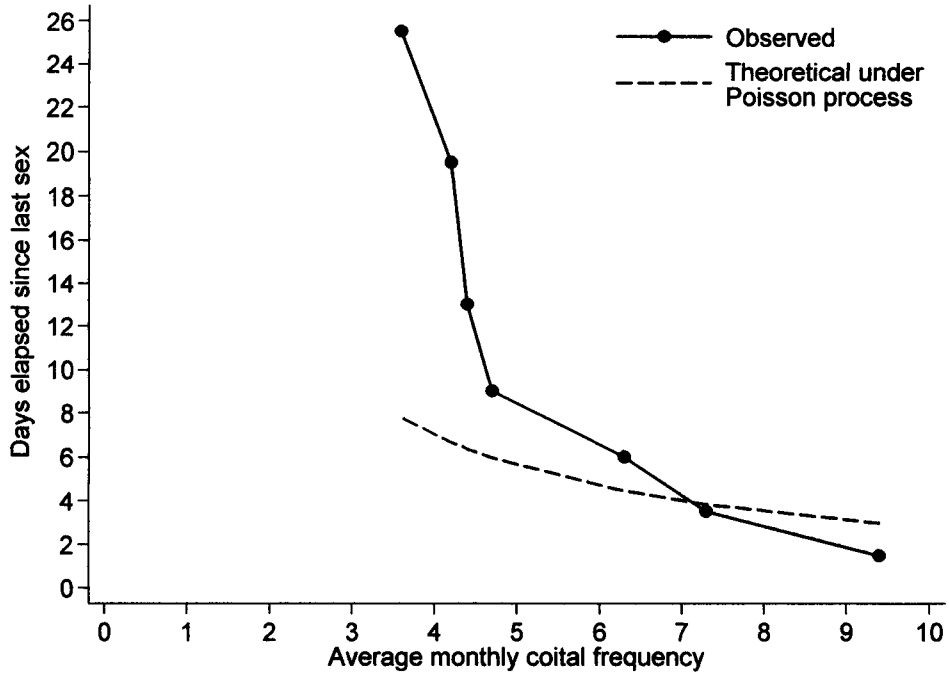


Figure 4: Mean monthly coital frequency and time elapsed since last sex, reported by married women in Matlab thana, Bangladesh who had had sex at least once in the month before the interview.

2.4 Cross-national comparisons

2.4.1 Regional variation between populations: Estimates from sub-Saharan Africa

The second round of Demographic and Health Surveys (DHS) provides the largest comparable source of estimates on the frequency of sex among members of the general population. Brown[5] used DHS data on the reported frequency of sex in the last four weeks and found that the mean monthly frequency reported by currently married women varied substantially across Africa. Women in three West African countries reported much lower frequencies (range 1.5 to 2.8) than women in six Southern and Eastern African countries (range 3.1-7.3). The veracity of the low coital frequency apparent in the DHS data for West Africa is supported by Blanc and Grey's[13] examination of the fertility decline in Ghana. Using the same DHS data they conclude that lowered coital frequency must explain at least some of the decline in fertility that has been observed in Ghana between 1988 and 1998 in the apparent absence of an increase in contraceptive use. They excluded alternative explanations such as the existence of a bias in the fertility data which changed over time, a

high proportion of users of highly effective methods among contraceptors. They found evidence for a moderate increase in ages at first sex and marriage, and evidence for a bias towards reporting older ages for both events as respondents aged. The period of post-partum insusceptibility showed little change over the decade. There was a decrease in redundant contraceptive use which may have increased the impact of contraceptive use without a change in the prevalence of use. Abortion rates could not be estimated but the authors acknowledge their likely importance. Analysis of the time elapsed since last sex, by contraceptive use and fertility preference, showed that non-contracepting women who did not want a child (immediately or at all), and women who were undecided, had a longer time since last sex than 1) women who wanted a child within the next two years and 2) women who were using a modern method of contraception. The authors interpret this as evidence for a deliberate reduction in coital frequency among couples who do not want to conceive. Whilst the evidence is not inconsistent with this conclusion it does raise two questions. One relates to marital circumstances since couples who are not having sex frequently may be estranged or frequently separated by short term absences for work. It may be these circumstances which determine fertility preference and coital frequency. Secondly, regulation of coital frequency to control fertility has been observed in other populations. The authors do not suggest a reason why lowered coital frequency should have had such a profound effect in this population but not elsewhere. One possible explanation is that coital frequency may already have been unusually low in Ghana. Brown estimated the mean monthly frequency to be 1.6 times per month for married women in 1993 and noted that small changes at such low frequencies can have a profound effect on the probability of conception.

In the mid-nineties the WHO, under the auspices of the Global Programme on AIDS (GPA) carried out a set of cross-sectional surveys in 11 countries (8 national surveys and 3 in major cities). These surveys collected data on coital frequency among married couples in the four weeks prior to the survey. These data are given Table 7 and show a range from 1.5 (women in Togo) to 8.7 (men in Brazil). These data also show that the frequencies reported by people in West Africa are much lower than those reported by East Africans. There are some marked discrepancies between men and women and Carael suggests that the difference between male and female reports in Cote d'Ivoire, Togo and Lesotho is due to the

prevalence of polygyny, which presupposes that coital frequency is the same for polygamously and monogamously married men but that men in polygamous marriages distribute this between all their wives.

2.4.2 Regional variation between populations: Estimates from Western Europe

Nine national surveys conducted in the early 1990s are summarised by Sandfort et al (1998). The mean weekly coital frequency is reproduced here in Table 1. Although the surveys are not directly comparable they derived common measures from each and found marked, and statistically significant, differences between countries. Coital frequency with a steady partner was higher in Southern than in Northern Europe. The authors note that the definition of a steady partner, the reference period for reporting, the categories used to code frequency of sex, and the partners referred to in the coital frequency question all differed between the surveys but not in such a way that differences in the survey methodology could have created this systematic difference. Results from France, Norway and Spain are restricted to respondents with cohabiting partners. In Belgium, Finland and Norway the question was about penetrative intercourse, elsewhere it was more phrased more generally about "making love".

Sandfort et al also found that the proportion in their highest frequency grouping (>5 times per week) declined with increasing age and duration of relationship in most countries. There is also some indication that there is a higher proportion reporting more frequent sex (>5 times per week) among respondents who have had more than one partner in the 12 months before the survey. These findings are similar to those from the contemporaneous Natsal study in Britain which found a median frequency of 4 acts per four weeks among married men and women, and 6 acts in the same period for cohabiting respondents[38]. The lower estimate is partly because this is the median not the mean and probably also because this study relied on formal status and did not report the estimates for those respondents known to have been sexually active in the year prior to the survey. Multivariate analysis of these data found respondents who reported multiple partners in the five years before the survey also reported more sex acts than respondents without multiple partners.

	Athens 1990	Belgium 1993	Finland 1992	France 1990	Germany West 1990	Netherlands 1989	Norway 1992	Spain 1990	Switzerland 1992
Men	2.02	1.74	1.88	2.06	1.94	1.8	1.87	1.94	1.92
Women	1.93	1.71	1.77	2.01	1.94	1.83	1.83	1.88	1.87

Table 1: Mean weekly coital frequency with a steady partner in nine European surveys. Denominator includes only respondents who reported a current steady heterosexual partner.

2.5 Determinants of coital frequency

Leridon[36] also used data from the French national survey to describe trends over age and duration of marriage. He assessed the influence of age, duration of relationship, number of partners in last four weeks, sexual orientation, type of most recent partner, strength of feelings towards most recent partner, age of first sex, contraceptive method, condom use in last year, optimal frequency of sex, stated enjoyment of sex and importance of religion in life. Leridon found that the youngest and oldest age groups had the least sex (18-19 and 55-69). Mean number of acts in the last four weeks was highest in the 25-34 group for women and the 35-44 group for men. Women's reported frequency was lower than men's, with the exception of the 18-19 year olds. He found steady declines with increasing duration of marriage for both men and women. People who reported two or more partners in the last month reported more sex than those with only one, but the increases were not in proportion to the number of partners. Sex was more frequent among people whose last partner was a spouse or principal partner compared to a less established partner. Similarly more frequent sex was reported by those with the strongest feelings for their partner and there was a decreasing trend with decreasing levels of love. Age at first sex showed a clear trend, with most sex being reported by respondents with younger age at debut. Users of coitus-independent methods of contraception reported more frequent sex than condom users or non-contraceptors. Preferred frequency of sex and enjoyment of sex showed the expected associations with respondents who preferred frequent sex, and those who reported the most enjoyment having the highest mean frequencies. The most religious respondents had the lowest mean coital frequencies. Although Leridon does not present any confidence intervals or statistical tests for these trends they are based on a large sample and show clear patterns which are unlikely to be due to chance alone.

Leridon also compared actual frequency in the last four weeks with the habitual frequency reported with the most recent partner (people who had only one partner) and found a very good correspondence between both the mean and variance estimates from both measures. He noted that this may be because people had already given a socially desirable response to the actual question.

2.5.1 Declines with increasing age and duration of marriage

There are several other sources of data from Europe and North America which document declines in coital frequency with increasing age and duration of marriage.

Using panel data from a 1974 probability sample of married white women in 16 urban areas in the USA, James[39] showed that coital frequency within marriage declined substantially in the first year of marriage and more slowly thereafter. He suggested the association of the decline with spousal ages, in particular the age of the wife, is explained mainly by marital duration. The clearer pattern of decline seen with women's as opposed to men's ages is due to women's age being more closely related to duration of marriage because, in this sample, there was less variation in women's age at first marriage than in men's. He shows a steep decline in rates during the first year of marriage from 17.2 times per month for those in the first two months of marriage to 11.6 times a month for those married for 7-12 months. He presents no data on pre-marital sexual experience, or on fertility intentions or the incidence of pregnancy. Little pre-marital sexual experience, a desire to conceive soon after marriage and subsequent pregnancy towards the end of the first year of marriage could explain this pattern. The pattern of decline observed in these American data from the 1970s may not therefore be widely generalizable.

In an earlier paper Udry et al[40] used data from USA, Thailand, Belgium and Japan to demonstrate an association between the ages of the husbands and wives and their coital frequency. These data were all collected during the 1960s and 1970s. The crude data showed that there was a decline in mean monthly frequency of sex as the age of the wife increased but they did not control for any other factors such as increasing parity, changes in contraceptive use or duration of marriage. The Thai, Belgian and Japanese data are cross-sectional but the US data are from a panel survey and show that this trend is consistent across the decade spanned in the three surveys and that there is a background trend

towards increasing coital frequency in all age groups. There was no attempt to look at trends in the individual, to see to what extent individual women deviate from the average pattern. Given the introduction of the pill into this population in this decade it seems the lack of data on contraceptive use and fertility preference is an important omission.

More recent data for North American married couples are available from the 1988 National Survey of Families and Households. The coital frequency data from this survey has been analysed by Call et al[41] who found a mean monthly coital frequency of 6.3 times for both sexes combined. As they did not separate the results for men and women it is therefore difficult to compare their declining trend with age with other published estimates. Their paper focuses heavily on imputation of missing values and presents most of the results graphically.

Changes in coital frequency with increasing age are seen in the WHO/GPA data[34] and these are shown in Figure 5. Broad declines with age are seen in Brazil and Thailand whereas in Burundi, Sri Lanka, Singapore and Zambia coital frequency initially increases with age, and then starts to decline. In the other countries there is little change with age, or possibly a slight increase for men in Togo and Lesotho, countries where polygyny is common.

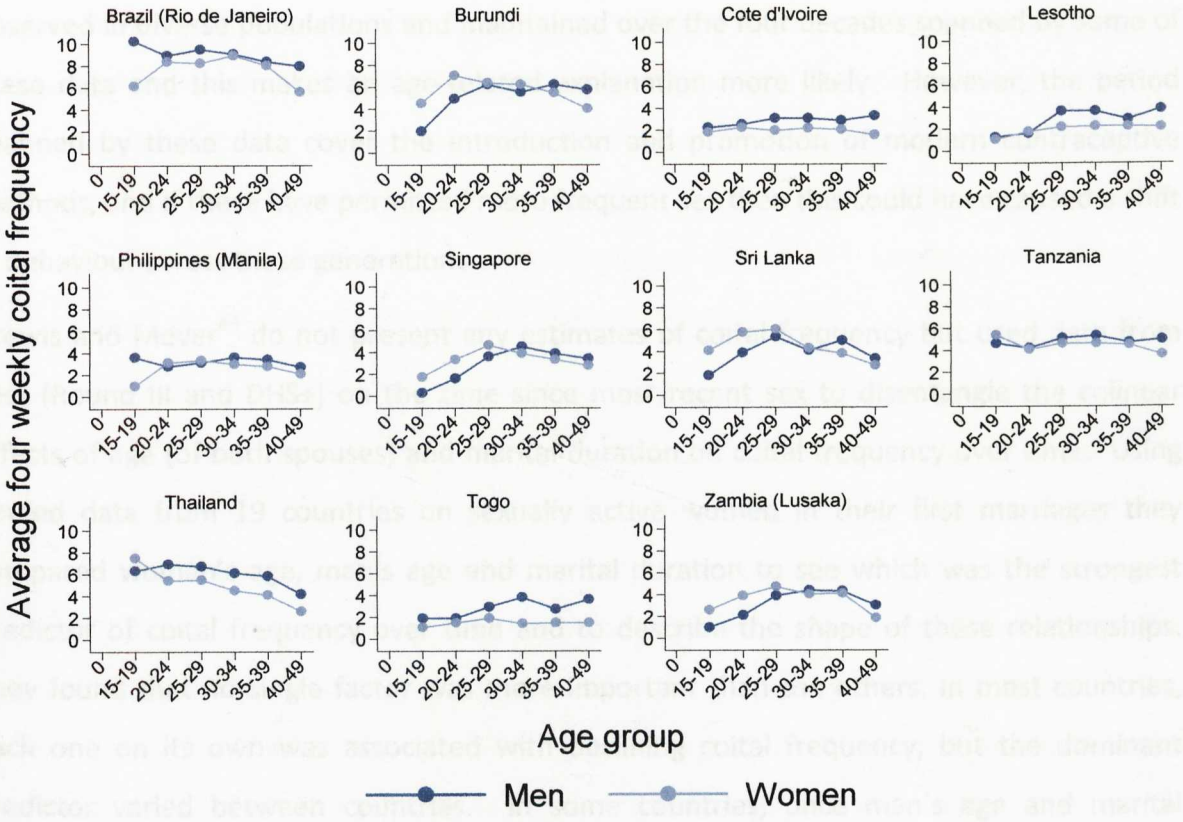


Figure 5: Mean four weekly coital frequencies for men and women in 11 countries, data from GPA surveys for currently married respondents. From:[34]

Declines in coital frequency with increasing age and increasing duration of marriage are also apparent in Chinese data[42] from a survey carried out in China between 1989-1990. The survey included a non-random sample of married men and women living in villages and cities. Respondents were asked to estimate their average monthly frequency during the year before the survey. The results for married men and women in cities are given in Figure 6 and show gradual and steady declines with increasing age and increasing duration of marriage. The trends were less apparent in village couples (not shown) but this may be due in part to a smaller sample of men in those areas (294 men, 1072 women).

Almost all of the data which show declines in coital frequency with increasing age are cross-sectional, or analysed as such. The observed decline would also be consistent with a sustained, secular increase is sexual activity during the decades closer to the survey, assuming that coital frequency depended on socialisation when starting sexual activity and remained constant thereafter. It seems unlikely that changes in such a fundamental and

private behaviour would be so amenable to social control or that such change would be observed in diverse populations and maintained over the four decades spanned by some of these data and this makes an age-related explanation more likely. However, the period spanned by these data cover the introduction and promotion of modern contraceptive methods, and if these have permitted more frequent sex then this could have caused a shift in behaviour across these generations.

Brewis and Meyer[43] do not present any estimates of coital frequency but used data from DHS (Round III and DHS+) on the time since most recent sex to disentangle the colinear effects of age (of both spouses) and marital duration on coital frequency over time. Using pooled data from 19 countries on sexually active women in their first marriages they compared woman's age, man's age and marital duration to see which was the strongest predictor of coital frequency over time and to describe the shape of these relationships. They found that no single factor was more important than the others. In most countries, each one on its own was associated with declining coital frequency, but the dominant predictor varied between countries. In some countries, once man's age and marital duration had been controlled for, woman's age was associated with increasing coital frequency at younger ages followed by a decline at older ages. Although marital duration was shown to be associated with the decline over the lifecourse there was some evidence in five countries for a 'honeymoon' effect of higher than expected frequencies in the first year of marriage. They also investigated the effects of pregnancy and parity and found that being pregnant tended to lower the frequency of sex. The effect of parity varies by number of children and across countries. They conclude that the decline over the lifecourse seen in these data is real but that cross-country comparisons should take careful account of marriage patterns (age gap, residency) and fertility (pregnancies, parity, contraceptive use) since differences in these might confound observed differences in coital frequency between populations. Although the time since last sex is not exactly equivalent to the number of acts in a set time period, these results concur with those based on the number of acts.

Blanc and Rutenberg[4] used the Round II DHS data to examine trends with increasing female age and marital duration. They also found inconsistent effects of age between countries once marital duration had been controlled for. Blanc and Rutenberg also compared the effects of contraceptive use and desire for more children across countries. Contraceptive

use was only investigated in the Latin American countries due to the low proportion of modern method users in the African countries. The users of coitus-independent methods had more frequent sex. Respondents who wanted more children had more frequent sex than those who did not want more. Although these results are based on large samples there are no statistical tests of these differences, which in some countries are quite modest. It would seem important to assess the combined effects of fertility intentions and contraceptive use on coital frequency, but that was not done here.

Ruzicka and Bhatia[44] present trends with increasing age and marriage duration for a non-random sample of married women from Matlab thana, Bangladesh in 1978. The found that the steepest decline was in the youngest respondents: mean monthly coital frequency was 10.9 (SD=7.8) for women aged under 18 and 6.8 (SD=4.9) for women aged 20-24. Thereafter declines with age were slow but steady. A similar pattern was seen against the husband's age, although the decline started at an older age, reflecting the age difference between spouses. Decline was also evident with increasing duration of marriage: coital frequencies were much higher in the first than in subsequent years; the decline was slower after the first year.

2.5.2 Other factors affecting coital frequency

Coital frequency is, of course, affected by factors other than age and duration of marriage.

Both Wang and Lin[45] and Westoff et al[11] investigated whether oral contraceptive use affects coital frequency in, respectively, Taiwan and the USA. Among Taiwanese family planning clinic attenders Wang and Lin found that pill users had a higher monthly frequency when other factors (age, marital status, duration of marriage, ethnic group, occupation and education) were controlled for. Westoff et al found a higher monthly frequency among pill users but did not control for other differences, nor report any statistical tests. It is also not clear what population their data refers to being a sub-sample from the US National Fertility Survey of 1965. It is presumably of currently married women. Both surveys were cross-sectional so it is not clear if pill users chose the pill because they were having frequent sex, or if the freedom of a coitus independent method encouraged more frequent sex.

Barden-O'Fallon et al examined correlates of coital frequency in one week among a representative sample of married women in a rural area of Nigeria[46]. Among these 644

women, they found that breast feeding and contraception were strongly associated with coital frequency (current breastfeeding was associated with a lower frequency and contraceptive use with higher frequency). Parity, age, wealth and religion were associated with coital frequency before breastfeeding and contraceptive use were taken into account. These data were summarised by the proportion of days on which coitus occurred, rather than the mean number of acts which facilitates linear regression analysis but makes it difficult to compare their results with the others. It is also possible that the factors which have a large effect on weekly frequency may not be as important over a four week period. However, their finding that contraceptive use is strongly associated with coital frequency agrees with Blanc and Grey's conclusions from Ghana which were based on a four week recall period.

Using data from ICCDR,B in Bangladesh, Becker[12] discovered that a partial explanation for the birth seasonality observed in this population is that coital frequency varies over the course of the year. This is partly explained by seasonal absences of the husbands (for the rice harvest etc) but this alone is not sufficient to explain the trend. Physiological factors affecting fecundity are not thought to explain the observed pattern. Respondents were asked when they last had sex. Becker used Leridon's method to transform the number of days elapsed since the last sex into a coital frequency and finds that this varies throughout the year in line with the pattern of births, at least in the younger age groups. If seasonal variation in coital frequency is common to many populations it could affect the way in which coital frequency data are collected and interpreted.

In a study from Denmark that examined coital frequency in relation to twinning[47] the monthly coital frequency among couples who had had a baby during 1984/5 was found to be 9.3 for parents of singletons, 9.9 for parents of monozygotic twins and 9.0 for parents of dizygotic twins. This provided no evidence to support the theory that coital frequency alters the chances of twinning. These data are probably a reasonable estimate for couples who are in a childbearing phase because the data for singleton births are a 1.5% random sample of all parents from that year.

Stewart et al[6] used Demographic and Health Survey data to look at the effect of female genital mutilation on coital frequency in the Central African Republic. They found that there was no association between women's reports of coital frequency and their FGM status.

2.6 Synthesis of findings

The papers which contain estimates of coital frequency rely on data that is at least 10 years old and, in many cases, 30 of 40 years old. With the exception of the data from Western Europe, the focus of the papers is on fertility and fecundity rather than on exposure to STIs. The data presented concern married people, the majority of whom are women. From the literature, we have very little information about male coital frequency and none whatsoever on coital frequency outside marriage or steady partnerships.

The literature also contains a wide variety of data collection methods, ranging from convenience samples to nationally representative sample surveys. The survey instruments are not described in detail but are likely to have been very different from one another. Many papers do not indicate how sex was defined for the respondent (whether penetrative vaginal sex was the only behaviour reported) or report the age ranges included in the surveys.

The diversity of methods limits the comparability of the results, and should certainly preclude naïve comparison of absolute differences between populations. The use of non-random sampling by some papers undermines the representativeness of the estimates and again precludes straightforward comparison. However, the relative differentials observed within the study samples do merit comparison across populations.

2.6.1 Key themes

Some key themes emerge from the literature. Declines in marital coital frequency are observed as age and marital duration increase [39,40,4 44]. The relative importance of male and female age and the duration of the relationship seem to vary as does the shape and timing of the decline. Brewis and Meyer[43] suggest that, although the negative correlations with either age or marriage are evident in most populations, there is no single pattern of association.

Some of the differences between men and women in the timing of the decline, and some of the difference between populations, is probably due to the relative timing of marriages for men and women. In many countries there is a difference in ages between spouses, for example, in East Africa men are typically 6 to 9 years older than their wives[48]. Where such

an age difference exists one would expect the changes with age for married men to start later than for women and there is some support for this from the GPA data for Burundi, Singapore, Sri Lanka, Thailand & Zambia (Figure 5). In each of those countries the line for men is similar in shape to that for women but displaced to the right, consistent with husbands being older than wives. This is not evident for the other countries (Brazil, Cote d'Ivoire, Lesotho, Tanzania and Togo). It may be that polygamy complicates the observed pattern because polygamously married men may maintain a higher coital frequency in later life that could mask any age effect. However Brazil, with little polygamy, and Zambia, where polygamy is common, do not fit with this explanation.

The prevalence of sex before marriage, and the familiarity of spouses at the time of marriage, probably influences whether there is a honeymoon effect, with very high coital frequencies in the first few months of marriage. Couples who start their sexual relationship at marriage may have a higher frequency in the first few months that those whose relationship began prior to marriage. In the absence of contraception, couples who hope to have a child soon after marriage, and those who wish to avoid it, may modify their coital frequencies accordingly. Formal marriage may not represent the start of cohabitation, and it may be cohabitation, not the actual marriage, which facilitates frequent sex. This may partly explain why duration of marriage is less important in some populations.

Surprisingly little attention has been given to contraceptive use and fertility intentions, though this is perhaps partly because many of the earlier studies were carried out in connection with contraceptive use effectiveness studies. Where these have been considered, it is clear that contraceptive use and fertility intentions are both associated with coital frequency but the direction of the associations is not clear. It may be that there is not a one-directional causal relationship operating since fertility intentions, contraceptive use and coital frequency may all be additionally influenced by external factors and it may be that people modify whichever is most within their power. Therefore in some circumstances regulating coital frequency might be a response to a desire to prevent pregnancy where effective contraception is not readily available whilst elsewhere low coital frequency gives rise to a low demand for contraception even when there is no wish to become pregnant. Power dynamics within couples, and the extent to which one partner is able to refuse or to

request sex may further complicate the relationships between fertility intentions and coital frequency.

That these themes emerge in quite different data sources from many different populations and despite the diversity of measurement methods, suggests that the observed patterns are real and that the same factors may influences on coital frequency in different populations, albeit in different ways.

2.7 Shortcomings of existing information for the present purpose

The literature does not address a number of questions. For the most part this is due to a lack of data for men and for non-marital partners. Consequently we know little about the difference in frequency between marital and non-marital partners. We also do not know whether people with many partners have more frequent sex with each partner than people with only one partner. In the Natsal 2000 data from Great Britain people who had had multiple partners during the 5 years before the survey reported more sex acts in the four weeks before the survey than respondents who did not report multiple partners. Both of these pieces of information are important in profiling the potential for exposure to STIs, and the risk of onwards transmission.

Another important omission is data on within-individual variation over the lifecourse: how does frequency change as a relationship evolves or partners change; is coital frequency an individual tendency or is it a product of the relationship i.e. does the same person have markedly different frequencies with different partners. This would require detailed, longitudinal data which is rarely collected though some African cohort studies with a focus on HIV are starting to collect these data.

Longitudinal data would help to investigate the directions of some of the relationships identified in the literature between fertility desires, contraceptive use, ageing and coital frequency. None of the authors comment on the possibility that a decreasing desire for more children may contribute in some part to the decline in coital frequency over time. Those that present estimates with increasing parity[43 46] find somewhat contradictory patterns. This may be because there is no set parity after which people want no more children, so one would not expect an effect of this sort to be readily observable in summary data.

Lastly, although there is considerable variation between populations evident in the literature, there is very little attention given to the amount of variation within populations. Only five papers present a measure of this[7 41 44 46 49]. In part this may have been because it is more complicated to estimate variance when using survey data that have a complex sample design.

In Jasso (1985), which presented results from surveys in 1970 and 1975 in the USA, the coefficients of variation were 0.8 and 0.7, respectively. In Ruzicka, for married women in Bangladesh it was 0.77[44]. Coefficients of variation greater than one were seen in the other two surveys: 1.1 in Call (1995) from the USA and 2.8 in Barden-O'Fallon (2003) from Nigeria. The first two studies were not based on representative samples whereas the latter two were, which may explain why there was less variation in the Jasso and Ruzicka data whose unrepresentative samples may have been more similar to one another. Within-population variance is very important when considering STI risk since differences between individuals in the level of sexual activity can contribute to heterogeneity in exposure to STIs and, among infected people, heterogeneity in the probability of onwards transmission.

2.8 Summary

In conclusion, the literature mostly relates to marital sex and focuses largely on married women. Many of the datasets are old, and many of the samples are not representative of the populations from which they were drawn. Nonetheless some key patterns are evident with most authors finding declines over age and/or marital duration. The scale and nature of the relationships differ between populations, and the data from comparable DHS and GPA surveys shows absolute differences between countries and relative differences in these declines which suggests that there are real differences in coital frequency between populations as well as these common patterns.

Table 2: Inventory of studies on coital frequency among members of the general population

Study	Population	Focus	Sample size	Determinant	Effect	Reference
AFRICA						
1) Central African Republic 1994 DHS	Nationally representative HH survey of women	Effect of female genital cutting (FGC) on cf	2188 married women	Age	Decrease with increasing age	6
				Education	Higher with more education	
				Ethnicity	No effect	
				Religion	No effect	
				Region	Marked variation by region	
				Urban/rural residence	No effect	
				Length of union	Decrease with increasing duration	
				Number of co-wives	No effect	
				Whether newest wife	Higher for newest wife	
				Has cash income	No effect	
				decision making over use of own income	Higher where decisions were joint	
				Number of living children	Decrease with higher number of living children	
				Contraception	Higher among those who wanted children	
				Ideal number of children	No effect	
				FGC	No effect	
2) Nigeria, Osun State: Fertility Awareness and Pregnancy Avoidance Study 1993-4	Household survey of married women	Fertility and FP	644	Age Education Parity Wealth Religion Ethnicity Menstruating Pregnant Breastfeeding Contraception Number of co-wives Fertility desire	Only breastfeeding and contraceptive use important	46
3) South Africa Nelson Mandela/HSRC Study of HIV/AIDS 2002	Nationally representative HH survey: subsample of 15-24 year olds	HIV/AIDS awareness and knowledge, sexual behaviour and HIV serostatus	2, 430 (70% response rate)	Descriptive analysis of sexual behaviour		50
4) Zaire 1989	HH survey in 10 sites Men 15-60 Women 15-49	Sexual behaviour & HIV risk	2000	Descriptive analysis of sexual behaviour		51
ASIA						

Table 3: Inventory of studies on coital frequency among members of the general population

Study	Population	Focus	Sample size	Determinant	Effect	Reference
5) Bangladesh, Matlab thana. ICDDR special survey 1978	Non-random sample of eligible residents Married women aged <50	Sexual behaviour	2301	Age Age of husband Duration of marriage Religion Fertility intentions Contraceptive use Attitudes to abstinence	Declines with age of respondent & husband Declines with duration Hindus have more sex no signif difference FP users less sex Norms seem not to have a direct effect in individual behaviour	44
6) China: Nationwide survey of sexual behaviour 1989/90	Married couples	Sexual behaviour, attitudes and lifestyles	7971	Age Marital duration	Declines with age Declines with increasing duration	42
7) Japanese hospital and FP clinic based survey 1975/6	Married women aged under 45 with husband present	Relative influence of male and female age	687	Age	Decline with increasing age for women's age but not husband's age	40
8) Taiwan (Taipei area) FP clinic based study 1991/92	Female clinic attenders	Frequency of sex	17047	Age Ethnicity Marital Status Duration of marriage Contraceptive use	Decline with age No difference More married women had sex but active unmarried women had more sex. Decline with duration Pill users have more sex	45
9) Thai women living in one area outside Bangkok 1967	Married women aged 15-44	Relative influence of male and female age	795			40
AUSTRALIA						
10) Australian Study of Health and Relationships 2001-2002	National sample of Australians	Sexual behaviour and lifestyles	10173 men 9134 women for analysis 7154 men 7374 women	Frequency of sex in regular (>=12 months) relationships Variations by background characteristics	Younger and more educated men and women had higher cf. Men with white or blue collar jobs had more sex Women who were bisexual had more sex.	52
EUROPE						
11) UK Catholic Marriage Advisory Council 1960s	Married Catholic couples seeking advice on rhythm method	F sex in 6 days of post ovulatory period	241 couples	Whether probability of sex on a given day is affected by sex on previous day	Yes	37
12) Great Britain National Survey of Sexual Attitudes and Lifestyles 1990	Household survey of men and women in Great Britain aged 16-59	Sexual behaviour and lifestyles	18,876 respondents. Freq sex available for: 7794 men 9684 women	Factors associated with number of acts in four weeks before survey.	In multivariate analysis (linear model), declines in number of acts with increasing age and duration of relationship. No difference between men and women. Higher number of acts reported by those with more partners in last 5 years. Social class and age of partner also associated.	38

Table 4: Inventory of studies on coital frequency among members of the general population

Study	Population	Focus	Sample size	Determinant	Effect	Reference
13) Great Britain National Survey of Sexual Attitudes and Lifestyles 2000	Household survey of men and women in Great Britain aged 16-59	Sexual behaviour and lifestyles	11,161 respondents 4,762 men 6,399 women	Descriptive analysis		49
12) Belgium- Dutch speaking population. NEGO III, 1975/6	Women aged 20-44 & married women 16-19	Relative influence of male and female age	15-44: 4463			40
13) France: ACSF 1992	Nationally representative sample of the general population	Sexual behaviour	20,055 (cf based on a sub-sample, size not stated)	Age Duration of relationship Number of partners in last four weeks Sexual orientation	Initial increase then decline with increasing age Decline with increasing duration More sex in total, but not in proportion to N partners	36
				Type of most recent partner	More frequent with spouses/regular partners than others	
				Strength of feelings towards most recent partner	More sex among those with strongest feelings	
				Age of first sex	Younger age at debut=higher cf at survey	
				Contraceptive method	Users of coitus-independent methods had more sex than condom users or non-users	
				Condom use in last year Optimal frequency of sex Stated enjoyment of sex Importance of religion in life	Higher optimal= higher cf greater enjoyment=higher cf More religious=lower cf	
NORTH AMERICA						
14) USA National Fertility Study 1965	Representative sample of women- probably married	Fertility, whether pill use affects c.f	4600	Contraceptive use Age Ethnicity Education Religion	Pill users have more sex.	11
15) US probability sample 1974	Married white women with husband in HH		~459 women	Age Duration of marriage	Duration is more important determinant than age and the association with duration is non-linear there being a sharp decline over the first year of marriage which abates afterwards	39
16) US probability samples 1965, 1970 and 1974	Married white women with husband in HH	Relative influence of male and female age	3512 4560 1633	Male age Female age	Female age is a more important determinant in all samples	40

Table 5: Inventory of studies on coital frequency among members of the general population

Study	Population	Focus	Sample size	Determinant	Effect	Reference
17) USA National Fertility Studies 1970 & 1975 (panel)			2361 white married couples	Age	No effect for men, increase with increasing age for women	7
				Marital Duration	Decline with increasing duration	
				Cohort (Period) effects	Decline between 1970 and 1975	
					Above findings disputed by reanalysis of same data, incorrect codings used in cf variable seems to have produced the reported associations.	8
18) US National Survey of Families and Households 1987-88	Individuals living in US HH aged over 19 and able to speak English or Spanish	Coital frequency and determinants in couples together <=5 years	13 017 total 1882 men 1930 women for analysis	Quality of reporting	Good correlation between men and women's reports ρ= 0.68.	53
				Whether cohabiting makes a difference	Cohabitees have more sex	
				Work status	Higher income less sex	
				Partners' health	Man in poor health -> less sex	
				Relationship quality	Man thinks relationship in trouble -> less sex	
				Duration of relationship	Older relationship -> less sex	
19) US small non-random sample from another study	Healthy, non-pregnant married or cohab women who had either IUD, tubal ligation or smokers who weren't on the pill	Whether prospective and retrospective reports of c.f are the same	91	Prospective v. retrospective	Retrospective reports too high	23
				Age	Decline with age	
				Education	Less education= more sex	
				Income	No effect	
				Cohabiting status	Sample too small	
				Duration of relationship	Decline with increasing duration	
				Contraceptive use	IUD and tubal ligation more sex	
20) US National Survey of Families and Households 1987-1988	Nationally representative survey-subsample married with spouse in HH	Frequency of marital sex	6785	Age	Decline with age	41
				Duration of relationship	Decline with duration but marked only in first year versus subsequent years	
				Quality of reported data		
21) USA General Social Surveys 1988 & 1989	Nationally representative HH survey	Sexual behaviour addendum to survey	1401	Descriptive analysis of sexual behaviour		54
MULTIPLE COUNTRIES						
22) WHO/GPA surveys	HH surveys	Sexual behaviour and HIV risk				34
23) DHS	Nationally representative HH surveys of women	Fertility and family formation	12 surveys, 67,286 women	Data quality	Data appear valid	4
				Age	Some decline with age BUT	
				Duration of marriage	Decline with increasing duration, removed age effect	
				Fertility intentions	More sex if want child	
				Contraceptive use	Users of coitus-independent methods= more sex than coitus-dependent methods	

Table 6: Inventory of studies on coital frequency among members of the general population

Study	Population	Focus	Sample size	Determinant	Effect	Reference
24) DHS	Nationally representative HH surveys of women	Fertility and family formation	9 African surveys N not reported	Fecundability & variation within marriage	Four week estimates insufficient to use in proximate determinants model	5
25) Review	Coital frequency studies, non-clinic base sample ≥300 conducted post 1980	Review of estimates				3

Table 7: Estimates of coital frequency by age from various sources

Survey	Population	Denom-inator	Sex	Period	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	Total	Reference
					15-19	20-24	25-29	30-34	35-39	40-49						Total	
Cote d'Ivoire	Representative HH survey, currently married	All	Men	4 weeks	2.2	2.5	3	3	2.8	3.2						2.9	**34**
			Women		1.8	2.2	1.9	2.1	2	1.5						2	
Togo	Representative HH survey, currently married	All	Men	4 weeks	1.9	1.9	2.9	3.8	2.7	3.6						2.9	**34**
			Women		1.1	1.5	1.9	1.4	1.5	1.5						1.5	
Burundi	Representative HH survey, currently married	All	Men	4 weeks	1.9	4.9	6.2	5.5	6.2	5.7						5.5	**34**
			Women		4.5	7	6.3	6.2	5.4	4						5.7	
Lesotho	Representative HH survey, currently married	All	Men	4 weeks	1.2	1.6	3.6	3.6	2.8	3.8						3	**34**
			Women		1	1.7	2.1	2.2	2.2	2.1						1.9	
Tanzania	Representative HH survey, currently married	All	Men	4 weeks	4.6	4.2	5.1	5.3	4.7	5						4.9	**34**
			Women		5.4	4.1	4.6	4.6	4.5	3.6						4.4	
Zambia (Lusaka)	Representative HH survey, currently married	All	Men	4 weeks	1	2.1	3.9	4.4	4.3	3						3.4	**34**
			Women		2.6	3.9	4.7	4	4.1	1.8						3.7	
Philippines (Manila)	Representative HH survey, currently married	All	Men	4 weeks	3.6	2.8	3.1	3.6	3.4	2.7						2.9	**34**
			Women		1	3.1	3.3	3	2.8	2.1						2.5	
Singapore	Representative HH survey, currently married	All	Men	4 weeks	0.3	1.6	3.6	4.5	3.9	3.4						3.6	**34**
			Women		1.7	3.3	4.6	3.9	3.3	2.8						3.4	
Sri Lanka	Representative HH survey, currently married	All	Men	4 weeks	1.8	3.9	5.3	4.1	5	3.3						4.1	**34**
			Women		4.1	5.7	6	4.3	3.8	2.7						4.1	
Thailand	Representative HH survey, currently married	All	Men	4 weeks	6.3	6.9	6.7	6.1	5.8	4.2						5.7	**34**
			Women		7.5	5.4	5.5	4.5	4.1	2.6						4.3	
Brazil (Rio de Janeiro)	Representative HH survey, currently married	All	Men	4 weeks	10.2	8.9	9.4	9	8.3	7.9						8.7	**34**
			Women		6.1	8.3	8.2	8.9	8	5.6						7.6	

Table 8: Estimates of coital frequency by age from various sources (continued)

Survey	Population	Denom-inator	Sex	Period	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	Total	Reference
					15-19	20-24	25-29	30-34	35-39	40-49						Total	
Nigeria population based study 1993-4	Married women	All	Women	Week		1.71	2.11	2.59	2.16							2.18	46
					16-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59			Total	
Great Britain. Natsal population based survey 1990	Household survey of men and women	All	Men	4 weeks before survey (Median)	0	3	5	4	4	4	3	2	2			3	38
			Women		0	5	4	4	4	3	3	1	0			3	38
						16-24		25-34		35-44						Total	
Great Britain. Natsal II population based survey 2000	Household survey of men and women	Those with ≥1 hetero-sexual partner in last year	Men	4 weeks before survey§		6.9 (3)		6.7 (4)		5.9 (4)						6.4 (4)	49
			Women	Mean (Median)		7.7 (5)		6.6 (5)		5.7 (4)						6.5 (4)	
					15-24		25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	Total	
Taiwan (Taipei area) FP clinic based study 1991/92	Female clinic attenders	All	Women	Month prior to survey	10.3		7.8	6.9	6.6	6.5	5.4	4.8	3.5	3.5	1.9	6.8	45
						20-25	26-30	31-35	36-40	41-45	46+						
Catholic Marriage Advisory Council (US?)*	Married Catholic couples seeking advice on rhythm method	Had sex at least once	Women	~Week - 6 days		2.15	1.91	1.73	1.76	1.79	1.25						37
						<25	25-34		35-44							Total	
US probability samples 1965, 1970 and 1974	Married white women with husband in HH	All	Women	Month													40
				1965		9.2	7.2		5.5							6.9	
				1970		10.6	8.9		6.5							8.5	
				1974		11.6	9.2		5.9							9.5	
US National Fertility Survey 1965	Married women	All	Women	Month		8.8	7.0		5.5							6.8	11

Table 9: Estimates of coital frequency by age from various sources (continued)

Survey	Population	Denom-inator	Sex	Period	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	Total	Reference
					15-19	20-24	25-29	30-34	35-39	40-49						Total	
Thai women living in one area outside Bangkok 1967	Married women aged 15-44	All	Women	Month		7.97	6.11		5.85							6.42	40
Japanese hospital and FP clinic based survey 1975/6	Women patients	All	Women	Month		10.5	8.2		6.6							8.3	40
Belgium- Dutch speaking population. NEGO III, 1975/6	Women aged 20-44 & married women 16-19	All	Women	Month		12.48	10.45		8.15							10.03	40
					18-19	20-24	25-34		35-44		45-54		55-69				
France: ACSF 1992	Men & Women aged 18-69	Any sex in last year	Men	4 weeks	4.6	8.1	9.4		9.6		8.5		4.8				36
			Women	4 weeks	7.2	8.1	8.7		8.1		6.1		4.0				
					16-24		25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+		Total	
US National Survey of Families and Households 1987-88	Aged 19+,able to speak English or Spanish & in relationship <= 5years	All	Women	Month-30 days	12.1		9.3	8.3	7.6	6.6	5.3	5.3	3.0	2.3		6.6	53
			Men		12.8		9.5	7.7	7.1	6.9	6.3	5.5	5.1	2.6		6.4	
	All	All	Women		12.3		9.8	8.6	7.8	6.9	5.9	5.2	3.0	2.2		7.0	
			Men		13.3		10.3	8.1	7.4	7.0	6.8	5.5	5.2	2.3		6.6	
					16-19	20-29		30-39		40-49		50-59				Total	
Australian Study of Health and Relationships 2001-2002	National sample of Australians in partnerships ≥ 12 months duration	All	Women	Week-typical in 4 weeks	2.2	2.2		1.9		1.6		1.3				1.8	52
			Men		2.7	2.7		1.7		1.7		1.5				1.9	
						21-29		30-32	33-38							Total	

Table 10: Estimates of coital frequency by age from various sources (continued)

Survey	Population	Denom-inator	Sex	Period	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	Total	Reference
					15-19	20-24	25-29	30-34	35-39	40-49						Total	
US small non-random sample from another study	Healthy, non-pregnant married / cohab women who had either IUD, tubal ligation or smokers who weren't on the pill	All	Women	Week Retros-pective		3.0		2.2	2.4							2.5	23
				Prosp-ective		2.3		1.5	1.4							1.7	
					18-29			30-39		40-49		50-59		60-69	70+		
USA General Social Surveys 1988 & 1989**	Nationally representative HH survey	Unclear	Both	1 year	78			78		67		46		22	8		54
					<18	18-19	20-24	25-29	30-34	35-39	40+					Total	
Bangladesh, Matlab thana. ICDDR special survey 1978	Non-random sample of eligible residents	Those with "regular" sex life	Women	Month-ly	10.9	8.0	6.8	6.7	6.1	5.4	5.3					6.5	44
					15-24												
South Africa Nelson Mandela/HSRC Study of HIV/AIDS 2002	Nationally representative HH survey: subsample of 15-24 year olds	Any sex in 12 months prior to survey	Men	Month													50
				0	22%												
				1-4 times	50%												
				5-9 times	18%												
				10+	10%												
			Women	0	26%												
				1-4 times	47%												
				5-9 times	16%												
				10+	11%												

* Couple's report ** Question asked for usual frequency in past year, means therefore transformed from these responses § Sex acts defined as oral, vaginal or anal sex

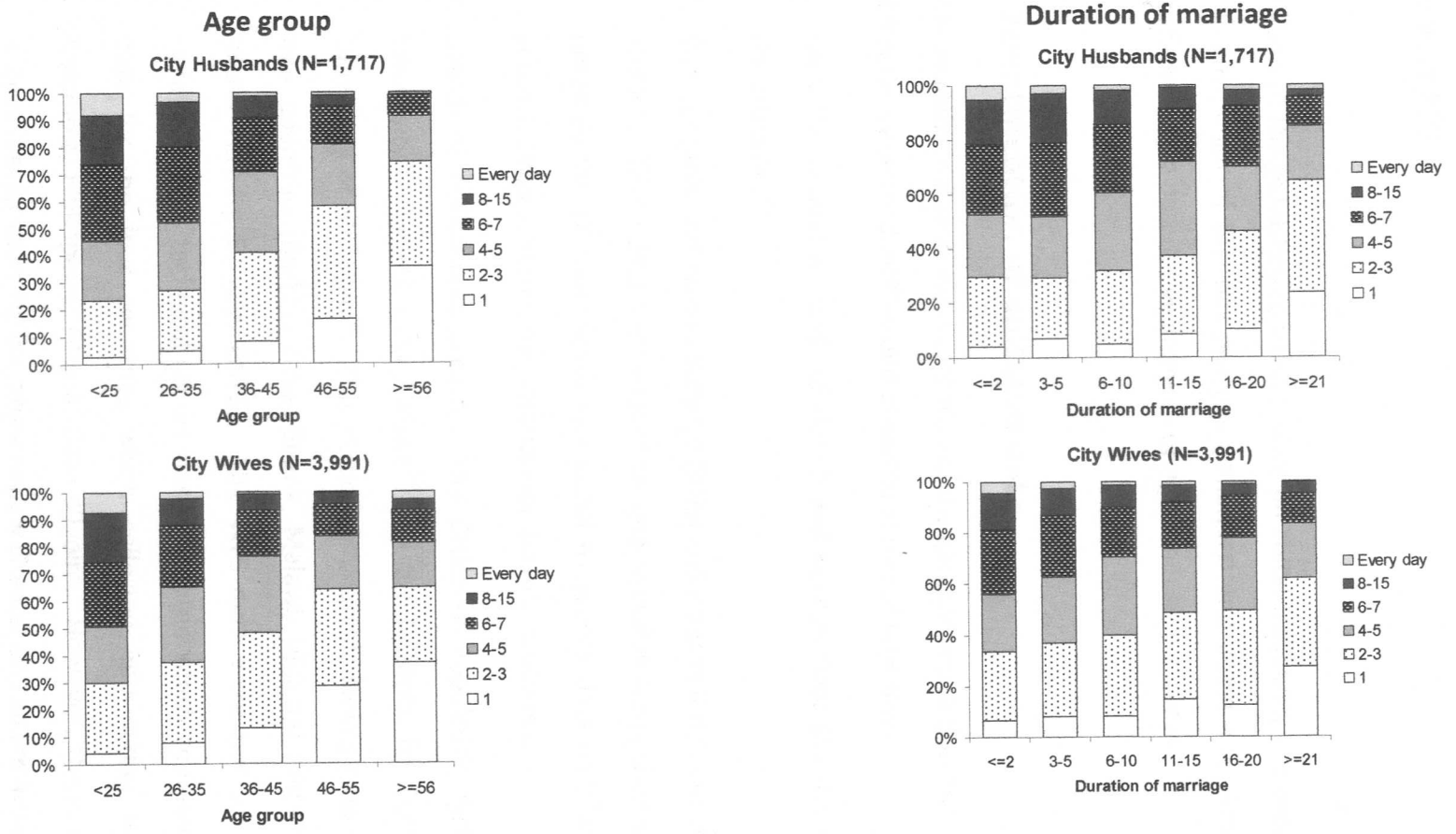
Table 11: Estimates of coital frequency by duration of marriage/marital status, from various sources

					Duration of marriage, in years												
					<1	1	2	3	4	5	6-10	11-15	16-20	21-25	26+	Total	
US probability sample 1974	Married white women with husband in HH	All	Women	Lunar month	13.2	11.0	9.5	8.4	9.8	9.5	9.4	9.4	6.8	5.6	4.8		39
Taiwan (Taipei area) FP clinic based study 1991/92	Female clinic attenders	All	Women	Month prior to survey		7.8	7.2	7.0	7.0	6.9	6.6	6.4	5.8	5.3	3.7	6.8	45
					0-1		2-4				5-9	10-14	15-19	20-24	25+	Total	
Bangladesh, Matlab thana. ICDDR special survey 1978	Non-random sample of eligible residents	Those with "regular" sex life	Women	Month	10.7		8.2				6.7	6.7	6.1	5.7	5.2	6.5	44
					0-4						5-9	≥10				Total	
US small non-random sample from another study	Healthy, non-pregnant married or cohab women who had either IUD, tubal ligation or smokers who weren't on the pill	All	Women	Week Retros-pective	2.9						2.3	2.4				2.5	23
				Prospe-ctive	2.0						1.6	1.6				1.7	
					Marital Status												
					Single		Marr-ied	Coha-biting	Widowed		Separated/ divorced					Total	
Great Britain. Natsal population based survey 1990	Household survey of men and women	All	Men	4 weeks before survey (Median)	0		4	6	0		1						38
			Women		0		4	6	0		0						
					Never		Currently		Widowed		Separated					Total	
Taiwan FP clinic based study 1991/92	Female clinic attenders	All	Women	Month	14.2		6.4		5.2		9.6					6.8	45

Table 12: Estimates of coital frequency by duration of marriage/marital status, from various sources

					Duration of marriage, in years											
					<1	1	2	3	4	5	6-10	11-15	16-20	21-25	26+	Total
					Single		Married									
Zaire 1989	HH survey in 10 sites Men 15-60 Women 15-49	All	Men Women	7days	1.1 1.0		2.3 2.1									51

Figure 6: Trends in coital frequency among married Chinese men and women by age and duration of marriage



Chapter 3 Data review of coital frequency in the general population: estimates, correlates and variation.

In addition to the published literature, data on coital frequency are available from national surveys and much of this has not been analysed and published. This chapter presents results from simple descriptive analyses of data from such surveys.

3.1 Identification of suitable data

Publicly-available datasets representative of the general population and with information on coital frequency were identified and obtained in one of four ways.

1. One, The Australian study of Health and Relationships (ASHR), was identified from the literature[52].
2. Demographic and Health Surveys (DHS) collected coital frequency during the early 1990s[55]. These data are indexed on, and available from, their website. Data were obtained for 27 countries where coital frequency data had been collected. Four countries had collected this information on two occasions.
3. Search of online data archives: The Office of Population Research at Princeton University[56], the UK Data Archive[57] and the Institute for Social Research at the University of Michigan[58]. This yielded comparable survey data from adolescents in four countries (Burkina Faso, Ghana, Malawi, Uganda) and the datasets for the World Fertility Surveys (WFS). The WFS data were not subsequently analysed because a WFS technical report was discovered which contained analysis of these data for the four countries which collected information on coital frequency: Colombia, Philippines, Ghana, Cote d'Ivoire. However, these results fitted in this chapter better than the literature review chapter and so are included here.

4. Through personal contacts: Natsal 2000 data for Great Britain and WHO/GPA data for Lesotho, Sri Lanka and Thailand were made available. WHO/GPA surveys had also collected coital frequency data in Burundi, Cote d'Ivoire, Tanzania and Togo and four city surveys but these data were not available. Estimates for married respondents from the four national surveys were published in a comparative analysis[34] and this analysis has been repeated here together with additional estimates for unmarried respondents.

This search also revealed other data on coital frequency, from representative samples of the general population, from several sub-national surveys conducted by Population Services International (PSI), African cohort studies in Uganda (Rakai), Zimbabwe (Manicaland) and Tanzania (Kisesa) and from a national survey in South Africa (National Communications Survey 2009). These are not included in this chapter as none are publicly available and, with the exception of the South African data, are not national surveys.

3.2 Data and Methods

Individual level data were obtained for all surveys with the exception of the WFS and four WHO/GPA surveys. Analysis was carried out using Stata 11[59] accounting where necessary for the characteristics of the survey design using Stata's svy commands[60]. Unfortunately, the WHO/GPA survey datasets obtained for this analysis did not contain the survey design information and so unadjusted estimates are presented here. This may have affected the estimates from Thailand, the only stratified sample, which may have required sample weights. My results for currently married men are higher than those published for these surveys[34] but the two sets of results for women are similar.

3.2.1 DHS (various countries)

The DHS have been analysed and included here because the literature does not cover all the data that is available, presented in a systematic way. The standard questionnaire for the early rounds of DHS included questions on the actual coital frequency in the four weeks before the survey and the usual coital frequency in four weeks. Individual surveys differed in whether these questions were addressed to currently married women, or to all women.

In addition, some surveys only interviewed ever-married women. The types of respondents for whom data are available are shown in Table 13. The responses to the question on the actual number of acts in the last four weeks were used for these analyses.

3.2.2 ASHR (Australia)

The ASHR asked respondents about sex in the four weeks before the survey. The question was asked for each of the respondent's recent partners, up to a maximum of three. A recent partner was one with whom the respondent had had sex at least once in the 12 months prior to the survey. Responses to each of these questions were summed and the resulting frequency used for this analysis. Relevant sections of this questionnaire are given in Appendix 1 page 1.

3.2.3 Natsal 2000 (Great Britain)

Natsal 2000 respondents were asked how many times they had had sex with a heterosexual partner in the four weeks before the survey. Responses to this question were used for this analysis.

3.2.4 WHO/GPA surveys (Lesotho, Sri Lanka & Thailand)

Results from the WHO/GPA surveys have been published[34] but only for married respondents. They have therefore be analysed and included here for all respondents. Respondents to the WHO/GPA surveys were asked two questions about how often they had had sex in the four weeks before the survey. They were asked about sex with their spouse/regular partner and about sex with other types of partner. For this analysis the responses to the two questions were summed.

3.2.5 National Survey of Adolescents (Burkina Faso, Ghana, Malawi, Uganda)

These National Surveys of Adolescents (NSA) were nationally representative surveys of 12-19 year olds only[61-64]. Young men, but not young women, were asked about the number of acts in the three months before the interview. This question was repeated for up to three partners from the last 12 months. Answers to all three questions were summed (with 0 values where not applicable). The exact reference period for the reported number of sex acts was not available because respondents were asked the first and last act with each partner but not whether the partnership was ongoing at the time of the survey. The total number of acts reported with all partners was divided by the duration of the longest relationship in days (maximum possible duration 90 days) to get an approximate daily frequency. This was multiplied by 28 to get an approximate four weekly frequency. These data are therefore the least comparable for two reasons: the sample is only of men under 20 and the four weekly frequency is estimated from reported behaviour for the three months prior to survey. This questionnaire is given in Appendix 1 page 13.

3.2.6 WFS (Colombia, Cote d'Ivoire, Ghana, Philippines)

The WFS data reported here come from a WFS technical report[65].

Four WFS collected information on coital frequency from currently married women.

In Philippines and Colombia women were asked about their actual frequency in the four weeks before the survey and their usual frequency. In Ghana & Cote d'Ivoire women were asked about their usual coital frequency in four weeks.

The universe of respondents differed between surveys. In Colombia and Cote d'Ivoire all currently married women were asked about coital frequency. In the Philippines, the questions were addressed to currently married, non-menopausal and non-pregnant women. The questions were not asked to abstainers or those whose spouse was not at home in the reference period but 0 values were imputed for these women.

In Ghana, the questions on coital frequency were addressed only to currently married women who said they were sexually active "these days". Due to some noted internal inconsistencies in the data, those who did not report themselves as sexually active were not

assigned a 0 coital frequency but were instead omitted from the analysis. Therefore the denominator for the Ghanaian estimates is not all currently married women.

3.2.7 Statistical Methods

This analysis focuses on respondents aged between 15 and 49 and includes both men and women of all marital statuses, subject to the availability of data. Some surveys provided coital frequency information for married respondents only, and therefore results have been presented by marital status groups to enable comparison across surveys.

The denominator for all results is all respondents, including those who have never had sex or not had sex recently. The few exceptions, where this was not possible to ascertain, are indicated in the tables as appropriate.

The assembled data were used to calculate: the mean number of acts in the last four weeks and the variance, the coefficient of variation, the percentage who reported only one act and the percentage who reported zero acts. The number of respondents in each survey and the number who reported a coital frequency are presented (i.e. the unweighted numbers).

Decline in coital frequency with increasing age

Some of these data have been used to demonstrate a decline in coital frequency with increasing age, as described in the previous chapter. This has not previously been shown with the data from the Natsal 2000 or ASHR surveys. Graphs showing the mean coital frequency by age, and 95% confidence intervals are presented for these two surveys.

Cross-national comparison of coital frequency net of age structure

Population summary measures of the number of sex acts are likely to be strongly influenced by the age structure of the population. To facilitate comparison between populations with different age structures, a measure of typical lifetime experience, net of age, was constructed, analogous to a total fertility rate. The total coitus rate was defined as the total number of sex acts experienced by an individual between the ages of 15 and 49 assuming they experienced the prevailing age specific rates throughout this period. It was calculated

by working out the mean number of sex acts in four weeks for men and women in five-year age groups in each survey. This was multiplied up to represent the number of acts expected in five years and summed across age groups to give the total coitus rate (TCR).

3.3 Results

3.3.1 Survey characteristics

Table 13 summarises the numbers and types of respondents asked about coital frequency in each of the surveys included here. The most striking finding is the paucity of data for men, who were rarely interviewed in the early rounds of DHS which contribute most of the data in this chapter. All the data come from large surveys with high response rates, with the exception of the British and Australian surveys whose response rates were lower, but not unusually low for developed countries.

The WFS and some DHS provide data from married women only (Morocco 1992, Sudan 1990, Indonesia 1991, Thailand 1987, Sri Lanka 1987).

The DHS and WFS interviewed women aged 15 to 49, the GPA and Natsal 2000 surveys covered a similar range. The ASHR interviewed the oldest respondents, up to the age of 61. The National Surveys of Adolescents, carried out in four countries during 2004, interviewed both young men and young women aged 12 to 19, but the questions on coital frequency were only addressed to young men.

Survey	Which respondents asked about CF	Age range: men	Number of men	Age range: women	Number of women	Reference period	Survey response rate[1] (%)
North & central Africa							
Morocco 1992 DHS	Currently married			15-49	5118	4 weeks	96.5
Cameroon 1991 DHS	All			15-49	3871	4 weeks	93.3
Sudan 1990 DHS	Currently married			15-49	5400	4 weeks	95.6
West Africa							
Senegal 1993 DHS	All			15-49	6310	4 weeks	95
Guinea 1987 DHS	All			15-44	5160	4 weeks	n/a
Côte d'Ivoire 1980 WFS	Currently married			15-49	4630	4 weeks*	
Burkina Faso 1993 DHS	All			15-49	6354	4 weeks	92.8
Burkina Faso 2004 NSA	All	12-19	3057		.	3 months	95.2†
Niger 1992 DHS	All			15-49	6503	4 weeks	96.3
Ghana 1979 WFS	Currently married			15-49	3040	4 weeks*	
Ghana 1988 DHS	All			15-49	4487	4 weeks	98
Ghana 2004 NSA	All	12-19	2283			3 months	89.3†
Nigeria 1990 DHS	All			15-49	8781	4 weeks	95.4
East & South Africa							
Rwanda 1992 DHS	All			15-49	6550	4 weeks	94.3
Kenya 1989 DHS	All			15-49	7150	4 weeks	96
Tanzania 1991 DHS	All			15-49	9238	4 weeks	95.8
Uganda 1988 DHS	All			15-49	4730	4 weeks	97.4
Uganda 2004 NSA	All	12-19	2593		.	3 months	86.6†
Burundi 1987 DHS	All			15-49	3970	4 weeks	98
Zambia 1992 DHS	All			15-49	7060	4 weeks	97.4
Namibia 1992 DHS	All			15-49	5419	4 weeks	92.7
Malawi 2004 NSA	All	12-19	2099			3 months	89†
Lesotho 1989 GPA	All	15-55	549	15-56	1033	4 weeks	
South America							
Peru 1986 DHS	All			15-49	4999	4 weeks	94.6
Peru 1991 DHS	All			15-49	15880	4 weeks	92.6
Mexico 1987 DHS	All			15-49	9310	4 weeks	96
Brazil 1986 DHS	All			15-44	5892	4 weeks	87.5
Brazil 1991 DHS	All			15-49	6223	4 weeks	90.7
Colombia 1976 WFS	Currently married			15-49	2806	4 weeks	
Colombia 1986 DHS	All			15-49	5329	4 weeks	n/a
Colombia 1990 DHS	All			15-49	8640	4 weeks	89
Bolivia 1989 DHS	All			15-49	7923	4 weeks	92.8
Ecuador 1987 DHS	All			15-49	4713	4 weeks	94.9
Paraguay 1990 DHS	All			15-49	5827	4 weeks	93.1
Dominican Rep 1986 DHS	All			15-49	7645	4 weeks	93.4
Dominican Rep 1991 DHS	All			15-49	7319	4 weeks	89.3
Asia							
Indonesia 1991 DHS	Currently married			15-49	21187	4 weeks	97.6
Philippines 1978 WFS	Currently married			15-49	6592	4 weeks	
Thailand 1987 DHS	Currently married			15-49	6226	4 weeks	94.1
Thailand 1990 GPA	All	15-49	1126	15-49	1675	4 weeks	
Sri Lanka 1987 DHS	Currently married			15-49	5449	4 weeks	n/a
Sri Lanka 1991 GPA	All	15-50	1512	15-50	1500	4 weeks	
Industrialised							
Britain 2000 Natsal	All	16-44	4747	16-44	6383	4 weeks	63.1
Australia 2001 ASHR	All	16-61	4181	16-61	3465	4 weeks	♂69 ♀78

Table 13: Survey Characteristics including the number of respondents (unweighted). [1]Response rate is the percentage of eligible respondents successfully interviewed. * Usual frequency in four weeks †Overall response rate for both men and women.

3.3.2 National estimates of four-weekly coital frequency by sex and marital status

Overall

Figure 7 shows the four-weekly coital frequency reported by men and women aged 15-49 in each survey. The line shows the median coital frequency for the four weeks prior to the survey; the box shows the interquartile range; the lines show the adjacent values and the markers show outlying individual values. These outliers have been truncated at 31 for presentation purposes: in all countries some (mostly only a few) respondents reported more than 31 times a month and these high values (see Table 14 and Table 15) and make it impossible to see the detail of the medians. The results from the four WFS have not been included because only the mean is available for these data.

In all surveys, the distribution is highly skewed to the right, with many respondents reporting much higher frequencies than the median, which is generally lower than 4 times per month.

The two surveys from industrialised countries (Great Britain & Australia) show quite high medians, though these are still in the range of the other surveys, and their distributions are also more skewed to the right. This may reflect more accurate reporting: both surveys were conducted in the 2000s, in permissive societies and used technology to enhance disclosure. CASI was used for this section of Natsal 2000 (which was mostly conducted face to face) and the ASHR was conducted over the phone. Alternatively, given the lower response rates, it is possible that the survey did not capture those with a lower level of sexual activity.

With the exception of the two surveys from the industrialised countries, there is no clear region pattern in these data. West Africa does not appear to have lower overall coital frequency than other regions which contrasts with the findings of Brown [5] and is due to the inclusion of more countries in this analysis, resulting in a range of observed frequencies within each region.

In three of the five surveys with data for men there is close similarity between men and women. In the other two, Lesotho and Sri Lanka, there is a difference between the male and female medians: in Lesotho the higher median for men relative to women may be

explained by polygyny. In Sri Lanka the higher median for men relative to women is less readily explained.

Four countries, Peru, Colombia, Brazil and the Dominican Republic, each have two DHS estimates available. In Colombia and Brazil, the median coital frequency is lower in the second survey. There was an increase in the median between the first and second surveys in Peru and the Dominican Republic.

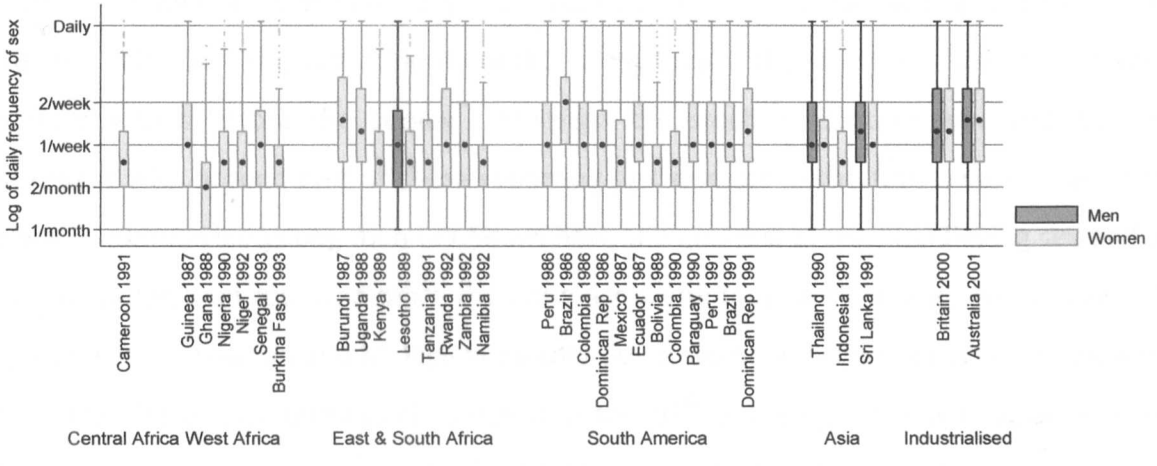


Figure 7: Box plot of reported coital frequency in the four weeks before the survey, by sex and survey, for all respondents aged 15-49.

Never married women

Table 14 shows, for never married women aged 15-49, the mean four weekly coital frequency, standard deviation, coefficient of variation, the proportion who had no sex in the four weeks before the survey and the proportion who had sex only once. In all except the two developed country surveys the vast majority of never married women reported no sex in the last four weeks. A substantial proportion of the remainder reported only one act in that period, indicating that pre-marital coital frequency is low. This is borne out by the mean frequency which is substantially below one except in Great Britain and Australia. In Great Britain and Australia, half of the never married women were sexually active in the four weeks before the survey, and their coital frequency was 3.8 and 4.0 respectively. In both countries, it is acceptable for unmarried, non-cohabiting people to have regular sexual relationships.

The coefficients of variation all exceed one, indicating that the standard deviation is bigger than the mean. Where the mean is very low the coefficient of variation tends to be large showing that, even when most never married women are not sexually active, there is a small number with a non-negligible coital frequency.

Never married men

Results for never married men should be treated in two groups. Those from the National Surveys of Adolescents include only men aged 15-19. Results for men aged 15 to 19 are given in Table 15. The vast majority of the young men in these surveys had not had sex in the four weeks before the survey. Amongst the small percentage who did, sex was infrequent with around half of these reporting just one act in the four weeks prior to the survey. Unmarried young men in Malawi have the greatest proportion having sex and 8% of these young men reported more than one act in the four weeks before the survey. The higher means in Uganda and Malawi are partly due to some very high reported frequencies, which may be errors, particularly given that the 95th percentile is much lower than the highest reported frequency. Results for 15-19 year olds from the surveys that interviewed men of all ages show a similar pattern. Most men had no sex during the four weeks before the survey and the mean frequency was below 1 in Lesotho, Thailand and Sri Lanka. In Britain and Australia the mean was higher, 1.2 in Australia and 3.2 in Britain. The British men were most likely to have had sex: a third had had sex more than once in the four weeks before the survey.

Five surveys included men aged 15 to 49 and Table 16 shows the mean four weekly coital frequency, standard deviation, coefficient of variation, the proportion who had no sex in the four weeks before the survey and the proportion who had sex only once.

There is a substantial range in mean coital frequency from 0.07 in Sri Lanka to 3.6 in Britain. The means for Australia and Britain may have been inflated by some very high reported frequencies. In several surveys a few young, unmarried men reported surprisingly high frequencies, raising the possibility of deliberate exaggeration beyond simple overstatement.

There are some interesting differences in the coital frequencies reported by never married men and women. Although one would expect broad similarity between men and women

differences could arise due to differences in the accuracy of male and female reporting, because of differences in the relative size of the male and female population or if people chose partners with a different marital status to their own.

In Thailand and Lesotho, women's mean coital frequency is less than men's. In Thailand, only two women (0.5%) reported any sex in the four weeks before the survey, compared to 21% of men. This survey was carried out in 1990, a time when commercial sex was prevalent in Thailand and this asymmetry could reflect unmarried men's use of sex workers.

In Lesotho, the discrepancy between the sexes is smaller; the difference may be due to commercial sex work or to sex between people of different marital status (never married men with married women or formerly married women).

In contrast, in Australia, Britain and Sri Lanka the mean coital frequency reported by women was higher than that reported by men. In Sri Lanka, only seven unmarried women reported any sex in the four weeks before the survey. The one woman that reported 56 occasions inflated the mean, which would otherwise have been 0.04 and lower than the mean for men. In Britain and Australia, the higher frequency reported by women could indicate women having partnerships with men who have been, or are still, married. If that was the case one would expect to see the opposite pattern in one of the other marital status categories.

Formerly married men in Britain and Australia have a higher coital frequency than formerly married women, suggesting that some formerly married men chose never married women as their partners, but that it is less common for formerly married women to have never married men as their partners.

Formerly married women & men

Results for formerly married men are shown in Table 19 and those for women are given in Table 20.

In the developing country surveys, most formerly married women reported no sex in the four weeks before the survey. Amongst those who did the mean number of acts in four weeks is mostly below 1 and, in all cases, below two. Although only a small proportion of

formerly married women were active in this time, reported coital frequency among those who did have sex was higher than the equivalent mean for never married women.

Apart from the two developed country surveys the only data for formerly married men aged 15-49 comes from the three GPA surveys. In Thailand and Lesotho, coital frequency for formerly married men is much higher than for formerly married women. Again these differences might reflect contact with commercial sex workers, with women in other marital status groups or simply differences in reporting between the sexes. In the Sri Lankan survey hardly any formerly married people reported any sex in the four weeks before the survey.

Currently married women

The most data is available for this group with estimates from 41 surveys in 32 countries. Table 17 gives the mean four weekly coital frequency, standard deviation, coefficient of variation, the proportion who had no sex in the four weeks before the survey and the proportion who had sex only once.

This group shows the widest range in mean frequencies across surveys, ranging from a low of 1.22 times in four weeks in the 1988 Ghana DHS to 8.02 times per four weeks in the 1986 Brazil DHS. Two higher frequencies, 9.7 and 9.8 were obtained from the two WFS surveys, in Cote d'Ivoire and Ghana respectively, which asked for usual frequency in four weeks.

The means are higher, and the coefficients of variation are much smaller, indicating that, within each survey, there is less variation in the coital frequency of married women than unmarried women. The proportion who had no sex in the four weeks before the survey ranges from 7% in Britain to 58% in Burkina Faso.

In seven countries there are estimates from two time points for married women: Brazil, Colombia, the Dominican Republic, Ghana, Peru, Sri Lanka and Thailand. There are substantial differences between the pairs of estimates in all countries apart from Sri Lanka and Thailand. In all seven countries the confidence intervals for the two estimates do not overlap (not shown) but it is impossible to rule out differences in the survey methodologies as the reason for the differences.

In Colombia, where there are three estimates, there is a steady downwards trend between 1976 and 1990 which may indicate that coital frequency has fallen quite steadily and markedly between 1976 and 1990, rather than being merely an artefact of different survey methods. An increase in coital frequency could be due to a lowering of the age at first sex and/or first marriage. If younger people with a partner tend to have more sex than older people (with partners) then an increase in the proportion of young people who have a regular partner (including spouses) could increase coital frequency overall. If the trend occurs in a young population, where a large fraction of the population is in the youngest age groups, then this could raise the overall coital frequency in the population over time.

Currently married men

Table 18 shows, for currently married men aged 15-49, the mean four weekly coital frequency, standard deviation, coefficient of variation, the proportion who had no sex in the four weeks before the survey and the proportion who had sex only once.

These five surveys show that, in common with married women, there is less variation in coital frequency among married men than among unmarried men. Most married men were sexually active in the four weeks before the survey and all surveys yielded a mean higher than 4 (i.e. sex at least once a week) with a coefficient of variation close to 1 . However, the mean frequency reported by married men is higher than that reported by women in Lesotho, Thailand and Sri Lanka. This may be an artefact of the GPA survey design, or may indicate substantial extra-marital sex in these countries. In Lesotho, this difference could also be the result of polygynous marriage.

Differences between men and women

Although, intuitively, one would expect some symmetry between the sexes in the reported frequencies of sex there are several reasons why this may not be apparent in survey data and in this analysis. Surveys typically cover the same age range for women and men, and for cross-national comparability, this analysis has been restricted to 15-49 year olds. In populations where women are typically younger than their sexual partners it means that surveys do not necessarily capture both sides of the story: the younger female partners of young men may be too young for the survey and the older male partners of older women might be above the upper age limit. This is likely to create some imbalance in male and

female reports if there are differences in coital frequency by stage of life. Secondly, the data have been analysed by marital status but not finer groupings by type of partner, because those breakdowns are not available for most of the data. Differences between men and women in the distributions of partner types, and in how respondents describe their partners during interview, can affect how the aggregate measures compare. For example, female partners may describe established partners as their spouse whilst their male counterparts describe the same women as girlfriends[28]. If this happens then some of the acts reported by women and ascribed to "married women" are listed under "unmarried men" rather than "married men" when reported by the male partner. The differences between the sexes, in this limited number of surveys, are more marked when comparisons are made by marital status. This suggests that differences in partner classification, and differences between partners' marital statuses may be at least part of the explanation for the observed difference.

Men and women may also differ in their willingness to participate in the survey and in their ability and willingness to accurately recall and report coital frequency. This may be due to employment and mobility that could affect both availability for survey and opportunity for sex, to differences in literacy and numeracy between the sexes, and to social norms about what it is acceptable for men and women to disclose.

Never married 15-49 year old women	Mean	Standard Deviation	Coefficient of variation	95th perc-entile	Highest reported frequency	% reported 1 act	% reported 0 acts	N never married women	N reported frequency
North & central Africa									
Cameroon 1991 DHS	0.68	1.59	2.36	4	15	11.2	73.5	834	833
West Africa									
Senegal 1993 DHS	0.11	0.80	6.99	0	22	2.5	95.1	1578	1578
Guinea 1987 DHS	0.04	0.57	13.16	0	12	0.4	98.8	1381	1381
Burkina Faso 1993 DHS	0.17	0.68	3.89	1	10	5.4	90.5	1037	1032
Niger 1992 DHS	0.06	0.43	6.82	0	7	1.6	96.9	926	923
Ghana 1988 DHS	0.37	1.30	3.50	2	28	7.0	83.1	889	885
Nigeria 1990 DHS	0.62	1.53	2.46	3	30	8.1	75.9	1701	1699
East & South Africa									
Rwanda 1992 DHS	0.09	1.18	13.54	0	45	0.9	97.6	2175	2170
Kenya 1989 DHS	0.28	1.16	4.07	2	21	5.5	88.1	1854	1828
Tanzania 1991 DHS	0.44	1.22	2.77	3	24	7.2	81.0	2188	2183
Uganda 1988 DHS	0.48	2.04	4.25	3	30	4.1	87.3	1018	1013
Burundi 1987 DHS	0.01	0.15	21.94	0	8	0.2	99.6	1043	1042
Zambia 1992 DHS	0.43	1.33	3.07	3	26	9.0	81.2	1765	1764
Namibia 1992 DHS	0.86	2.22	2.57	4	31	10.1	71.7	2708	2697
Lesotho 1989 GPA	0.37	1.39	3.79	3	11	4.3	88.5	141	139
South America									
Peru 1986 DHS	0.08	0.73	9.24	0	16	1.1	97.4	1761	1761
Peru 1991 DHS	0.24	1.34	5.67	1	30	1.9	93.4	5629	5612
Mexico 1987 DHS	0.05	0.67	13.71	0	20	0.4	98.6	3248	3241
Brazil 1986 DHS	0.29	1.62	5.69	1	30	1.1	94.3	2019	2008
Brazil 1991 DHS	0.25	1.35	5.30	1	24	2.3	92.9	2182	2181
Colombia 1986 DHS	0.14	1.05	7.66	0	30	1.4	95.8	1989	1964
Colombia 1990 DHS	0.18	0.93	5.17	1	16	1.6	94.1	3094	3092
Bolivia 1989 DHS	0.08	0.84	10.52	0	20	1.0	97.6	2452	2375
Ecuador 1987 DHS	0.06	0.60	10.77	0	15	0.4	98.4	1462	1462
Paraguay 1990 DHS	0.40	1.36	3.43	3	20	4.9	86.3	1871	1867
Dominican Rep 1986 DHS	0.02	0.24	15.16	0	6	0.3	99.4	2237	2237
Dominican Rep 1991 DHS	0.08	0.60	7.31	0	16	0.7	97.1	2005	1997
Asia									
Thailand 1990 GPA	0.02	0.24	14.95	0	4	.	99.5	439	439
Sri Lanka 1991 GPA	0.14	2.45	17.28	0	56	0.4	98.7	543	543
Industrialised									
Britain 2000 Natsal	3.83	6.95	1.82	18	120	7.2	49.5	1350	1292
Australia 2001 ASHR	3.97	7.99	2.01	20	88	3.8	59.0	1037	1037

Table 14: Never married 15-49 year old women: mean four weekly coital frequency.

Never married 15-19 year old men	Mean	Standard Deviation	Coefficient of variation	95th perc-entile	Highest reported frequency	% reported 1 act	% reported 0 acts	N never married men	N reported frequency
West Africa									
Burkina Faso 2004 NSA	0.43	2.93	6.84	1	28	3.0	93.5	1684	1633
Ghana 2004 NSA	0.08	1.00	12.34	0	28	1.3	97.7	1283	1231
East & South Africa									
Uganda 2004 NSA	0.65	5.25	8.06	1	84	4.2	91.5	1311	1167
Malawi 2004 NSA	0.99	5.27	5.32	3	140	5.8	85.9	1135	946
Lesotho 1989 GPA	0.67	1.58	2.38	5	8	3.5	78.9	60	57
Asia									
Thailand 1990 GPA	0.38	1.68	4.37	2	15	3.3	90.0	180	180
Sri Lanka 1991 GPA	0.02	0.23	9.95	0	3	0.4	98.8	256	256
Industrialised									
Britain 2000 Natsal	3.21	6.82	2.13	20	60	9.8	58.0	547	535
Australia 2001 ASHR	1.24	5.37	4.34	6	100	6.2	79.7	391	390

Table 15: Never married 15-19 year old men: mean four weekly coital frequency

Never married 15-49 year old men	Mean	Standard Deviation	Coefficient of variation	95th perc-entile	Highest reported frequency	% reported 1 act	% reported 0 acts	N never married men	N reported frequency
East & South Africa									
Lesotho 1989 GPA	0.93	1.96	2.12	5	12	10.4	70.1	140	134
South America									
Asia									
Thailand 1990 GPA	1.02	4.07	3.97	5	56	6.1	79.0	377	377
Sri Lanka 1991 GPA	0.07	0.51	7.45	0	8	1.2	97.3	660	660
Industrialised									
Britain 2000 Natsal	3.64	7.25	1.99	18	150	8.9	52.6	1597	1537
Australia 2001 ASHR	3.52	7.97	2.27	20	100	5.3	64.7	1725	1721

Table 16: Never married 15-49 year old men: mean four weekly coital frequency

Currently married 15-49 year old women	Mean	Standard Deviation	Coefficient of variation	95th perc-entile	Highest reported frequency	% reported 1 act	% reported 0 acts	Number Currently married	Number reported frequency
North & central Africa									
Morocco 1992 DHS	5.06	4.62	0.91	15	61	5.3	11.9	5118	5106
Cameroon 1991 DHS	2.61	3.72	1.43	10	30	9.8	41.3	2737	2733
Sudan 1990 DHS	4.23	4.87	1.15	13	30	5.0	34.7	5400	5361
West Africa									
Senegal 1993 DHS	3.43	4.21	1.23	12	42	10.5	31.1	4450	4442
Guinea 1987 DHS	4.07	5.11	1.26	15	30	10.0	26.7	3377	3257
Côte d'Ivoire 1980 WFS	9.69	1.88	0.19	12	12	.	.	7	7
Burkina Faso 1993 DHS	1.53	2.84	1.85	6	30	8.3	58.1	5096	5065
Niger 1992 DHS	2.96	3.44	1.16	9	32	10.0	27.3	5232	5208
Ghana 1979 WFS	8.78	0.63	0.07	10	10	.	.	7	7
Ghana 1988 DHS	1.22	1.87	1.53	4	20	12.8	53.7	3156	3133
Nigeria 1990 DHS	2.73	3.37	1.23	9	60	6.2	37.9	6696	6680
East & South Africa									
Rwanda 1992 DHS	7.27	8.52	1.17	28	50	8.0	10.7	3698	3691
Kenya 1989 DHS	3.00	3.82	1.27	10	28	10.4	31.8	4778	4623
Tanzania 1991 DHS	3.47	4.46	1.29	12	56	8.5	31.8	6091	6083
Uganda 1988 DHS	5.68	6.17	1.09	20	40	6.0	21.4	3055	3044
Burundi 1987 DHS	6.16	6.89	1.12	20	48	6.5	24.3	2612	2607
Zambia 1992 DHS	5.59	7.91	1.41	20	84	7.7	25.5	4467	4463
Namibia 1992 DHS	3.39	4.72	1.39	12	48	13.9	25.6	2297	2263
Lesotho 1989 GPA	2.44	4.82	1.97	12	33	8.9	53.4	735	696
South America									
Peru 1986 DHS	3.93	4.59	1.17	12	32	7.1	30.3	2900	2889
Peru 1991 DHS	5.02	5.01	1.00	15	60	8.8	13.3	9141	9098
Mexico 1987 DHS	3.15	4.70	1.49	12	45	7.3	37.0	5450	5161
Brazil 1986 DHS	8.02	6.61	0.82	20	50	4.4	10.1	3465	3283
Brazil 1991 DHS	5.83	5.69	0.98	20	72	7.5	10.1	3427	3408
Colombia 1976 WFS	5.70	2.05	0.36	9	9	.	.	14	14
Colombia 1986 DHS	4.95	4.63	0.93	12	32	7.9	13.9	2848	2609
Colombia 1990 DHS	4.11	4.28	1.04	12	40	9.7	12.9	4542	4524
Bolivia 1989 DHS	2.08	3.07	1.48	8	30	11.3	42.8	4895	3977
Ecuador 1987 DHS	4.37	4.64	1.06	12	30	6.2	23.4	2957	2941
Paraguay 1990 DHS	5.92	5.52	0.93	16	75	7.5	8.6	3634	3599
Dominican Rep 1986 DHS	3.67	5.05	1.38	14	35	5.0	37.2	4333	4317
Dominican Rep 1991 DHS	6.13	5.92	0.97	18	30	6.3	14.0	4226	4213
Asia									
Indonesia 1991 DHS	3.57	3.36	0.94	10	40	12.4	15.0	21187	21148
Philippines 1978 WFS	6.69	2.32	0.35	11	11	.	.	14	14
Thailand 1987 DHS	3.18	3.91	1.23	10	30	13.0	22.6	6226	6088
Thailand 1990 GPA	4.43	4.73	1.07	15	30	7.9	15.5	1133	1133
Sri Lanka 1987 DHS	4.12	4.53	1.10	12	40	6.8	23.0	5449	5418
Sri Lanka 1991 GPA	4.31	5.14	1.19	15	35	9.0	27.5	884	884
Industrialised									
Britain 2000 Natsal	6.51	6.06	0.93	18	60	8.0	6.9	3482	3379
Australia 2001 ASHR	6.49	6.37	0.98	20	80	5.8	16.4	1415	1415

Table 17: Currently married women aged 15-49: mean four weekly coital frequency

Currently married men aged 15-49	Mean	Standard Deviation	Coefficient of variation	95th perc-entile	Highest reported frequency	% reported 1 act	% reported 0 acts	N currently married men	N reported frequency
East & South Africa									
Lesotho 1989 GPA	4.11	5.88	1.43	15	31	5.6	36.1	321	305
Asia									
Thailand 1990 GPA	6.15	6.87	1.12	20	70	7.3	10.4	703	703
Sri Lanka 1991 GPA	4.65	7.52	1.62	15	114	5.7	31.7	813	813
Industrialised									
Britain 2000 Natsal	6.52	5.63	0.86	17	41	7.7	6.7	2185	2123
Australia 2001 ASHR	6.86	7.23	1.05	20	62	7.6	11.7	1409	1387

Table 18: Currently married men aged 15-49: mean four weekly coital frequency

Formerly married men aged 15-49	Mean	Standard Deviation	Coefficient of variation	95th perc-entile	Highest reported frequency	% reported 1 act	% reported 0 acts	N formerly married men	Number reported frequency
East & South Africa									
Lesotho 1989 GPA	3.61	4.99	1.38	15	17	3.0	48.5	35	33
Asia									
Thailand 1990 GPA	1.83	4.19	2.29	10	20	6.5	69.6	46	46
Sri Lanka 1991 GPA	0.21	0.92	4.36	4	4	.	94.7	19	19
Industrialised									
Britain 2000 Natsal	5.30	7.93	1.50	23	56	9.9	36.0	965	906
Australia 2001 ASHR	5.18	15.87	3.06	20	160	2.7	58.8	268	263

Table 19: Formerly married men aged 15-49: mean four weekly coital frequency

Formerly married women aged 15-49	Mean	Standard Deviation	Coefficient of variation	95th perc-entile	Highest reported frequency	% reported 1 act	% reported 0 acts	N formerly married women	N reported frequency
North & central Africa									
Cameroon 1991 DHS	1.07	2.17	2.02	6	23	8.4	66.0	300	300
West Africa									
Senegal 1993 DHS	0.35	1.48	4.25	3	18	3.5	89.4	282	282
Guinea 1987 DHS	0.25	1.11	4.42	2	12	0.8	92.7	402	399
Burkina Faso 1993 DHS	0.44	1.58	3.59	3	15	2.4	87.5	221	221
Niger 1992 DHS	0.24	1.38	5.84	2	20	0.8	94.1	345	343
Ghana 1988 DHS	0.49	1.15	2.35	3	8	8.1	78.6	442	434
Nigeria 1990 DHS	0.59	1.42	2.40	3	12	4.2	79.0	384	382
East & South Africa									
Rwanda 1992 DHS	0.38	1.85	4.89	2	20	4.3	89.5	677	677
Kenya 1989 DHS	0.52	1.49	2.86	3	20	6.9	80.4	518	503
Tanzania 1991 DHS	1.05	2.18	2.08	5	30	8.1	66.3	959	958
Uganda 1988 DHS	1.11	2.68	2.42	5	28	3.1	73.9	657	655
Burundi 1987 DHS	0.22	1.26	5.74	0	15	0.7	95.0	315	314
Zambia 1992 DHS	0.96	2.65	2.76	5	30	8.0	73.2	828	827
Namibia 1992 DHS	1.09	2.70	2.48	5	26	10.3	69.3	414	410
Lesotho 1989 GPA	1.56	3.05	1.96	6	23	8.1	58.1	89	86
South America									
Peru 1986 DHS	0.46	1.80	3.89	3	20	3.6	87.0	338	338
Peru 1991 DHS	0.47	1.90	4.05	3	30	3.4	87.3	1110	1105
Mexico 1987 DHS	0.37	2.02	5.43	2	30	1.2	92.4	612	607
Brazil 1986 DHS	1.28	3.56	2.78	8	30	5.2	75.3	408	395
Brazil 1991 DHS	1.14	2.92	2.57	6	40	9.0	70.6	614	613
Colombia 1986 DHS	0.70	2.67	3.80	4	30	3.3	83.9	492	472
Colombia 1990 DHS	0.60	2.41	4.03	3	20	4.2	85.4	1004	1003
Bolivia 1989 DHS	0.14	0.74	5.37	0	8	1.2	95.1	576	548
Ecuador 1987 DHS	0.37	2.13	5.79	2	30	1.4	92.5	294	294
Paraguay 1990 DHS	0.62	1.97	3.20	4	20	4.6	81.6	322	322
Dominican Rep 1986 DHS	0.44	1.73	3.96	3	28	3.5	87.2	1075	1075
Dominican Rep 1991 DHS	0.63	2.28	3.61	4	28	4.3	83.5	1088	1085
Asia									
Thailand 1990 GPA	0.03	0.22	7.53	0	2	1.0	98.1	103	103
Sri Lanka 1991 GPA	0.00			0	0			60	60
Industrialised									
Britain 2000 Natsal	4.99	7.53	1.51	20	100	10.1	37.2	1551	1485
Australia 2001 ASHR	3.56	8.80	2.47	20	100	2.9	64.6	368	368

Table 20: Formerly married women aged 15-49: mean four weekly coital frequency

3.3.3 Changes in coital frequency with age

The results presented in Figure 8 show a clear decline in coital frequency with increasing age for both men and women in both countries. The decline appears more pronounced in Australia than Britain, for two reasons. Firstly, the peak coital frequency for men in Australia is higher than for men in Britain, though the confidence intervals are wide so this difference may have been observed by change. Secondly, the Australian survey interviewed respondents in their late forties and fifties whereas the British survey stopped at age 44. A second decline is seen in the fifties in Australia, and may well occur in Britain: the mean frequencies reported by people aged 40-44 were quite similar in the two countries.

The peak coital frequency is reported by respondents aged 25-29 in Australia and 20-24 in Britain. Correspondingly the decline appears to start earlier in Britain, women in their late thirties are already significantly different to women in their early twenties.

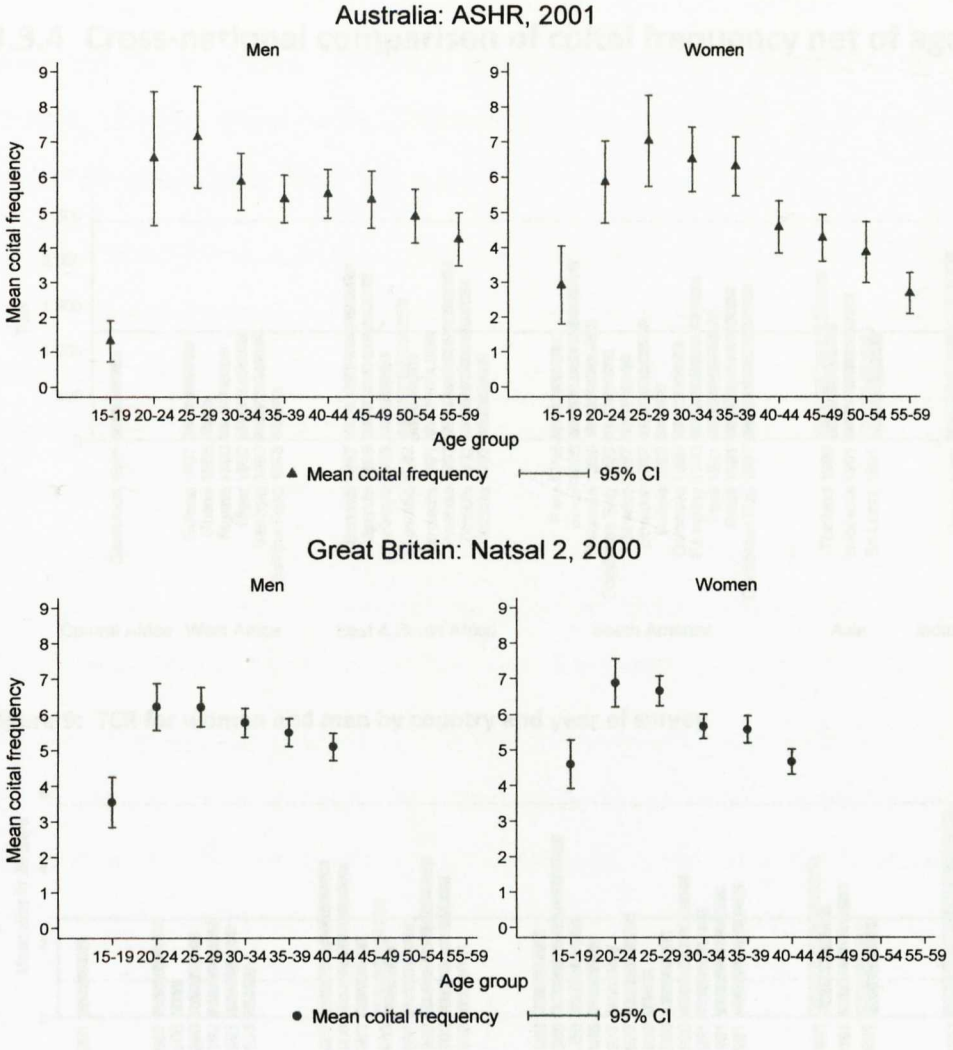


Figure 8: Mean four weekly coital frequency by age group for men and women from Australia and Great Britain.

3.3.4 Cross-national comparison of coital frequency net of age structure

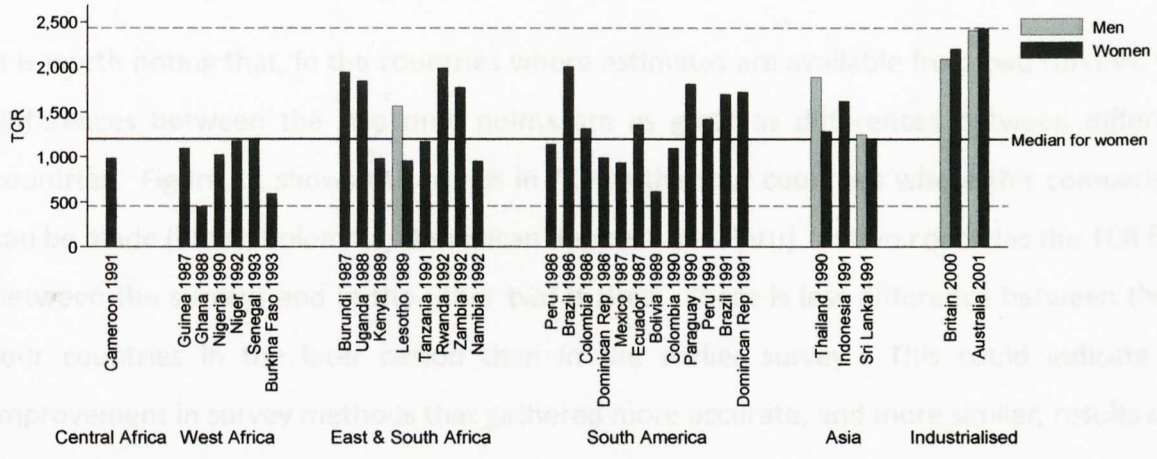


Figure 9: TCR for women and men by country and year of survey

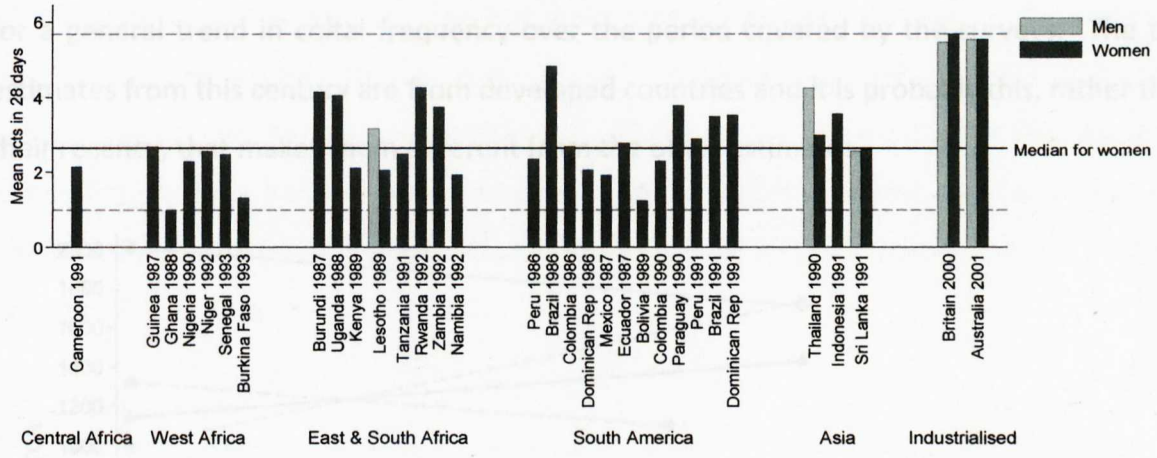


Figure 10: Mean number of acts in 28 days for women and men by country and year of survey

Differences between populations in summary measures of coital frequency could be partly due to differences in the age structures. Populations that have a large proportion of people in the groups that report the highest number of sex acts could appear to have a higher coital frequency overall. Figure 9 and Figure 10 show the total coitus ratio (TCR) and mean number of acts in 28 days, respectively. The TCR is the number of sex acts the average person would have between the ages of 15 and 49 if they experienced the prevailing age-specific rates in each age group. As such, it is independent of the age structure of the population. The mean number of acts is not independent of the age structure. Comparing the two figures, the relative positions of the national estimates are similar in both graphs

which suggests that age structure is not an important factor in the differences observed between the countries. The most noticeable difference between the mean and TCR is in Britain, but this arises because the survey did not include 45-49 year olds and the TCR is therefore incomplete for this group.

It is worth noting that, in the countries where estimates are available from two surveys, the differences between the two time points are as great as differences between different countries. Figure 11 shows the trends in TCR in the four countries where this comparison can be made (Brazil, Colombia, Dominican Republic and Peru). In two countries the TCR falls between the surveys and in the other two it rises. There is less difference between these four countries in the later period than in the earlier survey. This could indicate an improvement in survey methods that gathered more accurate, and more similar, results or a regional trend towards more similar coital frequency in these countries.

Figure 12 shows, for all surveys, the TCR for women by year of survey. It shows no evidence for a general trend in coital frequency over the period covered by the surveys. The two estimates from this century are from developed countries and it is probably this, rather than their recency, that makes them different from the other estimates.

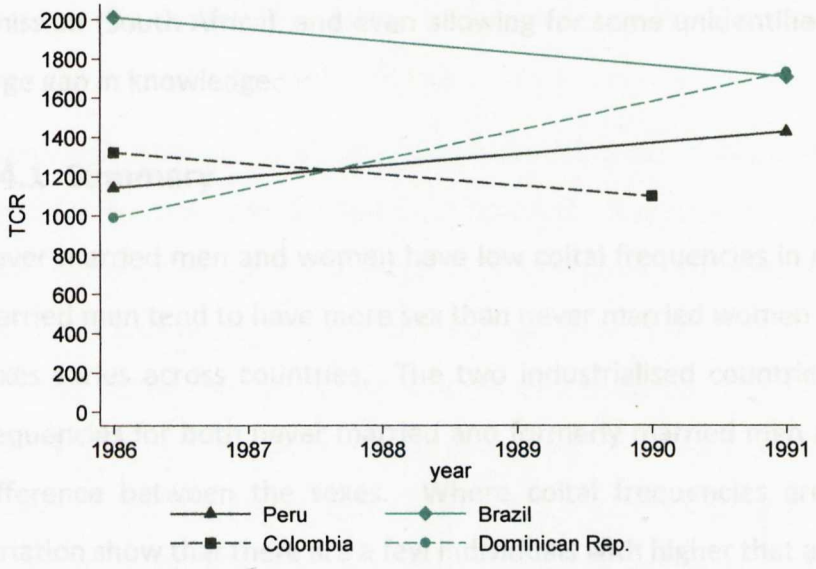


Figure 11: Trends in TCR for women in the four countries for which estimates are available from two surveys.

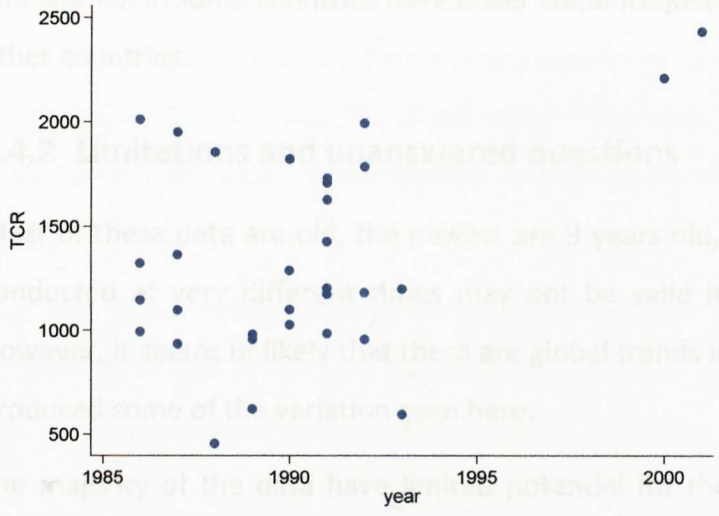


Figure 12: TCR for women by year of survey

3.4 Discussion

The review of the data echoes the literature review: there is little information on men and little on sex outside marriage. There is some overlap in the data sources between the literature review and this chapter where I have re-analysed both DHS and WHO/GPA data because the literature made only partial use of both sources. Almost all of the nationally representative data from the general population has been included here, I know of only one omission (South Africa), and even allowing for some unidentified surveys, there is clearly a large gap in knowledge.

3.4.1 Summary

Never married men and women have low coital frequencies in most surveys, though never married men tend to have more sex than never married women the difference between the sexes varies across countries. The two industrialised countries show much higher coital frequencies for both never married and formerly married men and women, and much less difference between the sexes. Where coital frequencies are low, high coefficients of variation show that there are a few individuals with higher that average coital frequencies.

Married men and women have the highest coital frequencies, and are more similar to one another than unmarried people. For women, comparing across different surveys and all countries, there is a wide range of coital activity within marriage. There are not enough data points for men to assess this. Inter-country differences are so large that married men

and women in some countries have lower coital frequencies than unmarried respondents in other countries.

3.4.2 Limitations and unanswered questions

Most of these data are old, the newest are 9 years old, and comparisons between surveys conducted at very different times may not be valid if behaviour is changing over time. However, it seems unlikely that there are global trends in coital frequency which could have produced some of the variation seen here.

The majority of the data have limited potential for the investigation of the correlates of coital frequency. This is because the surveys do not build up a comprehensive and rounded picture of respondents' sexual activity in a given time frame but instead are restricted to compartmentalised questions on certain partners or particular aspects of behaviour. For instance, in most surveys we have no information on how many people the respondent had sex with during the four weeks before the survey. For most respondents, the answer would be 0 or 1, but the small numbers with more than one partner are of great interest for understanding STI transmission. The surveys from the industrialised countries are far more comprehensive, because they are surveys of sexual behaviour, but have less focus on family planning and fertility intentions. Variables such as duration of marriage, a cornerstone of DHS style enquiries, are not collected.

It would be possible to use the data to look for broad associations between some of the correlates identified in the literature (duration of marriage, contraceptive use, desire for a child). If correlations were identified, interpretation of the results would be complicated by the many unknowns. A person's behaviour with different partners is a product of the interplay within the partnership and the circumstances that surround it. Coital frequency and condom use within the partnership are influenced by familiarity with the partner, fertility desires and knowledge and access to contraception and condoms. They may also be influenced by factors external to the partnership such as the existence of other partners, or financial or social circumstances. None of the data presented here would help unravel these complex dynamics: this would require, at the very least, contraceptive use, fertility preference and coital frequency data to be collected separately for every partner in a set reference period- perhaps over a two year period.

Although the correlates of coital frequency identified in the literature are interesting the key question for STI prevention is how coital frequency interacts with the number of partners, the types of partner and the duration of relationships with partners. These questions remain unanswered from the literature and largely unanswerable from the data reviewed here.

The two WFS surveys which collected actual coital frequencies (Philippines and Colombia 1976) yielded higher estimates than other surveys in the region. This is probably because these surveys asked for actual frequency in the week before the survey, rather than the month as in most other surveys. This result was multiplied by 4 to scale it up to an approximate 4 weekly frequency but this appears to be too high. This raises a point about reporting of coital frequency. It has been generally assumed, when asked for a monthly, or four weekly frequency, that respondents think of a weekly frequency and multiply it by four[4] [65]. However, if that were happening, we would not see the disparity between the WFS results generated in this manner and the results from other surveys. It may be easier, or more tempting, to give a normative response for a short reference period, such as a week, than for a longer time leading to more over-estimation for the weekly figure than for the four weekly estimate. Perhaps, when asked to think about four weeks, respondents have to think harder and therefore give more detailed, maybe even more accurate answers, than for a relatively straightforward response about the last week.

We know nothing about the coital frequency with partners that were not current at the time of the survey. It is extremely difficult to collect data on ex-partners in a cross-sectional survey both from the point of view of the respondent and their ability to recall but also in choosing an appropriate recall period for a series of events that may have occurred many months before the interview. Coital frequency at the very end of a relationship may be very different from that in the heyday of the relationship and may present a misleading picture , unless it is possible to identify the estimate as coming from the end of the relationship. However, in a cross-sectional surveys, some current partnerships will be in decline while others will be in the early stages and so at the population level this effect might not be important.

The problem with limiting data collection to current partners, in a cross-sectional survey, is that most respondents' riskiest partners will be in their past, and most of the risky partners

identified in the survey will be ex-partners. This is because a cross sectional survey will be more likely to identify longer term partners as current at the time of the interview. Although this gives a realistic representation of the respondents' partner status, it may result in very small numbers of respondents with risky partners.

To help understand STI spread, coital frequency data is needed for a wider range of partners, in combination with other information on partnerships, to explain the intensity of contacts between partners of all types. The existing data and literature says very little about this.

Chapter 4 Estimating coital frequency from time elapsed since most recent sex

As highlighted in the literature (Chapter 2) and data (Chapter 3) reviews, there is comparatively little data on coital frequency but much more on time since most recent sex (time since last sex- TSLS).

In surveys, a question about time since last sex has often been favoured over direct questions about coital frequency because the question on TSLS can be made precise and relevant to all respondents regardless of their level of recent sexual activity. The specific nature of the question should make it easier for respondents to recall and report an accurate answer. The relevance to all respondents (except those who have never had sex) means that there should be no null responses, except for those who cannot remember or refuse to answer. This is in contrast to reported coital frequency where those who have had sex, but not in the reference period, report a zero value that is difficult to use in analysis.

TSLS may be less vulnerable to reporting problems than coital frequency: there is unlikely to be a normative response for TSLS and, if there is not an established, socially acceptable range of responses, then respondents may not be able to edit their answers to be more socially desirable. TSLS is adequate for determining recent exposure to the risk of pregnancy at the population level but not at the individual level in the absence of data on menstruation. It is less useful for ascertaining exposure to STIs because, although it indicates sexual activity within a set period or the absence of any activity, it provides no information on the intensity of any exposure.

TSLS and coital frequency describe different aspects of the same process and are therefore statistically related to each other. On this basis it may be possible to derive a measure of coital frequency from TSLS. This would make it possible to use the distributions of TSLS reported in population survey data to estimate average frequencies of sex for sub-groups of the survey respondents hence filling in some of the data gaps identified in the preceding chapters.

4.1 Using TSLS to estimate coital frequency.

I make the assumption that, at an individual level, the frequency of sex (number of acts in a given time period) is a Poisson process with the following characteristics. For each individual, sex acts occur at a constant rate (with each partner), i.e. the hazard of sex on a given day is constant for each individual. (In reality, this hazard pertains to the couple, but with survey data it is usually only possible to see one member of the couple.) Individuals with multiple partners are considered to have separate processes governing the number of acts with each partner. Within the population, the hazard of sex can vary between partnerships but stays constant within partnerships over the relatively short reference period for the survey (up to one year).

Given that the frequency distribution of events is generated by Poisson processes then the incidence rate for the events governed by the Poisson process can be derived from the distribution of times to event (TSLS)[66]. This can be estimated, using survival analysis techniques, by fitting a survival time regression model with the exponential distribution to the observed TSLS.

If no covariates are included in the regression model the incidence rate derived from the waiting time distribution will be the same for every individual. Given that the coital frequency is known to vary between partnerships, it is necessary to identify some covariates which can be used to subdivide the study population into groups such that there is no variation in coital frequency within the groups but there are differences between the groups. In this way it should be possible to use the mathematical properties of the Poisson process to describe a link between the distribution of TSLS and coital frequency

The difficulty with this approach lies with identifying the covariates and knowing when the selected covariates adequately classify subjects into groups that are sufficiently homogenous for coital frequency that the predicted hazards capture the differences in underlying coital frequency. Using a survival time model with the exponential distribution the hazards are constrained to be constant within the groups defined by the covariates.

Identification of appropriate and important covariates is likely to be difficult. The literature review shows that the factors associated with coital frequency differ between populations

and also that factors commonly shown to be associated, such as age, have effects that vary between populations.

Using covariates to adequately partition respondents into groups with similar coital frequency is likely to be imperfect, at best. It is probable that coital frequency is influenced by factors that are not usually measured in surveys, and quite possibly factors that cannot be measured in surveys such as personal preference, partner's preference and physiology. This means that some of the heterogeneity in the data cannot be explained by the available covariates, there is unobserved heterogeneity.

Choice of statistical model

Parametric regression models for survival analysis can be fitted in two metrics: proportional hazards (PH) or accelerated failure time (AFT). Parametric models in the PH metric specify a functional form for the baseline hazard. This is chosen at the outset of analysis. Covariates, and their coefficients fitted to the data, elevate or reduce the hazard from the baseline hazard which is derived from the data and constrained to follow the selected functional form.

In the AFT metric, failure times are not described by a single functional form (such as the exponential or Weibull, for example). Instead the distribution of failure times is described by the equation:

$$\tau_j=\exp(-x_j\beta_x)t_j \qquad (1)^{67}$$

Survival time models in the AFT metric fit:

$$\ln(t_j)=x_j\beta_x+\ln(\tau_j) \qquad (2)^{67}$$

The natural log of the time to failure is therefore dependent on the covariates and their fitted coefficients and the natural log of the distribution of failure times. This distribution can be specified (e.g. lognormal or exponential). Alternatively, the gamma regression model can be used. This three parameter model has a flexible hazard function and so selecting this distribution makes no prior assumption about the shape of the distribution of the failure times.

For the gamma regression model the distribution is described as:

$$\tau_j \sim \text{Gamma}(\beta_0, \kappa, \sigma) \qquad (3)^{67}$$

In Stata this is achieved as follows:

$$S(t) = \begin{cases} 1 - I(\gamma, u), & \text{if } \kappa > 0 \\ 1 - \Phi(z), & \text{if } \kappa = 0 \\ I(\gamma, u), & \text{if } \kappa < 0 \end{cases}$$

$$f(t) = \begin{cases} \frac{\gamma^{\gamma}}{\sigma t \sqrt{\gamma}\Gamma(\gamma)} \exp(z\sqrt{\gamma} - u), & \text{if } \kappa \neq 0 \\ \frac{1}{\sigma t \sqrt{2\pi}} \exp(-z^2/2), & \text{if } \kappa = 0 \end{cases}$$

where $\gamma = |\kappa|^{-2}$, $z = \text{sign}(\kappa)\{\log(t) - \mu\}/\sigma$, $u = \gamma \exp(|\kappa| z)$, $\Phi(z)$ is the standard normal cumulative distribution function, and $I(a, x)$ is the incomplete gamma function. See the `gammap(a,x)` entry in [D] **functions** to see how the incomplete gamma function is implemented in Stata.

This model is implemented by parameterizing $\mu_j = \mathbf{x}_j\beta$ and treating the parameters κ and σ as ancillary parameters to be estimated from the data.

Source: Stata 11 Manual [ST] Survival Analysis , streg — Parametric survival models page 361

The survival time model that uses the generalized gamma distribution (`streg, d(gamma)`) allows for some unobserved heterogeneity in the data and this is reflected in two ways. Firstly, the estimated hazards are conditional on survival time. Secondly, two ancillary parameters are fitted to the data, κ and σ , and can be fitted for the whole model, or allowed to vary by a combination of covariates. In this way, the unobserved parts of the process can be taken into account. The values of these parameters can be used to indicate how closely the fitted model represents an exponential distribution. If κ=1 and σ=1 the distribution is exponential.

Fitting a survival time model using the generalized gamma distribution to the distribution of TSLS will yield estimates of κ and σ. The closer both of these estimates are to 1, the more closely the distribution of failure times (τ_j) resembles an exponential distribution. From a practical point of view this approach has two advantages for tackling the problem of relating TSLS to underlying coital frequency. Firstly, the gamma model requires no prior assumptions about the shape of the distribution of the times to last sex. Secondly, given the assumption of a constant hazard over the relatively short reference period used in survey data, the fitted values of κ and σ can be used to guide the selection of covariates for the inclusion in the regression model. The aim being to include sufficient covariates to identify

sub-groups of observations that share the same underlying coital frequency. If this has been adequately done the fitted values of κ and σ should be close to 1. Thus reflecting the fact that the distributions of TSLS conform to an exponential distribution and differences in the underlying rates between the sub-groups are sufficiently described by the model coefficients.

If this cannot be done, it could be for two reasons: 1) random error or 2) because the assumption of constant hazard is not correct. For data where the underlying hazard is known to be constant it should be possible to fit models where the values of κ and σ come close to 1.

4.2 Relationship between the negative binomial regression model for count data and the survival time model with the gamma distribution

The simplest model for count data is the Poisson regression model and the counterpart of this for the distribution of waiting times to event is, in survival analysis, the model which uses the exponential distribution[66]. More sophisticated models are available for both count and survival (waiting) time data but these typically do not have the neat relationship that is evident between the Poisson model and the survival time model with an exponential distribution. When waiting times are modelled as

$$\ln(t_i)=x_i'\beta + \varepsilon_i - u_i \qquad (4)$$

where ε_i are iid extreme value distributed and u_i is a log gamma random variable. This corresponds to the negative binomial model for counts[66].

$$\ln(t_j)=x_j\beta_x+\ln(\tau_j) \qquad (2)$$

4.3 Using number of events to estimate underlying rate of coital frequency

The distributions of number of sex acts can be modelled to give an estimate of the incidence rate for sex (the coital frequency). As above, this will work best if the population can be partitioned into sub-groups that share the same underlying rate. This can be done using a

negative binomial model (NB-2 as defined by [66]). This is expected to be more appropriate than a Poisson model because it is very likely that data on number of sex acts will be over-dispersed, that is the variance of the distribution exceeds the mean. In such circumstances a Poisson model is not valid, even though the data may have been generated via a Poisson process. The over-dispersion observed in survey data may be real or merely apparent in the survey sample. If the over-dispersion is apparent rather than real there are series of possible causes[68], in this example it is assumed the most likely important reason is that the survey has not captured one or more important determinants of coital frequency.

Methods

4.3.1 Simulation of data

To illustrate the analysis outlined above, I simulated a dataset containing 50,000 observations. These were divided into five groups of 10,000 observations and I allocated to each group a different rate of coital frequency. Hazards were chosen to represent a realistic range of reported frequencies: Once every two days (0.5), twice a week (0.28571429), once a week (0.14285714), once every 10 days (0.1), once a fortnight (0.07142857). Thirty variables were created, each containing a randomly generated number. This number was generated using Stata 11's `runiform()` function which produces a uniformly distributed number between 0 and 1. A further thirty variables were created to represent thirty days of observation. Whether sex occurred on each day of the 30 day period was determined using one of the thirty random numbers for each individual according to their underlying coital frequency. The total number of days on which sex occurred was summed to give a total number of events for each record. The number of days since sex last occurred was calculated for each observation. The resulting dataset represented the information that might be collected in surveys: number of events in 30 days and number of days elapsed since the most recent event (TSLS).

Subsequently the dataset was extended to cover a 120 day period.

The dataset also contained a categorical variable which perfectly partitioned the model population into groups with the same coital frequency. Another series of variables were constructed which classified individuals by underlying coital frequencies with different levels of accuracy: 90% correctly classified, 70% and so on to 10% correctly classified. For each variable, the percentage that were not correctly classified were arbitrarily, but evenly, allocated to one of the five groups.

The distributions of a) time since last sex and b) number of sex acts were graphed for each group and for the whole dataset.

Waiting time models

Survival time regression models using a) the exponential distribution and b) the generalized gamma distribution were fitted to the data without any covariates. These models were first

fitted separately for each of the five groups and then to the entire dataset. The mean and median hazards predicted by these models were compared with the actual hazard. In addition the values of κ and σ were compared and a Wald test of the null hypothesis that κ=σ=1 was carried out. The gamma model was specified such that κ and σ were the same for each observation in the model.

Initial analysis was done using the complete dataset of 50,000 observations. However, it became apparent that, with this many observations, the models were not behaving as expected. Therefore a different approach was tried and the analysis was carried out on a random 1% sub-sample of observations from the dataset, and this was repeated 20 times.

A series of exponential and gamma models were then fitted to the dataset with all 50,000 observations. Each model included a covariate that correctly classified a different proportion of subjects. The mean and median hazards, gamma model parameters and Akaike's information criterion (AIC)[1] were compared for these models.

Following each model the hazard was predicted for each observation. The predicted hazards from the models with different percentages correctly specified (both exponential and gamma) were used to estimate number of sex acts, using the method outlined above. The random numbers used to determine whether or not the event occurred on a particular occasion were expected to have a large influence on the results. Therefore the predicted coital frequencies were based on the mean of ten iterations using different random numbers. The mean predicted number of events in 30 days was compared between the models with different levels of classification and with the actual number of events.

Count data models

Negative binomial models were fitted to the count of the number of sex acts in 30 days. A series of models were fitted, each with one covariate that correctly allocated a different fraction of observations into sub-groups that shared the same underlying coital frequency rate.

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[1] Akaike's information criterion (AIC) is defined as AIC = $-2\ln L + 2k$ in which $\ln L$ = maximized log-likelihood from the regression model and k =number of parameters.

After each model the predicted rates were calculated and these were plotted against the true coital frequencies.

4.4 Results

Figure 13 shows the distribution of the total number of sex acts in 30 days (coital frequencies) for each of the five groups with different underlying hazards, and for the entire dataset. The distributions within the individual groups are close to normal, and are consistent with what is expected from a Poisson distribution. The distribution for all groups combined, titled 'Total' in Figure 13, has a long tail to the right.

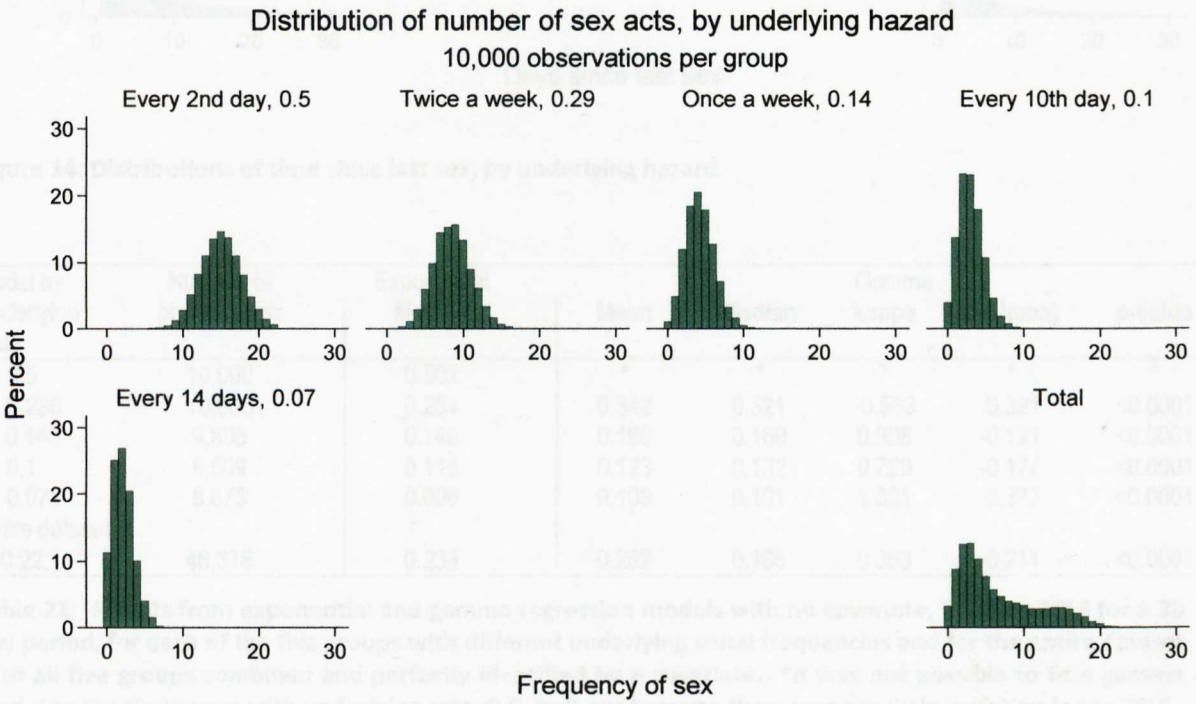


Figure 13: Distributions of number of sex acts in 30 days, by underlying hazard.

Figure 14 shows the distributions of time since last sex, in each of the five groups and for the entire dataset. Each group has the largest number of observations in the days immediately before the survey and shows a decline thereafter. The scale is the same in all graphs and so this pattern is most evident in the groups with the higher frequencies.

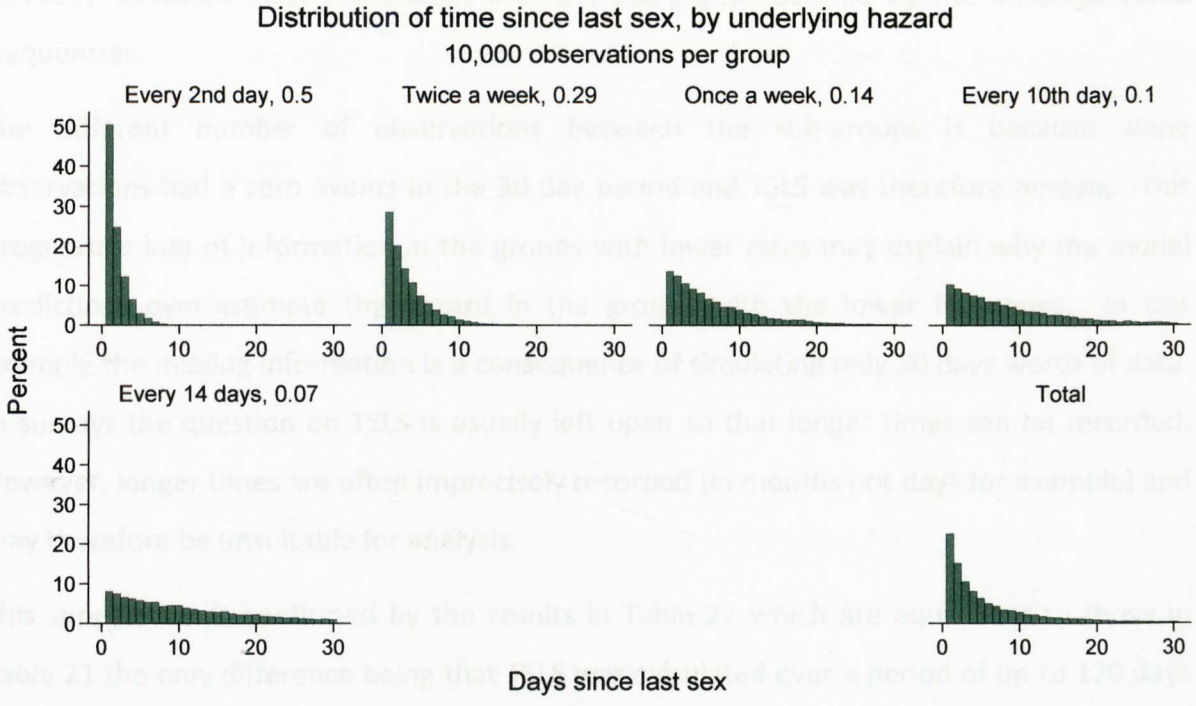


Figure 14: Distributions of time since last sex, by underlying hazard.

Model by Underlying Rate	Number of observations	Exponential Median	Gamma Mean	Gamma Median	Gamma kappa	Gamma ln(sigma)	Gamma p-value
a) 0.5	10,000	0.502	*	*	*	*	*
b) 0.286	10,000	0.284	0.342	0.321	-0.533	-0.321	<0.0001
c) 0.143	9,896	0.149	0.160	0.169	0.308	-0.121	<0.0001
d) 0.1	9,609	0.115	0.123	0.132	0.729	-0.177	<0.0001
e) 0.071	8,873	0.096	0.108	0.101	1.321	-0.377	<0.0001
Entire dataset:							
f) 0.22	48,378	0.233	0.262	0.186	0.363	-0.211	<0.0001

Table 21: Results from exponential and gamma regression models with no covariate, fitted to TSLS for a 30 day period, for each of the five groups with different underlying coital frequencies and for the entire dataset with all five groups combined and perfectly identified by a covariate. *It was not possible to fit a gamma model to the first group with underlying rate=0.5, perhaps because there was too little variation in the TSLS.

Table 21 shows the results from a series of regression models. For each of the five groups with a different underlying coital frequency two models were fitted: one with an exponential distribution and one with a gamma distribution. The median hazards from these models were compared with the underlying rate in each group. In addition, for the gamma model, the values of κ and $\ln(\sigma)$ are presented together with the p-value from a Wald test of the null hypothesis $\kappa=\sigma=1$. The last row shows the same results from exponential and gamma models fitted to the entire dataset with a single covariate that

correctly allocated each respondent into the sub-groups defined by the different coital frequencies.

The different number of observations between the sub-groups is because some observations had a zero events in the 30 day period and TSLS was therefore missing. This progressive loss of information in the groups with lower rates may explain why the model predictions over-estimate the hazard in the groups with the lower frequency. In this example the missing information is a consequence of simulating only 30 days worth of data. In surveys the question on TSLS is usually left open so that longer times can be recorded. However, longer times are often imprecisely recorded (in months not days for example) and may therefore be unsuitable for analysis.

This supposition is confirmed by the results in Table 22 which are equivalent to those in Table 21 the only difference being that TSLS was calculated over a period of up to 120 days and the models fitted to those results. Accordingly only the group with the lowest frequency has any missing data (just two observations) and the degree of overestimation has dropped markedly. From the results in Table 21, the median hazards estimated for the group with the lowest coital frequency (0.071, once every 14 days) were 35% and 42% above the actual rate for the exponential and gamma models respectively. Based on the results in Table 22 this overestimate was 0% for the exponential model and 6% for the gamma model.

When the groups with different underlying coital frequency rates were modelled separately the gamma model consistently estimated higher hazards than the exponential. Both mean and median values were higher than the true coital frequency for the group and higher than the estimate from the exponential model. However, for the model that included all the sub-groups, the median hazard from the gamma model was 0.17, higher than the true median hazard (0.14) and considerably lower than the true mean hazard. The exponential model correctly estimated the mean hazard at 0.22 and the median at 0.14.

The two parameters of the gamma model that describe the distribution of failure times (κ and σ) are not close to 1 in any of the models which is contrary to what might be expected. Given that the data in each of models *a* to *e* were generated using the same constant rate it was expected that the models would fit κ and σ as an exponential distribution. However,

the p-values from the Wald test of $\kappa=\sigma=1$ are all very small for all models, indicating that the null hypothesis can be rejected and these values are not both equal to 1. Inspection of the values shows that in none of the models are either κ or σ close to 1 and that their values are not similar between the different models.

In this ideal scenario, where all the observations can be perfectly classified into groups based on underlying coital frequency, the exponential model yields an estimate that is closer to the underlying rate than the estimate from the gamma model.

Underlying Rate	Number of observations	Exponential	Gamma				
		Median	**Mean**	**Median**	**kappa**	**ln(sigma)**	**p-value**
a) 0.5	10,000	0.502	*	*	*	*	*
b) 0.286	10,000	0.284	0.342	0.321	-0.533	-0.321	<0.0001
c) 0.143	10,000	0.142	0.153	0.159	0.182	-0.087	<0.0001
d) 0.1	10,000	0.101	0.106	0.112	0.409	-0.049	<0.0001
e) 0.071	9,998	0.070	0.072	0.076	0.549	-0.017	<0.0001
Entire dataset:							
f) 0.22	49,998	0.220	0.238	0.170	0.244	-0.143	<0.0001

Table 22: Results from exponential and gamma regression models, fitted to TSLS for a 120 day period, for each of the five groups with different underlying coital frequencies and for the entire dataset with all five groups combined and perfectly identified by a covariate. *It was not possible to fit a gamma model to the first group with underlying rate=0.5

Failure of the gamma model to fit an exponential distribution of failure times

One possible explanation for the failure of the gamma models to fit an exponential distribution to the failure times is that the very large number of observations introduced sufficient noise into the data that the exponential was not the best fit. To assess this, the analysis was repeated, with TSLS based on 120 days but with only 100 observations in each group of underlying rate. This was replicated 20 times.

Using this approach, the fitted values of κ and σ did not differ from 1 in some of the models, as indicated by a Wald test p-value greater than 0.05. This was more likely in the groups with the lower underlying coital frequencies, as shown in Table 23. Out of the 20 models fitted for each category of underlying rate, half of those in the lowest frequency group (group e) were such that the p-value for the Wald test with H_0 $\kappa=\sigma=1$ was large enough not to reject this null hypothesis. In the other groups this happened in fewer models. In the two groups with the highest rates (a and b), and in the model with all groups combined, in none of the 20 model fits did $\kappa=\sigma=1$. In the three groups with the lowest frequencies (c d and e), the models in which κ and σ were not significantly different than 1 could have been due to a lack of power, rather than the model fitting values that were near to 1. However all the models had the same number of observations and should therefore have had similar power. Comparison of the mean values of κ and σ between the models where $\kappa=\sigma=1$ and those where this was not the case showed that the values of κ and σ in the former models were indeed closer to 1 than in the other models. Table 24 shows the hazards predicted by the gamma and exponential models for each group of underlying rates and the fitted values of κ and $\ln(\sigma)$ for the gamma models. These results are the means of 20 iterations. The minimum and maximum values of κ and σ from individual iterations are also shown. In the lowest frequency groups, the values of both parameters are closer to 1 for κ and 0 for $\ln(\sigma)$ than in the other categories. Therefore, with fewer observations and lower frequency, the gamma model does perform as expected and κ and σ tend towards 1 when the data come from an underlying Poisson process and share the same underlying rate. However, the model with all groups combined, which included the groups with the higher frequencies, did not fit $\kappa=\sigma=1$. When only the two groups with the lowest frequencies were combined in one model (results not shown) the model did not fit $\kappa=\sigma=1$.

Models by underlying rate	Number of models in which $\kappa=\sigma=1$ ($p>0.05$)
a) 0.5	0
b) 0.286	0
c) 0.143	2
d) 0.1	5
e) 0.071	10
All groups combined	
f) 0.22	0

Table 23: Number of gamma regression models in which it was not possible to reject the null hypothesis $\kappa=\sigma=1$

	Predicted hazards (mean of 20 iterations)		Kappa (mean)	Kappa (range)	ln(sigma) (mean)	ln(sigma) (range)
	Exponential	Gamma				
a) 0.5	0.507	-	-		-	
b) 0.286	0.281	0.338	-0.417	-0.991 to 0.022	-0.313	-0.525 to -0.191
c) 0.143	0.141	0.154	0.109	-0.275 to 0.416	-0.087	-0.198 to 0.019
d) 0.1	0.106	0.112	0.411	-0.406 to 0.882	-0.075	-0.204 to 0.06
e) 0.071	0.075	0.079	0.500	0.094 to 1.035	-0.045	-0.185 to 0.11
All groups combined						
f) 0.22	0.221	0.241	0.183	-0.217 to 0.36	-0.147	-0.193 to -0.095

Table 24: Hazards predicted by exponential and gamma regression models for each rate group separately, with 100 observations in each group, and for all the groups combined i.e. 500 observations. The results shown are the means hazards from 20 iterations and, for the gamma model, the means of kappa and sigma and the minimum and maximum values of these parameters fitted in different iterations.

Classification of observations by underlying rate of coital frequency

In the analyses so far, the data have been partitioned into groups that share the same underlying rate of coital frequency. However, the more realistic scenario is that this classification is not possible or is inaccurate. Under those circumstances the gamma model would be expected to perform better than the exponential because it allows for the unobserved heterogeneity (the imperfect identification of the groups sharing the same underlying coital frequency) by letting the hazard vary both as a function of the covariates, the time and by fitting the values of κ and σ to the data.

Table 25 compares the results of a series of exponential and gamma regression models that each include a covariate which correctly allocates different fractions of observations into the groups defined by their underlying coital frequency. As above, the true median hazard is 0.14 and the true mean is 0.22. These models were based on the entire dataset of 50, 000 observations.

The AIC show that, in every scenario, the gamma model is preferred over the exponential because the AIC for the gamma model is smaller than the AIC for the equivalent exponential model. The median hazard estimated by the gamma models is consistently higher than the true median hazard whereas that estimated by the exponential is much closer to 0.14. However the mean hazard predicted from the gamma models is consistently closer to the

true mean of 0.22 than that estimated from the exponential models. The values of κ and σ and the results of the Wald test that $\kappa=\sigma=1$ show that none of the gamma models has come to resemble an exponential model, which reinforces the conclusions drawn from Table 22. With 100% of observations correctly classified by underlying rate, the AIC show that the gamma model is preferred to the exponential even though, as noted above, the hazard estimated by the exponential model is closer to the true value than that estimated by the gamma model.

Percent correct	Exponential Mean	Median	AIC	Gamma Mean	Median	AIC	κ	ln(σ)	p-value
10	0.137	0.135	157777	0.168	0.177	147049	-0.573	-0.003	<0.001
30	0.140	0.137	156402	0.170	0.172	146029	-0.513	-0.002	<0.001
50	0.150	0.138	153175	0.177	0.162	143651	-0.381	-0.007	<0.001
70	0.165	0.14	148574	0.191	0.158	139529	-0.222	-0.032	<0.001
90	0.194	0.141	140900	0.216	0.165	133278	0.030	-0.086	<0.001
100	0.220	0.142	135607	0.238	0.170	128580	0.244	-0.143	<0.001

Table 25: Mean and median hazards predicted from survival time models using exponential and generalised gamma distributions, and parameter values from the gamma models, based on covariates that correctly classified different proportions of subjects by the underlying hazard.

This is illustrated in Figure 15 which shows, by underlying rate, the hazards predicted by the exponential and gamma models with 50% and with 90% of observations correctly classified. With only 50% of observations correctly classified, the differences between the groups with different underlying rates are small. The predictions from the gamma model show a wider range than those from the exponential. The within group variance in the hazards predicted by the exponential model arises from the random allocation of the unspecified observations into other covariate groups. This is why the range is the same in all groups of underlying coital frequency. With 90% correctly classified, the hazards predicted for each group are much closer to the true hazard. The estimates from the gamma model are consistently higher than those from the exponential.

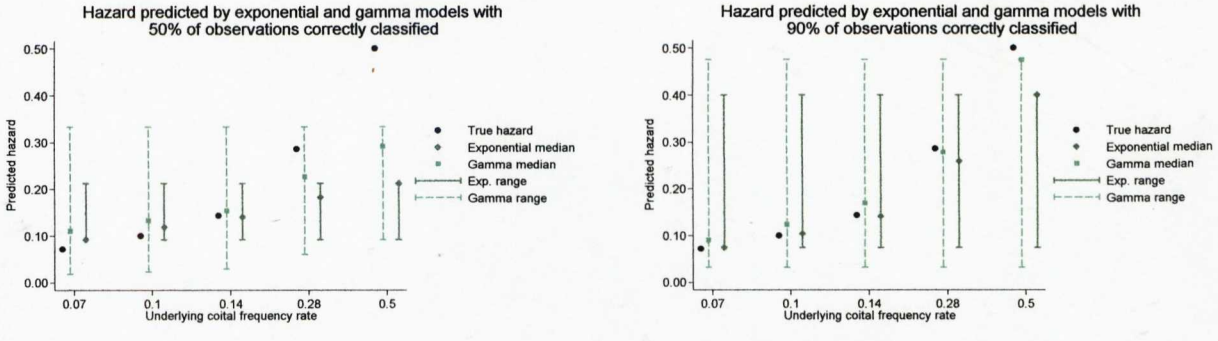


Figure 15: Hazards of sex predicted by the exponential and gamma regression models with 50% of observations correctly identified and with 90% of observations correctly specified.

Figure 16 shows the distributions of number of sex acts from the simulated data and that based on the exponential and gamma models with 90% of observations correctly specified. The estimates from the exponential model are bunched at the lower values whereas those from the gamma model show a distribution that is more similar to that of the simulated data.

Figure 17 compares the predicted number of events estimated by two gamma models (50% and 90% correctly specified) by underlying rate. With only 50% correctly specified the overall distribution is not sufficiently skewed to the right. The estimated counts are too high in the low-rate groups and too low in the higher rate groups. With 90% correctly specified the overall distribution closely resembles that of the actual data. The correspondence is worst in the groups with the lower rates.

Figure 18 shows the residuals plotted against themselves and and the cumulative hazard function for gamma and exponential models with different fractions of observations correctly allocated to sub-groups sharing the same underlying coital frequency rate. It shows that even at high levels of specification the models are a poor fit at the lower coital frequencies.

Figure 19 and Figure 20 show the predicted number of events versus the actual based on the results of the exponential and gamma models respectively, with different proportions of observations correctly classified. When less than 70% of observations are correctly classified there is little correlation between the predicted and actual frequencies.

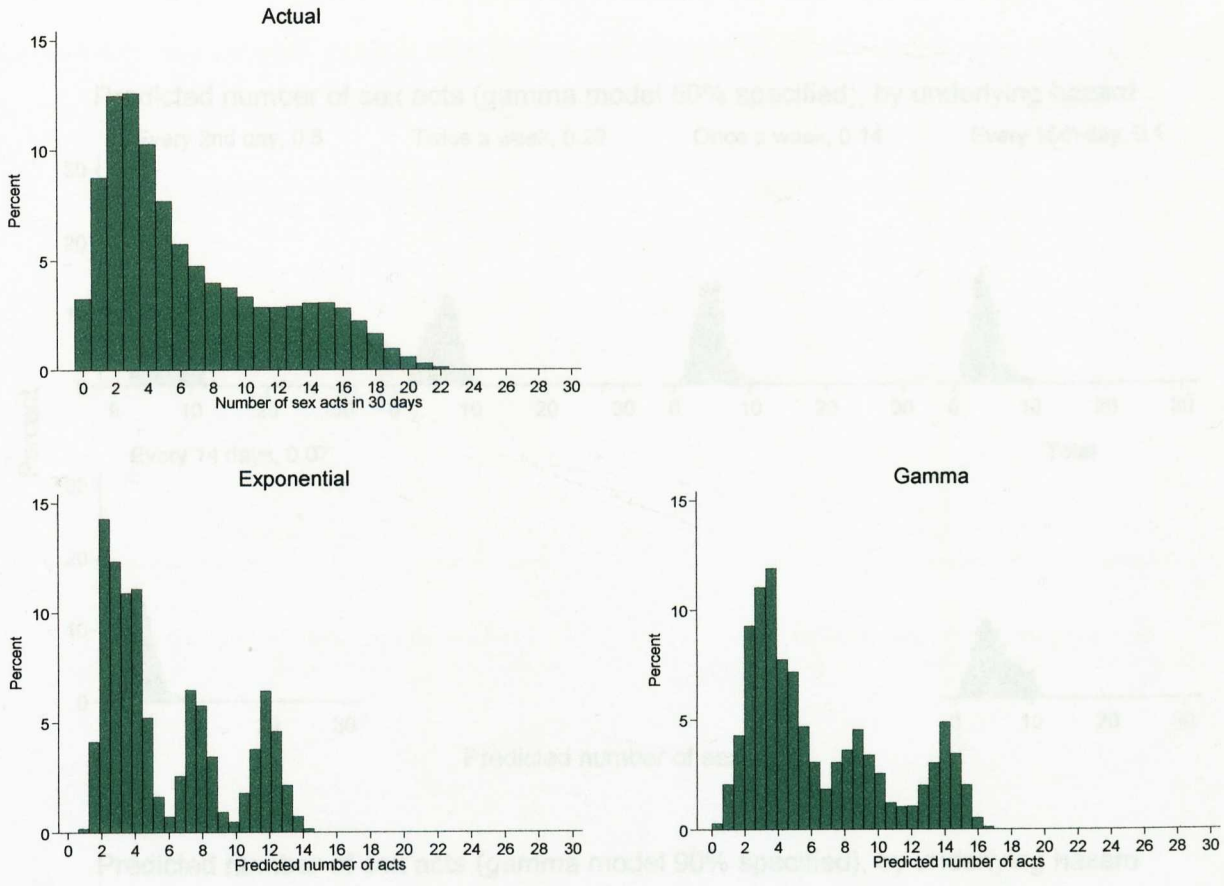


Figure 16: Actual number of events in 30 days and that estimated by exponential and gamma models with 90% of respondents correctly classified.

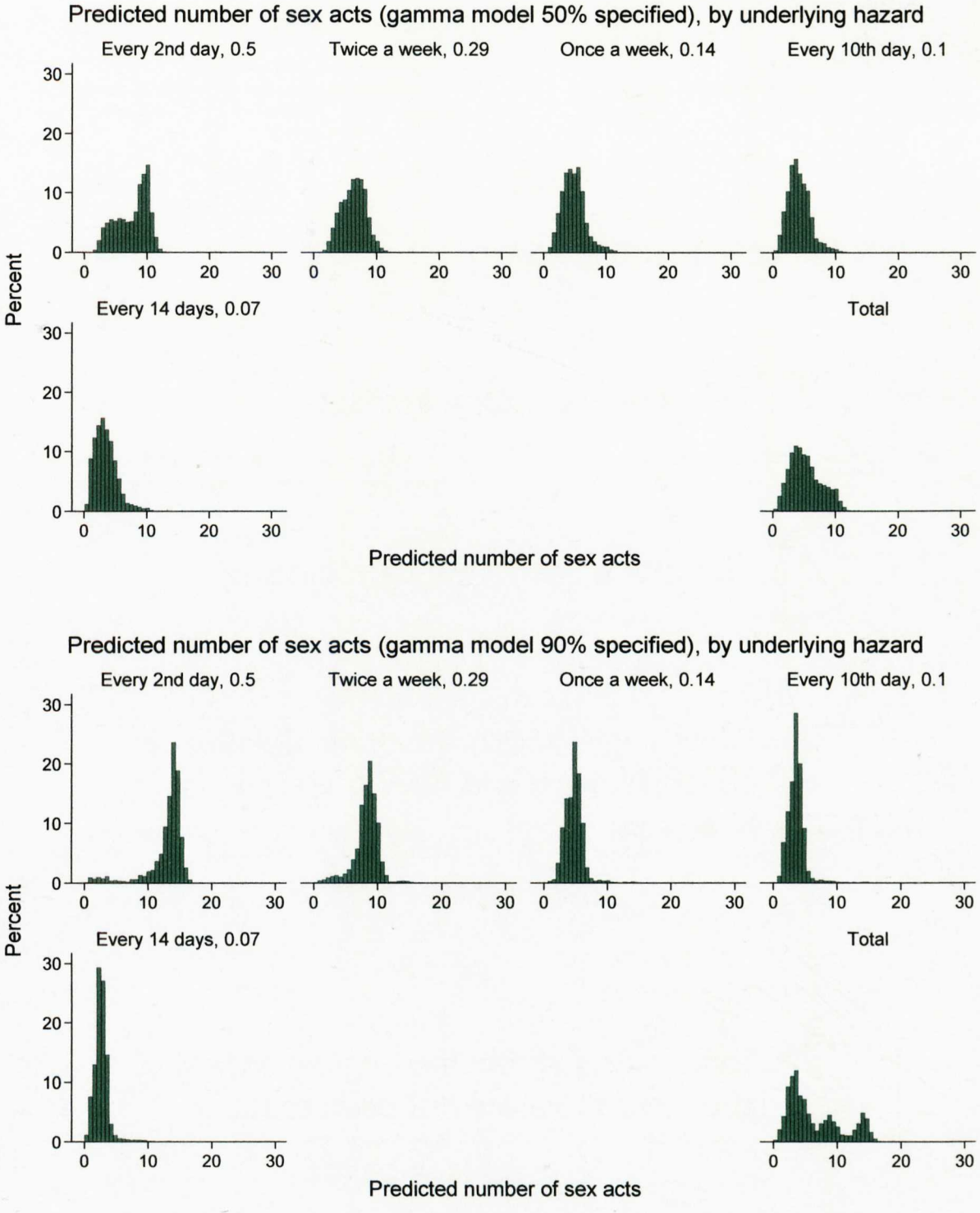


Figure 17: Number of sex acts predicted using hazards estimated from gamma models with 50% and 90% correctly specified.

Figure 18: Residuals plotted against themselves and the cumulative hazard function for gamma and exponential models with different fractions of observations correctly allocated to sub-groups sharing the same underlying coital frequency rate.

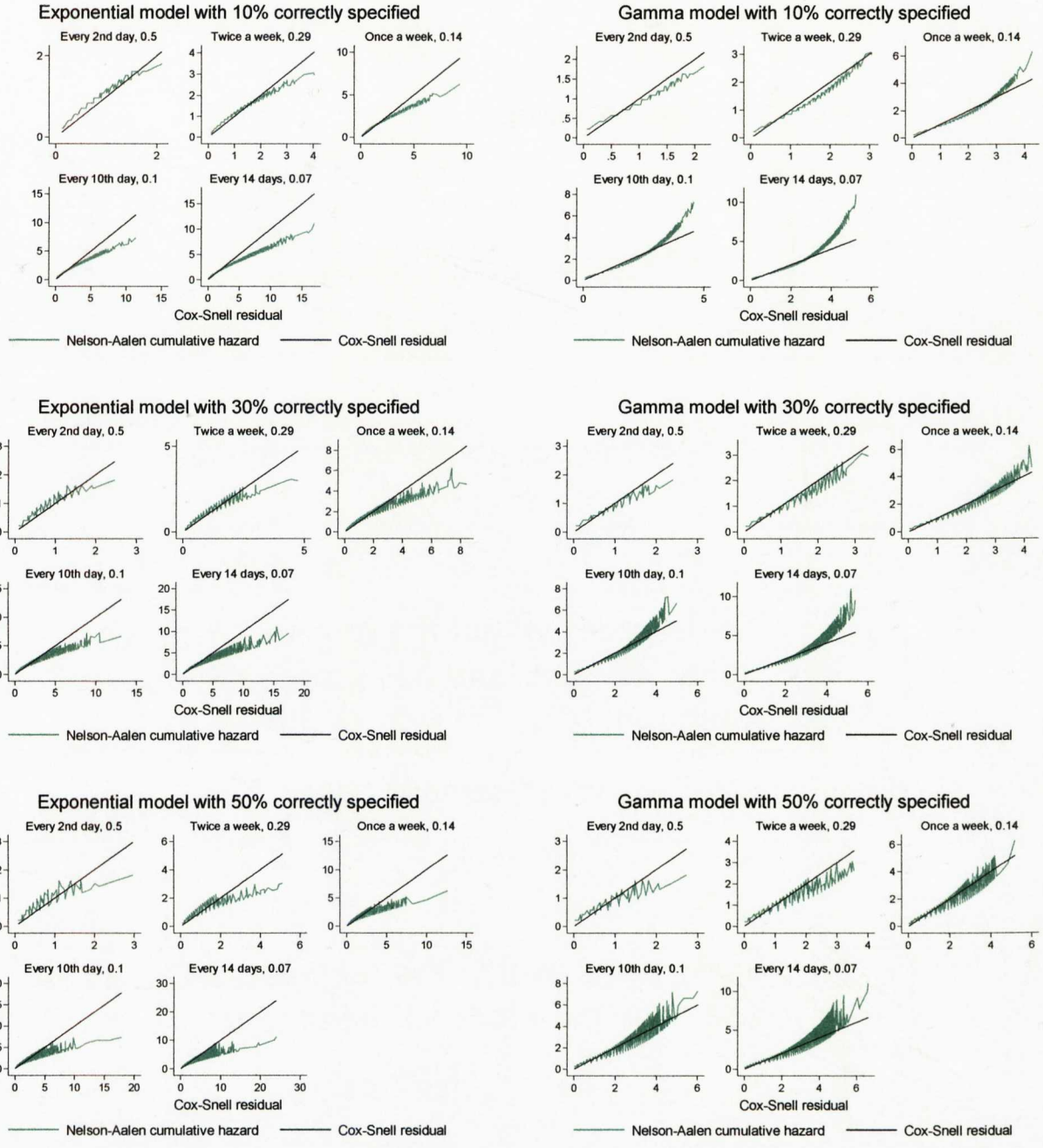
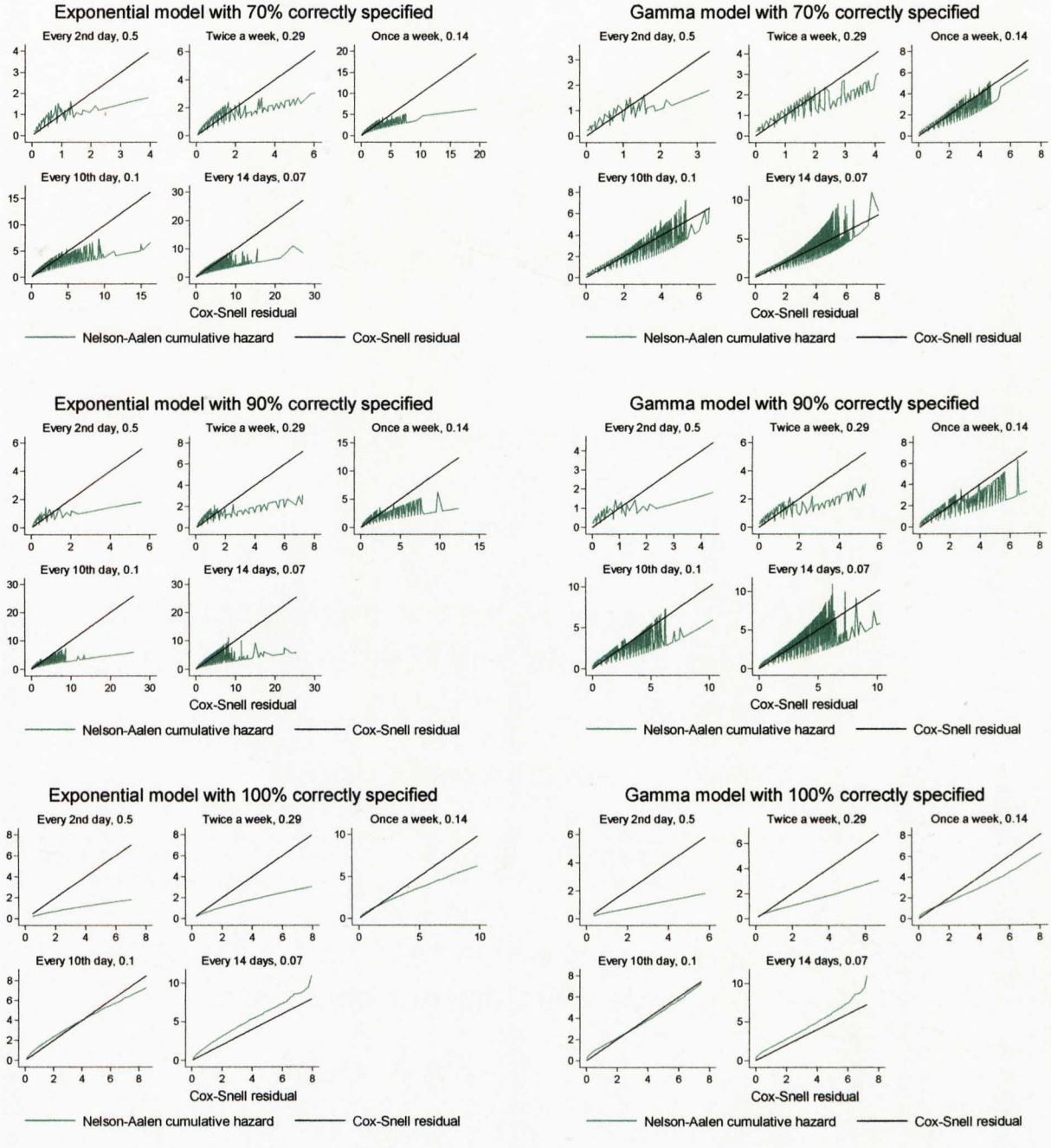


Figure 18: Residuals plotted against themselves and the cumulative hazard function for gamma and exponential models with different fractions of observations correctly allocated to sub-groups sharing the same underlying coital frequency rate. (continued)



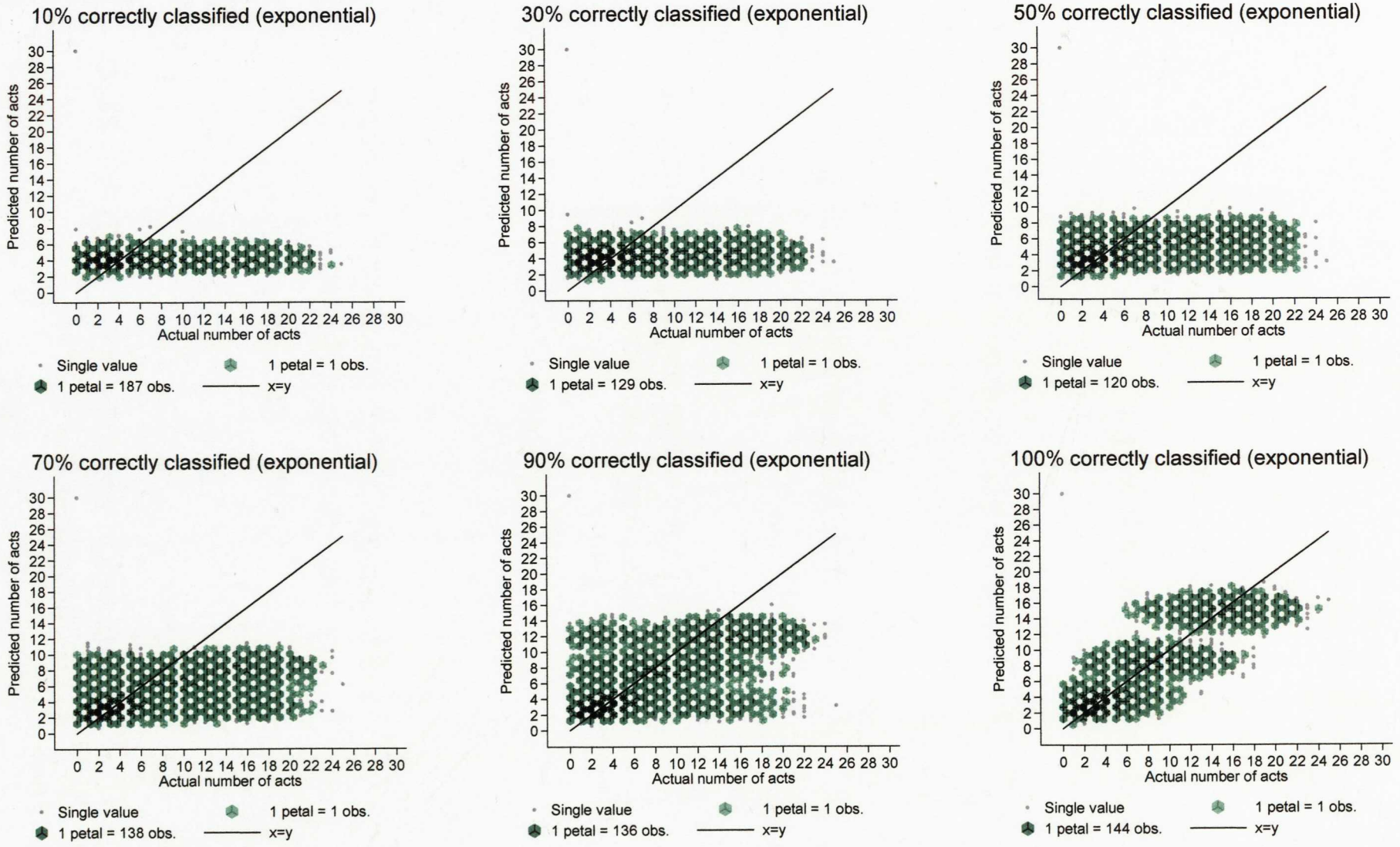


Figure 19: Number of events predicted by exponential models with different proportions of observations correctly classified versus actual number of events.

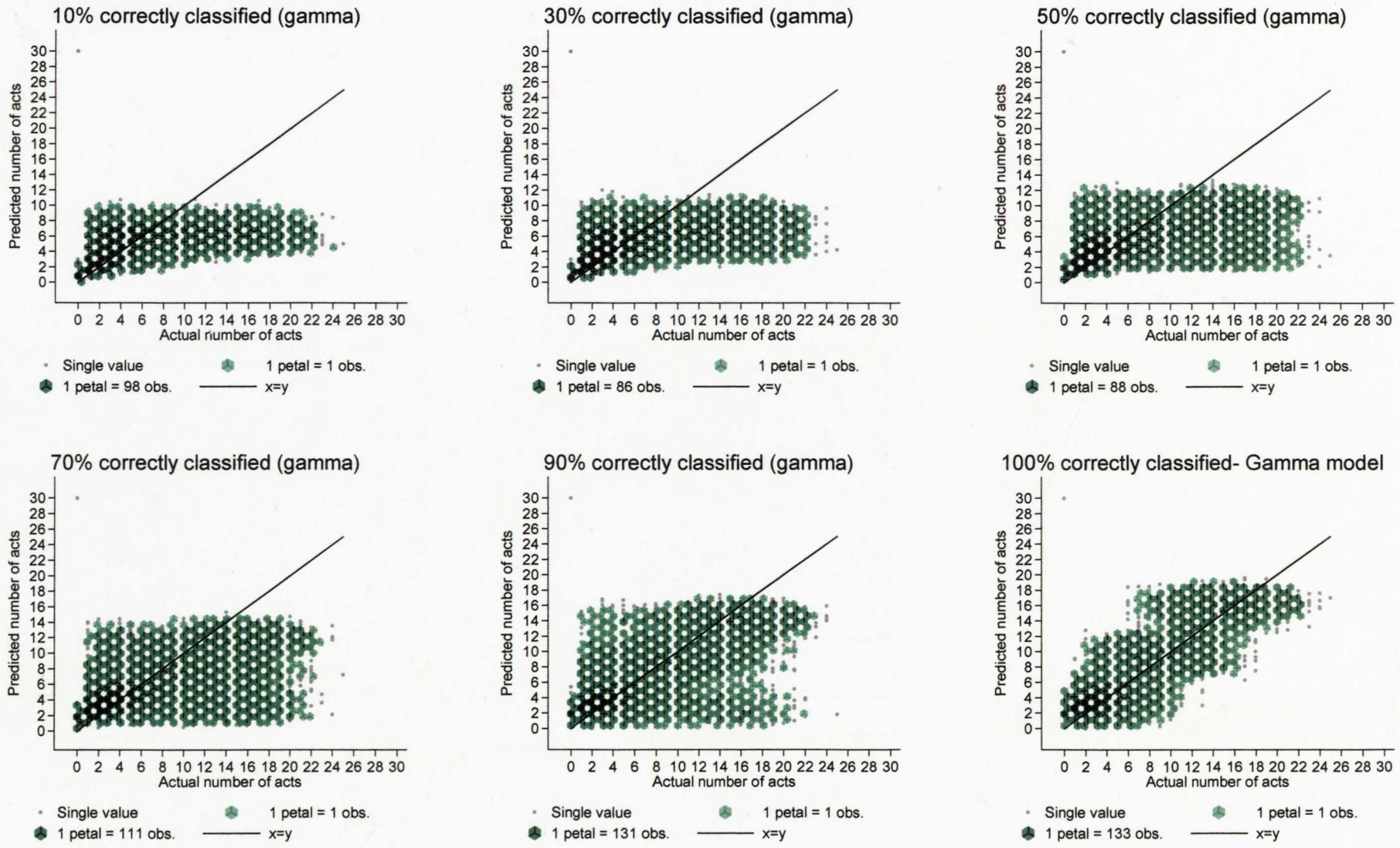


Figure 20: Number of events predicted by gamma models with different proportions of observations correctly classified versus actual number of events.

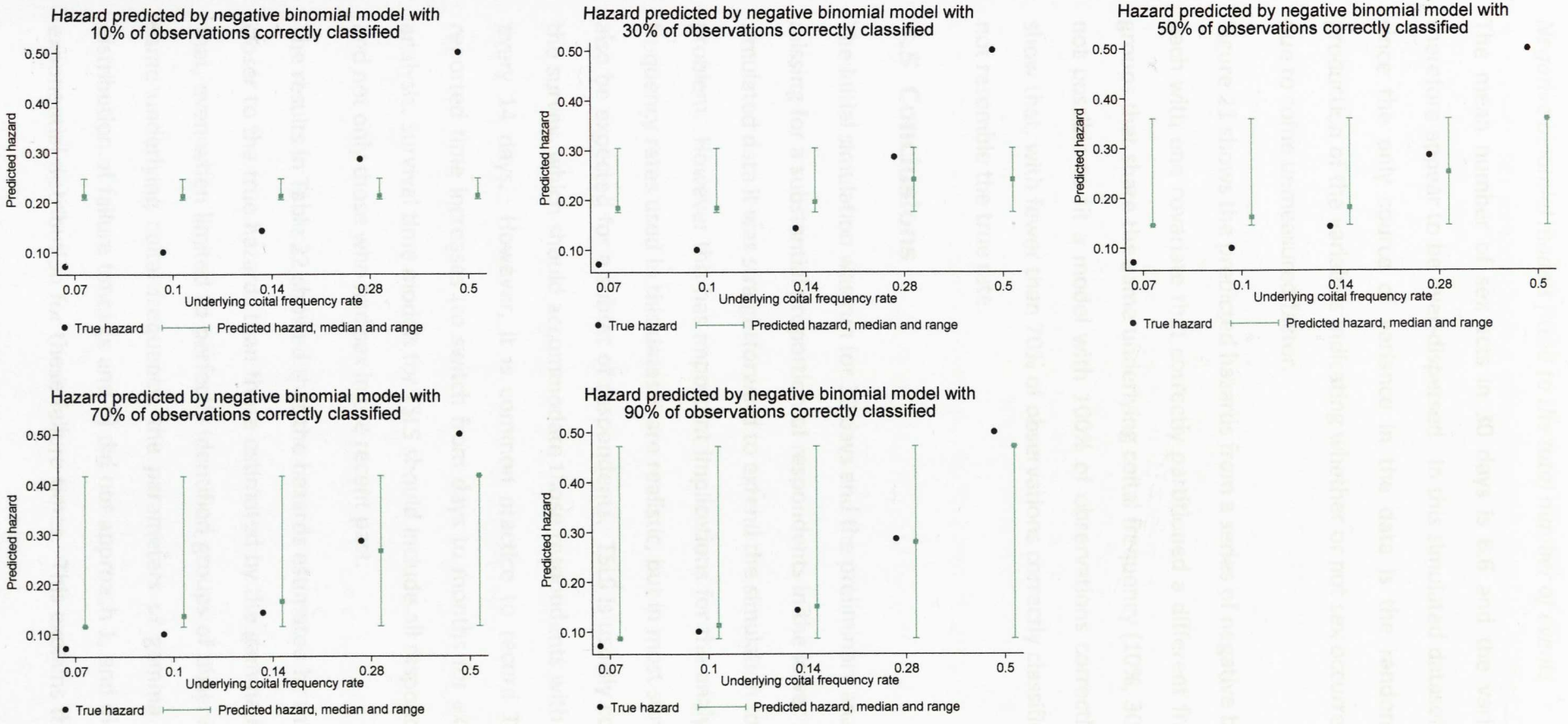


Figure 21: Results from negative binomial regression models on the number of sex acts in 30 days with different fractions of observations correctly allocated into sub-groups that share the same underlying rate of coital frequency.

Negative binomial models fitted to the total number of events

The mean number of sex acts in 30 days is 6.6 and the variance is 26.9. These data therefore appear to be over-dispersed. In this simulated dataset the over-dispersion is real since the only source of variance in the data is the random error introduced in the production of the variables indicating whether or not sex occurred on a given day and is not due to some unmeasured factor.

Figure 21 shows the predicted hazards from a series of negative binomial regression models, each with one covariate that correctly partitioned a different fraction of observations into groups that share the same underlying coital frequency (10%, 30%, 50%, 70%, 90%). It was not possible to fit a model with 100% of observations correctly classified. These results show that, with fewer than 70% of observations correctly classified, the predicted rate does not resemble the true rate.

4.5 Conclusions

The initial simulation was run for 30 days and the preliminary analysis showed that TSLS was missing for a substantial proportion of respondents in the lower frequency groups. In these simulated data it was straightforward to extend the simulation to 120 days which solved this problem. However this has important implications for the analysis of real data. The coital frequency rates used in this dataset are realistic, but in most survey data lower rates would also be expected for a subset of respondents. TSLS is usually collected for the year before the survey, which should accommodate those respondents with frequencies less than once every 14 days. However, it is common practice to record TSLS less accurately as the reported time increases (to switch from days to months for example) which could hinder analysis. Survival time models for TSLS should include all respondents with an accurate TSLS and not only those who had sex in the recent past.

The results in Table 22 showed that the hazards estimated by the exponential models came closer to the true hazards than those estimated by the gamma models. They also revealed that, even when limited to perfectly identified groups of observations which all shared the same underlying coital frequency, the parameters of gamma model which describe the distribution of failure times (κ and σ) did not approach 1, and did not therefore describe an exponential distribution for these failure times. This explains the difference in the hazards

estimated by the two types of model. It is not feasible to use the fitted values of κ and σ to assess whether a model has an adequate classification of observations by underlying coital frequency such that it can be used to make good predictions of number of sex acts based on TSLS.

Repeating the analysis with fewer observations (Table 23 and Table 24) showed that, at the lower rates of coital frequency, the gamma model did fit κ=σ=1, at least approximately, for some of the 20 iterations when the models were restricted to sub-sets of observations that all shared the same underlying rate. The noise in the data introduced by the stochastic element of the simulation appears to be enough to prevent the gamma model fitting an exponential distribution of failure times when the number of observations is large and the underlying rate is higher than around 0.1. The gamma model may behave as expected if there is a relatively small number of observations in each sub-group of underlying rate (100 or less in this example) and the underlying frequencies are low (<= 0.14 in this example).

The model fit statistics indicate that the survival time model using the generalised gamma distribution is preferable to that using an exponential distribution. However the hazard estimated by the generalised gamma model is higher than that estimated by the exponential model and the latter estimates are the closest to the original data. Use the gamma model for TSLS in preference to the exponential despite the difference in the estimated hazards. The variation in the data is of more practical interest than the central tendencies and the gamma model captures this better than the exponential.

The exponential model is such that, if the data within each sub-group conform to the exponential distribution then the fixed effects (values of $\beta_i x_i$) for the sub-groups defined by the covariates should be adequate to describe the differences in the underlying hazards. Using a gamma model if, in each group, the exponential is the best functional form for the distribution of the survival times the values of κ and σ should be the same (and equal to 1) for all the sub-groups. Extending this logic there is therefore no reason to fit the values of κ and/or σ separately for each sub-group when the covariates adequately partition the data into groups that share the same underlying frequency. However, if this cannot be done, then it is possible to fit κ and σ separately for groups defined by covariates. This might be a useful strategy for real data.

The results from the negative binomial regression of the count of the number of sex acts in 30 days are qualitatively the same as those from the survival analysis. Predicted hazards are very similar across the groups of underlying rates when fewer than 70% of observations are correctly classified. The negative binomial model does not have the equivalent of the κ and σ that could be used to determine the level of correct classification that would be important to predict underlying coital frequency rates. The practical application of a model of this sort is in understanding correlates of coital frequencies in real populations, rather than estimating underlying rates.

The results from this chapter suggest that a survival time model based on TSLS from cross-sectional survey data is highly unlikely to produce good estimates of the number of sex acts during a given period. For the approach to succeed it would require adequate partitioning of survey respondents into groups that share similar underlying coital frequency rates. This could be done using covariates but, without prior knowledge of which are the most important, one would have to rely on the fitted gamma model parameters to indicate when the model was sufficiently well specified for the approach to be feasible. Having demonstrated that this does not work well with simulated data it seems unlikely to produce satisfactory results on real data. However, there is no harm in trying and this is the focus of the next chapter.

Chapter 5 Analysis of ASHR data on coital frequency and time since last sex

5.1 Introduction

This chapter uses data from the Australian Study of Health and Relationships (ASHR) to examine the relationship between time since last sex (TSLS) and coital frequency. In this study, respondents reported both time since last sex and coital frequency. These data are especially useful because these measures are rarely collected from the same respondents.

5.2 Data and Methods

5.2.1 The Australian Study of Health and Relationships

The Australian Study of Health and Relationships (ASHR) was a national survey of men and women aged between 16 and 59 that was conducted in Australia between May 2001 and June 2002 [69-70].

The survey was conducted by phone and used computer-assisted interviewing. Separate sample frames were used for men and women. The sample was drawn by random digit dialling, was stratified by state and, within New South Wales, Victoria, Queensland and Western Australia, the sample was further stratified to ensure a representative sample from areas of particular interest. One person was interviewed per household, so it is highly unlikely that both partners in any couple were included in the survey.

The response rates were 69% and 78% for eligible men and women respectively. 4,184 men and 3,469 women completed the long form of the questionnaire, out of a total of 10,183 men and 9,142 women.

The survey collected information on socio-demographic background, sexual history and recent sexual practices, sexual dysfunction, sexually transmitted infections (knowledge and history of STI) and injecting drug use. Two questionnaires were used, a long form and a short form. The short form was used for those who reported only one sexual partner in the last year and who had never had any homosexual experience. Both questionnaires collected information on socio-demographic background, first sexual experience, partners in the

respondents' lifetime and the 5 years and year before the survey. The long form of the questionnaire included additional sets of questions about regular partnerships and about the respondents' most recent sexual partnerships during the year prior to the survey. The long form was used for anyone who reported:

- multiple partners in the year before the survey
- any homosexual experience
- a random 20% of the respondents who had reported only one partner in the year before the survey

Detailed information was collected about recent partners: the relationship to the partner, the age of the partner, the length of the relationship, coital frequency in the last four weeks, the time of the most recent sex, whether a condom was used, and use of contraception. In addition, men who reported ever having used condoms (with same or opposite sex partners) were asked how many condoms they had used in the 12 months before the survey. Relevant sections of the questionnaire are reproduced in Appendix 1 page 1.

5.2.2 Data management and recodings

Data were obtained from the Australian Social Science Data Archive (http://www.assda.edu.au).

Summary socio-demographic variables were derived for each respondent. The information on sexual behaviour required for this analysis was collected in two sections of the questionnaire and had to be collated prior to analysis.

The first of these sections collected information on one or two current regular heterosexual partners. These were partners that the respondent either lived with (whether formally married or not) or defined as a regular partner who did not live with them. The definition 'regular' was the respondents' own though they were prompted to include their spouse if they had earlier reported one but did not spontaneously mention them in response to this question. Current was defined for the respondent as *"an ongoing sexual relationship ...(Ongoing means he expects the relationship to continue and to have sex with the partner again)"*.

The second relevant section covered recent heterosexual partners: the three most recent partners in the 12 months prior to the survey. This section is subsequently referred to as the partner history. Similar information was collected in both these sections: relationship to partner, partner's age, duration of relationship, frequency of sex in the four weeks before the survey, contraceptive use and reasons for non-use.

Although all respondents completed the partner history, certain questions were omitted for some respondents, to avoid repetition of questions already answered in the section on regular partners. Unfortunately the dataset did not contain the information used by the interviewer to match the regular partners discussed in the partner history with the one(s) already reported in the preceding section on regular partners and this variable had to be reconstructed using the logic inherent in the questionnaire.

An additional minor problem was that the questions on the duration of the relationship and contraceptive use were not identical between the regular partner section and the partner history.

Some of the data in the dataset were not available as reported but only in edited versions. This is noted in the definitions of the variables used for analysis, which are given in Table 26.

Table 18: Definition of variables used for this analysis.

Variable	Definition	Notes
Characteristics of the respondent		
Age	Age in years	Only year of birth reported
Age group	Five year age groups, range 16 to 61.	First group 16-19, last group 55-61
Education	Lower secondary or less, Completed secondary, higher	School leaving age is 18
Marital status	Never married, currently married, formerly married	Cohabiting included as 'married'
Ideal frequency of sex	Reported ideal frequency: >1 a day, every day, 5-6 times a week, 3-4 times a week, 2-3 times a week, once a week, once a fortnight, once every 3 weeks, once a month,<1 a month, once in 6 months, once a year, never, don't know/can't remember, refused.	
Number of partners in the life	Number of opposite sex partners in lifetime, grouped above 5: 6-10, 11-100, Don't know/refused.	
Number of partners in the last year	Number of opposite sex partners in the year before the survey, grouped above 5: 6-10, 11-100, Don't know/refused.	
Reported partners	Number of partners reported in partner history	
Complete partners	Number of partners with complete information	
Characteristics of the partnership		
Days since last sex	Number of days between most recent sex and the interview.	Was supplied already transformed into days from reported time, which was a number of : days (max 14), weeks (max 8) months (max 24) or years (max 50).
Smoothed days since last sex	Smoothed to remove heaping resulting from data collection method	
Days since first sex	Number of days elapsed between first sex and interview.	Was supplied already transformed into days from reported time, which was a number of : days (max 14), weeks (max 8) months (max 24) or years (max 50). Only available from partner history, therefore not available for most regular and cohabiting partners.
Duration of relationship	Grouped duration of relationship- time elapsed between first sex and interview. Durations of less than one month have been grouped as tenths of one month, durations between 2-12 months as whole months, and thereafter groups of 1-4 years, 5-9 years, 10+ years.	Cohabiting and regular partners were reported in months of years. Durations reported as 0 months were recoded to 0.5 months.

Table 26: Definition of variables used for this analysis (continued).

Variable	Definition	Notes
Frequency of sex in four weeks	Number of sex acts in the four weeks before the interview. NB. sex acts not necessarily intercourse	Question was phrased *"How many times in the past 4 weeks have you had sex with your partner? Even if this wasn't typical for you. Not just intercourse, but including other forms of sex. Interviewer explains that the response is for number of sessions, not number of acts, i.e. a session of oral + intercourse + manual = 1session. If they stopped for dinner or sleep and continued, that's 2 sessions."*
Age of the partner	Within 5 years of respondent, 5+ years older, 5+ years younger	Respondent reported age of partner in whole years.
Contraceptive use	Contraceptive method used with this partner: None, hormonal method, IUD, sterilisation, condom, traditional, other modern, don't know.	For partners reported in the partner history this was use at last sex but for those reported in regular partners section it was habitual use.
Fertility intentions	Does not want a child, is ambivalent/ leave it to fate, wants a child, already pregnant, not fertile, refused to answer, no sex	Respondents who reported no contraception were asked their reasons for non-use. Respondents who reported contraception were assumed not to want a child.
Relationship to partner	Spouse or cohabiting partner, regular partner, casual, other	
New partner	Indicator for partners of less than 3 months duration at interview	
One night stand	Indicator for partners where last sex was also first sex	Casual and other partners only.
Intercourse	Whether most recent sex involved vaginal or anal intercourse	
Condom	Whether condom was used at most recent intercourse	
Available for analysis	Whether complete information available for this partner	

As is evident from Table 26 a number of analytical decisions had to be made. The over-arching decision was the types of partners and sexual activities to include in the analysis.

The ASHR took an inclusive approach and asked respondents about all types of sexual activity with same sex and opposite sex partners. Only heterosexual sex is considered here. Same sex partners were reported elsewhere in the questionnaire so bisexual respondents had the same opportunity as heterosexual respondents to report heterosexual partners. For the purposes of this analysis, where the primary aim is to compare time since last sex with reported frequency of sex, the definition of sex must be comparable. In the partner

history the time since last sex and the frequency of sex were not limited to vaginal intercourse but included anal intercourse and non-penetrative sex. An estimate of the frequency of vaginal intercourse cannot be derived; it would be possible to establish time since last sex only for those reports that included vaginal intercourse but not the time since last vaginal intercourse for all reported partners. Therefore the data were used as collected and some of the times since last sex and frequencies of sex do not refer only to vaginal intercourse, which is typically the implicit focus of other studies. The vast majority of the last sex acts (94%) involved vaginal intercourse so the inclusion of other forms of sex is probably unimportant.

Several decisions had to be taken regarding the comparability of data from the regular partners and partner history sections and to compensate for the categorisation of some continuous data during data collection.

The time elapsed between last sex and interview was reported in days if less than or equal 14 days, weeks if more than 14 days less than or equal to 8 weeks and months thereafter. The first month was the most important for this analysis and there was significant heaping as a result of the way in which the data were recorded. These data were smoothed using an exponential distribution. Times since last sex (TSLS) of less than 14 days were taken as reported and not smoothed. TSLS of 14, 21 and 28 days were smoothed to account for the inaccuracy inherent in the data collection. I assumed that both respondents and interviewers rounded the actual TSLS to the nearest week. TSLS of 14 days was taken to mean 14 days or more on the basis that any time less than 14 days would have been reported in days. A random fraction of half a week (i.e. 3.5 days) was added to reports of 14 days. TSLS of 21 or 28 days was taken to mean somewhere in the ranges 17.5 to 24.5 and 24.5 to 31.5 respectively. Therefore a random fraction of half a week was either added or subtracted (also at random) whenever a TSLS of 21 or 28 days had been recorded. Random numbers were generated in Stata.

Unfortunately, two questions were not asked in exactly the same way in the two sections of the questionnaire. The duration of relationships was, in both sections, defined as the time since the first sex but in the regular partnerships section the smallest recorded unit of time was 1 month whereas in the partner history the smallest unit was one day. Duration of partnership was grouped for descriptive analysis. The groupings were based on the

information in the literature which showed that duration seems to have the greatest impact at the start of relationships. Very new partners, of less than one month's duration, were categorised by tenths of a month. Partners reported in the regular partner's section with a duration of 0 months were given 0.5 months duration. Partnerships between 2 and 12 months old were grouped into whole months; durations reported in the partner history in days were divided by 30.4 to convert into calendar months. Partnerships that were more than a year old were grouped into 1-4 years, 5-9 and 10+ years. For regression analysis in which the duration of the partnership was the exposure time, the reported number of days since the first sex was used wherever this was less than 28 days before the interview. However it should be noted that, for partners reported in the partner history, durations up to 14 days were reported in days and durations between 15 and 28 days had been recorded in weeks but subsequently transformed to days. Consequently there is heaping in these data.

The use of contraception was collected as 'use at last sex' for recent partnerships but 'usual use' was asked for regular partnerships. This was assumed to be equivalent, i.e. that the usual method of contraception was used at most recent sex with cohabiting or regular partners.

Fertility intentions with each partner were derived not from a direct question about this but from reasons given for not using contraception. If contraception had been reported it was assumed that the preference was to avoid pregnancy.

Incomplete reports on individual partners were excluded from analysis because they could not contribute to multivariate analysis. However, individuals who provided incomplete reports for some but not all of their partners were included. Some respondents gave contradictory information at different points in the questionnaire. These individuals have been retained for the initial descriptive analysis but omitted for the subsequent analysis because their contradictory information would undermine the results.

More information is missing for regular partners than for casual or other partners, in contrast to what is usually seen in sexual partner history data. This is a consequence of the questionnaire design. Some of the information for cohabiting and regular partners had to be transferred from the regular partners section. By and large this was possible but for

some regular partners the information was in neither section of the questionnaire, presumably due to some ambiguity in the identification of partners between these two sections.

5.2.3 Inclusions and assumptions for regression analysis

In the partner history, respondents were asked about partners with whom they had had sex in the last year. They were not asked whether the partnership was current, that is whether they were likely to have sex again. This is a problem, since a waiting time model cannot provide a reasonable approximation of coital frequency if the observed interval includes the time since the end of the relationship.

All partners with whom sex was reported at least once in the four weeks before the survey were included in the analysis and it was assumed that all of these partnerships were ongoing at the time of the survey. Partners with whom the most recent sex was more than four weeks before the survey were excluded on the grounds that the processes governing any sex versus no sex during that period are likely to be different to those that determine the coital frequency. In addition, the coital frequency reported by respondents was for the four weeks before the survey and excluding those whose last sex was more than four weeks before the survey removed most of the respondents who reported zero values for coital frequency, making it easier to compare the reported frequency with that predicted from the regression models.

Some partnerships had not been in existence for the whole of the four weeks before the survey. Time since first sex was known for all partnerships that were completely described in the partner history and this was used as the exposure time. For partners that were only partially described in the history (cohabiting and regular partners) time since first sex was known to the nearest month and their exposure time was therefore assumed to be four weeks unless the reported duration was 0 months, in which case exposure time was taken to be two weeks.

Partnerships which appeared to have been one-night stands were excluded from these models because the frequency of sex with one-off partners is governed by the rate at which

these partners are acquired rather than a set pattern within an established relationship. This could be modelled independently using a Poisson model.

5.2.4 Statistical methods

Descriptive analysis

The characteristics of respondents, and of their partnerships, were summarised by the distributions of the variables listed in Table 26.

The distribution of the total number of sex acts, by the relationship of the partner to the respondent, was shown on a pie chart.

Histograms were drawn to show the distributions of time since last sex by relationship to the partner and the sex of respondent

The distribution of duration of partnerships, for the period immediately before the survey, was tabulated.

The distributions of frequency of sex were summarised by medians and histograms for men and women by the relationship to the partner.

Sunflower plots were drawn to show the frequency of sex by the time since last sex.

Complex survey design

Responses were weighted to allow for the aspects of the study design which resulted in unequal probabilities of selection[70]. This included an adjustment for completing the long questionnaire versus the short form. The sample weights were used throughout the descriptive analysis and for survival analysis of the factors associated with frequency of sex. Standard errors were adjusted for the stratification and clustering in the data using Stata 11.1's survey commands[59]. However, the regression of time since last sex on frequency of sex was carried out twice, once adjusting for survey design and once ignoring the complex survey design. Model fit statistics could be calculated on the models that ignored the survey design, but are not valid for the models that account for the survey design.

Regression of time since last sex on frequency of sex in the 14 days before the survey

The frequency of sex in the 14 days during the survey was modelled as a function of time since last sex. Four different models were compared: Poisson, negative binomial with

dispersion as a function of the mean, negative binomial with constant dispersion and generalised negative binomial. The negative binomial model with the dispersion as a function of the mean allows the dispersion to be different for each combination of covariates. The negative binomial with constant dispersion gives the same dispersion to each observation. The generalised negative binomial model fits α, the shape parameter, to a set of covariates, allowing more variation in the dispersion than the alternative negative binomial models. The models were compared using the log likelihood and AIC.

Each model included TSLS as an explanatory variable and another variable that described both the sex of the respondent and the relationship to the partner, to see whether the nature of the relationship between TSLS and frequency of sex was different for men and women, and for type of partner. These models did not but did include a term which identified those respondents who were undersampled in the survey because their behaviour did not automatically qualify them to take the long form of the questionnaire.

After identifying the most appropriate model for these data, the model was expanded to explore the associations between reported number of sex acts and other characteristics: Age of respondent, age difference with partner, education, marital status, number of partners in lifetime, number of partners in last year, contraceptive use, fertility intentions, condom use and duration of partnership. Each of these was examined for association with reported number of sex acts and those that showed an association were included in the regression model. Variables that were no longer important were eliminated one by one. The resulting model was then explored for interactions between the remaining covariates.

After fitting this model, in which the unit of analysis was partnerships, another model was constructed this time with respondents as the unit of analysis. The outcome was total number of sex acts in the month before the survey (summed across all partners if necessary). For this analysis, the reference period was one month, the period for which acts were reported. The previous analysis was restricted to the 14 days before the survey because of concerns about heaping of reported TSLS after this point but, since TSLS was not included in this analysis, the full reference period was used.

The covariates explored in the per-partnership model were respecified to relate to the person rather than the partnership. For example, condom use was defined as any condom

use at last sex with any of the partners reported in the partner history. A new variable was defined that described the number and mix of different partners reported for the year before the survey: spouse, regular partner, casual or some combination of those types. These covariates were then entered into the model for the total number of sex acts in the last month to see whether the associations observed in the partnership model were also observed at the level of the individual. The covariates therefore refer to behaviour and the characteristics of partnerships that occurred at some point in the year before the survey, whereas the outcome – total number of sex acts – is for the month before the survey.

Survival time models of time since last sex

Models were fitted for spousal and regular partnerships where last sex occurred during the 14 days before the survey.

Data were declared as survival time data in Stata using the stset command. Time to event was the number of days elapsed between survey and last sex (TSLS). The event of interest was last sex, and every record included in the analysis ended in a failure.

Based on the results of earlier analysis (Chapter 4), it seemed unlikely that a exponential distribution would adequately describe the data because the assumption of a constant hazard was untenable. A generalised gamma distribution was selected instead because this does not require the shape of the hazard function to be predefined and allows for unobserved heterogeneity. This model has two parameters, σ and κ, and there are several different options for estimating these parameters when fitting a model that uses a gamma distribution:

1. The model can be estimated by fitting the same values of both σ and κ for all observations.

2. It can be stratified by a variable such that the model intercept and the values of σ and κ can be different in each stratum, but model coefficients are the same across strata.

3. One parameter, σ, can be fitted to a set of covariates such that σ takes different values in each group defined by the covariates but the model intercept, coefficients and κ are the same for all observations.

4. Lastly, both the ancillary parameters can be fitted to the data which means that both σ and κ take different values for each group defined by the covariates. σ and κ are fitted separately and can be fitted to different covariate groups. In this option the model intercept and coefficients are the same for all observations.

Based on the descriptive analyses of these data and results from analyses of other data it was thought that sex of the respondent and the relationship with the partner may profoundly influence coital frequency and therefore that capturing these differences in the survival time models would be essential to adequately explain the data. A series of models was fitted, using the variables describing sex of the respondent (`sex`) and relationship to the partner (`who`) as:

1) Independent fixed effects (`sex` and `who`)

2) Independent fixed effects with an interaction (`sex` and `who`)

3) and 4) Fixed effect for relationship to partner (`who`), stratified by sex (`sex`) and vice versa

5) and 6) Fixed effect for relationship to partner (`who`) and fitting σ to the sex of the respondent (`sex`) and vice versa

7) No fixed effects, fitting σ to the relationship to the partner (`who`)

8) No fixed effects, fitting σ and κ to the relationship to the partner (`who`)

Models 7 and 8 explored fitting the parameters to the relationship with the partner, but not sex of the respondent, because the earlier models showed that the sex of the respondent had little influence. The p-values for the Wald tests for each coefficient (for main model, stratum specific and fitted parameter estimates, as applicable) were inspected. Where this test showed that the coefficient was unlikely to be non-zero it was deemed not to improve the fit of the model and that option was rejected.

After identifying the best parameterisation for the model, the crude effect of each of covariate on time to event was estimated (these were: relationship to partner, age group, education, marital status, lifetime number of partners, number of partners in the last year, age of the partner, contraceptive use, fertility intentions, whether a new relationship, condom use at last sex, time since first sex and questionnaire type). All of these variables

were then included in a single regression model. Those which showed no independent effect in the crude analysis, and no effect in the adjusted model, were removed.

5.3 Results

5.3.1 Characteristics of survey respondents

The characteristics of the survey respondents are given in Table 27.

The sample was fairly evenly distributed by age. Most of the sample, 73% of men and 63% of women, had completed secondary school and a third had at least some tertiary education. Half of the sample was currently married or living as married. 7% of men and 6% of women had never had sex, and a further 7% and 8% respectively had not had sex in the year before the survey. The mean number of partners in a lifetime was 4.6 for men and 3.4 for women. The mean number in the year before the survey was 1.1 for men and 0.97 for women. A quarter of female respondents said they had had only one lifetime partner. Most people had had just one partner in the year before the survey (73% of men & 78% of women) and almost as many (68% and 69%) reported one partner in the month before the survey. Overall, 71% of respondents had had sex in the four weeks before the survey, the period for which an estimate of frequency of sex was collected.

The modal frequency of sex, among those who had sex in the four weeks before the survey, was 2 for both men and women. However more than half of those who had sex in the last four weeks reported frequencies of 5 or more, i.e. more than once a week. There is some contradiction between the reports of sex in the last four weeks, based on time elapsed since last sex, and the frequency of sex in the that period. Some respondents reported last sex within the four weeks before the survey, but gave a frequency of zero. Others reported last sex more than four weeks before the survey but gave a non-zero report for frequency in the four weeks before the survey. Both groups of respondents are included in Table 27 but excluded from the multivariate analysis.

Around 60% of respondents had sex with a spouse or cohabiting partner in the year before the survey; 17% had a regular partner in that period. Fewer respondents reported any other type of partnership: 13% of men and 7% of women.

Table 27: Selected characteristics of ASHR respondents, by sex. *denominator for this percentage is all respondents.

Characteristics	Men		Women	
	Number of respondents	Percent (of non-missing data)	Number of respondents	Percent (of non-missing data)
Age groups				
16-19	396	7.2	279	6.4
20-24	480	11.6	372	11.6
25-29	477	11.6	383	11.7
30-34	568	12.5	453	13
35-39	492	12.3	490	13.1
40-44	546	12.2	454	12.1
45-49	443	11.4	390	11.3
50-54	403	10.3	318	10.2
55-61	374	10.7	330	10.7
Missing	5 (0.1%*)		0	
Education				
lower secondary or less	1089	27.5	1195	36.8
HSC or technical/trade cert.	1552	38.2	926	26.9
College/uni	1538	34.3	1345	36.3
Missing	5 (0.1%*)		3 (0.1%*)	
Legal marital status				
Never married	2252	40.2	1436	33.1
Currently married	1365	50.3	1302	53.6
Formerly married	564	9.5	727	13.3
Missing	3 (0.1%*)		4 (0.1%*)	
Partners in lifetime				
0	502	7.2	307	5.7
1	381	13.6	567	24.9
2	277	8.3	353	13.2
3	240	7.7	301	9.8
4	196	6.2	239	7.6
5	189	5.1	269	8.5
6-10	727	19.3	651	16.5
11-20	667	15.1	374	7.2
21+	898	15.3	262	3.5
Don't know/refused	107	2.2	146	3.2

Table 19: Selected characteristics of ASHR respondents, by sex. *denominator for this percentage is all respondents. (continued)

Characteristics	Men		Women	
	Number of respondents	Percent (of non-missing data)	Number of respondents	Percent (of non-missing data)
Partners in year before survey				
0	1164	13.9	1025	14.1
1	1832	73.2	1886	78
2	552	5.9	319	4.2
3	224	2.2	97	1.3
4	114	1.4	47	0.6
5	74	0.6	19	0.3
6-10	138	1.3	15	0.1
11-100	46	0.6	8	0.1
Don't know/refused	40	0.8	53	1.4
Partners in last four weeks				
0	1873	31.9	1573	30.8
1	2148	66.3	1838	68.4
2	125	1.3	58	0.8
3	38	0.5	0	
Sexually active in last year				
Never had sex	540	7.9	360	7
No sex last year	664	7	727	8.7
Had sex last year	2979	85.1	2381	84.3
Missing	1		1	
Had sex in last four weeks				
No	1800	30.4	1488	29.2
Yes	2307	69.6	1890	70.8
Missing	77 (2.4%*)		91 (2.5%*)	
Frequency of sex in 4 weeks before survey				
0	1871	31.1	1549	30.8
1-4	919	28.9	703	27
5-8	512	18.1	431	18.4
9-12	336	10.4	314	12
13-16	142	3.7	117	4.1
17-28	214	5	171	4.5
29-100	80	1.6	39	.8
Refused/DK	33	1.3	56	2.5
Missing	77 (2.4%*)		89 (2.4%*)	
Had sex with spouse/cohabiting partner in last year				
No	2555	41.4	1944	38.9
Yes	1629	58.6	1525	61.1

Table 19: Selected characteristics of ASHR respondents, by sex. *denominator for this percentage is all respondents. (continued)

Characteristics	Men		Women	
	Number of respondents	Percent (of non-missing data)	Number of respondents	Percent (of non-missing data)
Had sex with regular partner in last year				
No	3306	82.8	2866	83.5
Yes	878	17.2	603	16.5
Had sex with casual/other partner in last year				
No	3178	87.2	3042	93.1
Yes	1006	12.8	427	6.9
Mix of partners in last year				
None	1239	16.6	1126	17.1
1 spouse	1425	57.7	1414	61.5
1 regular	288	10.8	320	12.8
1 casual	142	3.5	90	2.6
2 Spouse & reg	44	.5	37	.4
2 spouse & cas	91	.9	48	.5
2 Reg & cas	198	2.7	110	1.8
2 Regular	89	1.1	50	.9
2 casual	150	1.7	55	.7
2 other combination	4	0	7	.1
3 Reg & cas	79	.7	36	.4
3 casual	47	.5	18	.2
3 other combination	36	.3	15	.2
4+ Reg & cas	142	1.4	34	.5
4+ casual	97	1.1	17	.2
4+ other combination	45	.5	9	.1
Missing	68 (1.9%*)		83 (2.7%*)	

5.3.2 Characteristics of reported partnerships

The 2979 male and 2381 female respondents who had been sexually active in the year before the survey gave detailed information on a total of 3683 and 2450 partners respectively. 81 men and 98 women reported at least one partner in the year before the survey but gave no details in the partner history. These respondents have therefore been excluded from further analysis.

Of the 3683 partners reported by men for the year prior to the survey, most recent sex was within four weeks of the survey for 2233 of those. Women reported 2450 partners in the year before the survey and for 1814 of those partners most recent sex was within the four weeks before the survey.

The characteristics of all partners from the 12 months before the survey and of partners from the four weeks before the survey are given in Table 28.

Most of the reported partners were spouses or cohabiting partners. Of the partners in the four weeks before the survey around 80% were spouses or cohabiting and 17% were regular partners. Men reported slightly more casual and occasional partners than women. Casual partners were reported more often for the longer time period, as would be expected if these tend to be short term partnerships or if casual partners quickly evolve into regular partners, and this difference is especially pronounced for men.

Three quarters of female respondent's partners were within five years of their own age. A greater proportion of male respondent's partners were said to be 5 or more years younger.

Half of the reported partners had been acquired more than 10 years before the survey. The distributions of time since first sex reflect the greater proportion of casual partners reported by the men compared to the women: 25% of men's partners from the last year had been acquired during the year before the survey, compared to 16% of women's and 14% of the men's partners who were acquired in the four weeks before the survey.

10% of men's partners in the year before the survey were one night stands, compared to 5% of women's partners. This figure was much lower for partners in the four weeks before the survey: 2% and 1% for men and women respectively.

Respondents were told that sexual partners were anyone they had had sexual activity with, not simply people with whom they had had intercourse. However, all of the most recent encounters with men's reported sexual partners involved intercourse (anal intercourse is included here though it was infrequently reported). Women's most recent encounter with a partner did not necessarily involve intercourse (5% of last encounters with women's partners) though it may be simply that men chose only to report those partners with whom they had had penetrative sex.

Respondents were asked about condom use at last sex and contraception with each of their partners. Condom use was reported at last sex with 29% of men's partners from the 12 months before the survey and 19% of women's partners from the same period. It was lower for partners in the four weeks before the survey: condoms were used with 21% of men's partners and 15% of women's partners on the most recent occasion. This question was not addressed to the 121 women who said their last sex did not involve intercourse.

The most commonly reported contraceptive methods were hormonal methods followed by condoms. No contraception was used with 40% of men's partners and just over half of women's partners. This proportion was higher for partners in the last 4 weeks than for partners from the last year.

Cross-tabulation of fertility intentions with contraceptive use showed that, for partners where no contraception was used, very few of these couples were trying to avoid pregnancy: 9% of partnerships reported by a male respondent and 7% of partnerships reported by a female respondent. Around 10% of partnerships were not using contraception because they were trying for a child or because the woman was already pregnant. Approximately three quarters of the non-using couples (72% of partnerships reported by men and 76% of partnerships reported by women) thought they were not at risk of pregnancy.

In most of the reported partnerships there was no desire for a child, less than 10% were either ambivalent about a pregnancy, wanting one or already pregnant.

The most commonly reported frequency of sex with individual partners was 2 times in the four weeks before the survey (12% of partnerships), followed by 4 times and, for women's partners only, 1 time. In around 40% of reported partnerships where there was any sex in

the four weeks before the survey, the reported frequency was once, or less than once a week. A quarter of partnerships reported sex between 5 and 8 occasions in four weeks and there was a substantial tail with much higher frequencies reported for a minority of partnerships.

Table 28: Characteristics of sexual partners from the 12 months and four weeks before the survey.

	MEN				WOMEN			
	Last year		Last 4 weeks		Last year		Last 4 weeks	
Characteristics (with/of this partner)	**Number partners**	**Percent**	**Number partners**	**Percent**	**Number partners**	**Percent**	**Number partners**	**Percent**
Relationship:								
live-in	1,465	64	1,365	78	1,394	73	1,292	80
regular	761	16	537	17	492	17	396	17
occasional	489	7	139	3	240	5	61	2
casual	968	13	192	3	323	6	65	1
refused	0	0	0	0	1	0	0	0
Partner's age								
Within 5 years of respondent	2,172	63	1,384	64	1,699	75	1,292	76
Partner 5+ years younger	1,240	32	741	33	264	7	159	7
Partner is 5+ years older	271	5	108	4	487	18	363	17
Contraception used:								
None	1,119	39	838	44	1,032	48	847	51
hormonal	837	24	624	27	620	27	501	28
IUD	19	1	18	1	28	1	23	1
Sterilised	113	5	102	6	88	4	76	4
Condom	1,571	31	632	22	645	19	337	15
Traditional	17	1	12	1	23	1	19	1
Other mod.	7	0	7	0	14	1	11	1
Don't know	0	0	0	0	0	0	0	0
Fertility intentions:								
No child	2,682	64	1,472	59	1,501	55	1,023	52
Ambivalent/fate	178	3	68	2	85	3	45	2
Want child	70	3	62	3	70	3	62	3
Pregnant	41	2	37	2	55	3	50	3
Not fertile	692	28	577	33	719	37	624	39
Refused	14	1	12	1	7	0	5	0
No sex	6	0	5	0	13	0	5	0
Vaginal or anal intercourse at last sex								
No	0	0	0	0	121	5	96	5
Yes	3,683	100	2,233	100	2,329	95	1,718	95
Used a condom at last sex:								
No	2,212	71	1,637	79	1,717	81	1,411	85
Yes	1,471	29	596	21	612	19	307	15

Table 20: Characteristics of sexual partners from the 12 months and four weeks before the survey. (cont)

	MEN				WOMEN			
	Last year		Last 4 weeks		Last year		Last 4 weeks	
Characteristics (with/of this partner)	**Number partners**	**Percent**	**Number partners**	**Percent**	**Number partners**	**Percent**	**Number partners**	**Percent**
Grouped frequency of sex in last 4 weeks								
0	1,506	25	59	1	667	17	34	1
1-4 times	978	33	975	43	725	34	722	40
5-8 times	479	20	479	27	430	23	430	27
9-12 times	328	12	328	15	310	15	310	18
13-16 times	133	4	133	6	113	5	113	6
17-28 times	190	6	190	7	169	6	169	7
29-100 times	69	2	69	2	36	1	36	1
Refused	0	0	0	0	0	0	0	0
First sex <3 months ago								
No	3,160	93	1,890	94	2,187	94	1,624	94
Yes	523	7	343	6	263	6	190	6
Was one night stand								
No	2,926	90	2,108	98	2,188	95	1,775	99
Yes	728	10	123	2	252	5	37	1
Time since first sex								
<=1 year	1,743	25	689	14	742	16	347	11
1-4 years	640	20	441	23	487	19	383	19
5-9 years	366	13	291	15	344	16	298	17
10+ years	934	41	812	48	877	49	786	53
missing/NA	0	0	0	0	0	0	0	0

Distribution of sex acts by type of partner

Figure 22 illustrates the distribution of all sex acts by relationship to the partner. The majority of sex acts take place between regular and cohabiting partners. There is good symmetry between the male and female distributions. This is noteworthy because there tends to be considerable asymmetry between the reported behaviour of men and women and in particular the numbers and types of partners.

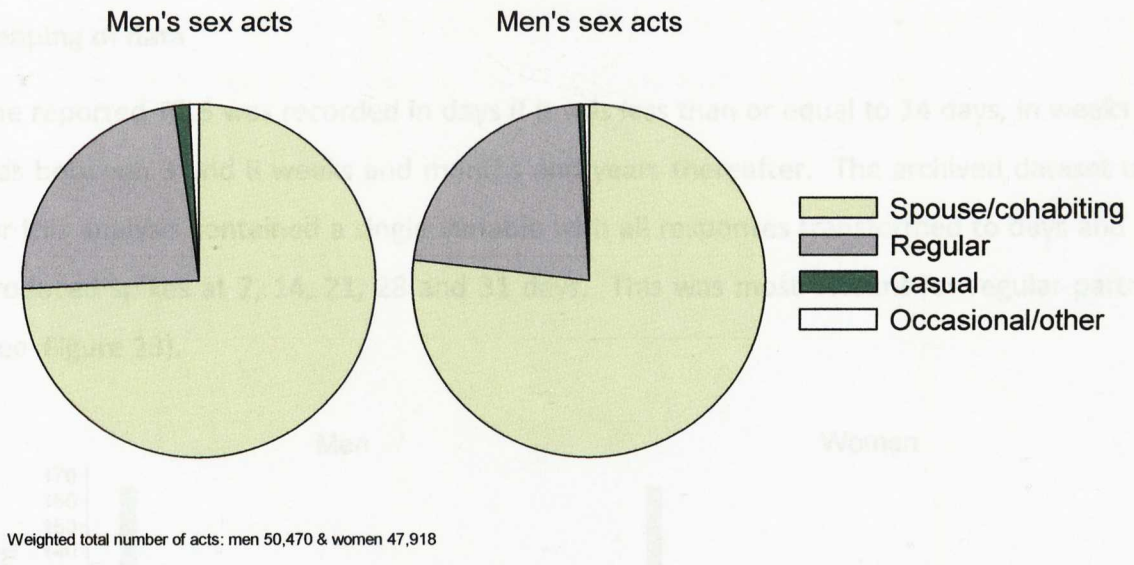


Figure 22: Distribution of sex acts reported in the four weeks before the survey by relationship to partner.

5.3.3 Descriptive analysis of the data with reference to model assumptions

Inclusion criterion: sexual activity within the four weeks before the survey

For comparison of time since last sex and reported frequency of sex, analysis is restricted to the four weeks before the survey because that is the time for which frequency of sex was reported.

Respondents were asked to report in detail on up to 3 recent partners. If a respondent had had more than three partners in the four weeks before the survey we would be missing information about partners four and above. There were 35 men (out of a total of 4184 male respondents) who reported more than three partners in the last year and whose last three partners were all in the month before the survey. This is just 1.5% of the respondents

and their weighted contribution is lower because respondents with multiple partners are downweighted in these data due to the under-representation of people with only one partner, the majority of whom took the short questionnaire. Although there is no information on the total number of partners these men had in the four weeks before the survey, it is unlikely that a large proportion of their partners were omitted as a result of the questionnaire design.

Reporting and distribution of time since last sex

Heaping of data

The reported TSLS was recorded in days if it was less than or equal to 14 days, in weeks if it was between 3 and 8 weeks and months and years thereafter. The archived dataset used for this analysis contained a single variable with all responses transformed to days and this produced spikes at 7, 14, 21, 28 and 31 days. This was most evident for regular partners (see Figure 23).

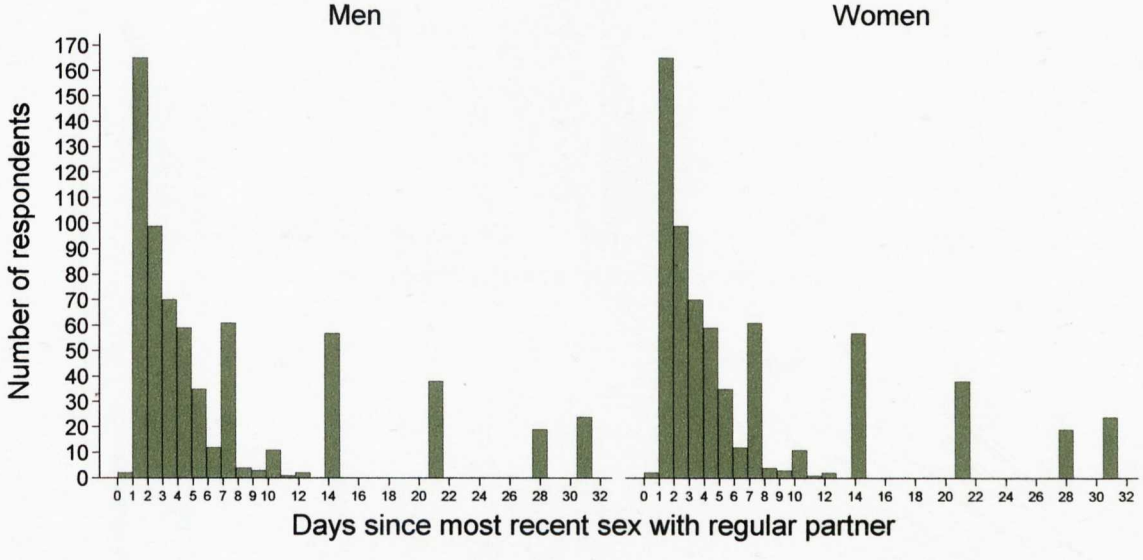


Figure 23: Actual time since last sex with a regular partner reported by men and women.

Since this distribution was an artefact of the way in which the data were reported and recorded it was appropriate to smooth the values to achieve a more even distribution. Following smoothing, it is evident from Figure 24 that the distribution of the time since last sex is closer to the expected pattern of exponential decay for cohabiting and regular partners but not for casual/other partners. For cohabiting and regular partners, the correspondence is good for the two weeks before the survey, for which TSLS was reported

in days. It is not possible to tell if the pattern of exponential decay would have been evident for 2 to 4 weeks before the survey if the TSLS had been collected more accurately, or whether a different relationship exists for that period.

For all partners, there is considerable heaping of TSLS at 7 days before the survey. This was not smoothed because this heaping was a result of the respondent's reports rather than an artefact of the data collection. However the apparent excess of reports for 7 days since last sex does suggest that the reported number is more of an estimate than a precisely recalled time because the survey was conducted on different days of the week and is not therefore the result of a weekly pattern, such as more sex occurring at the weekend.

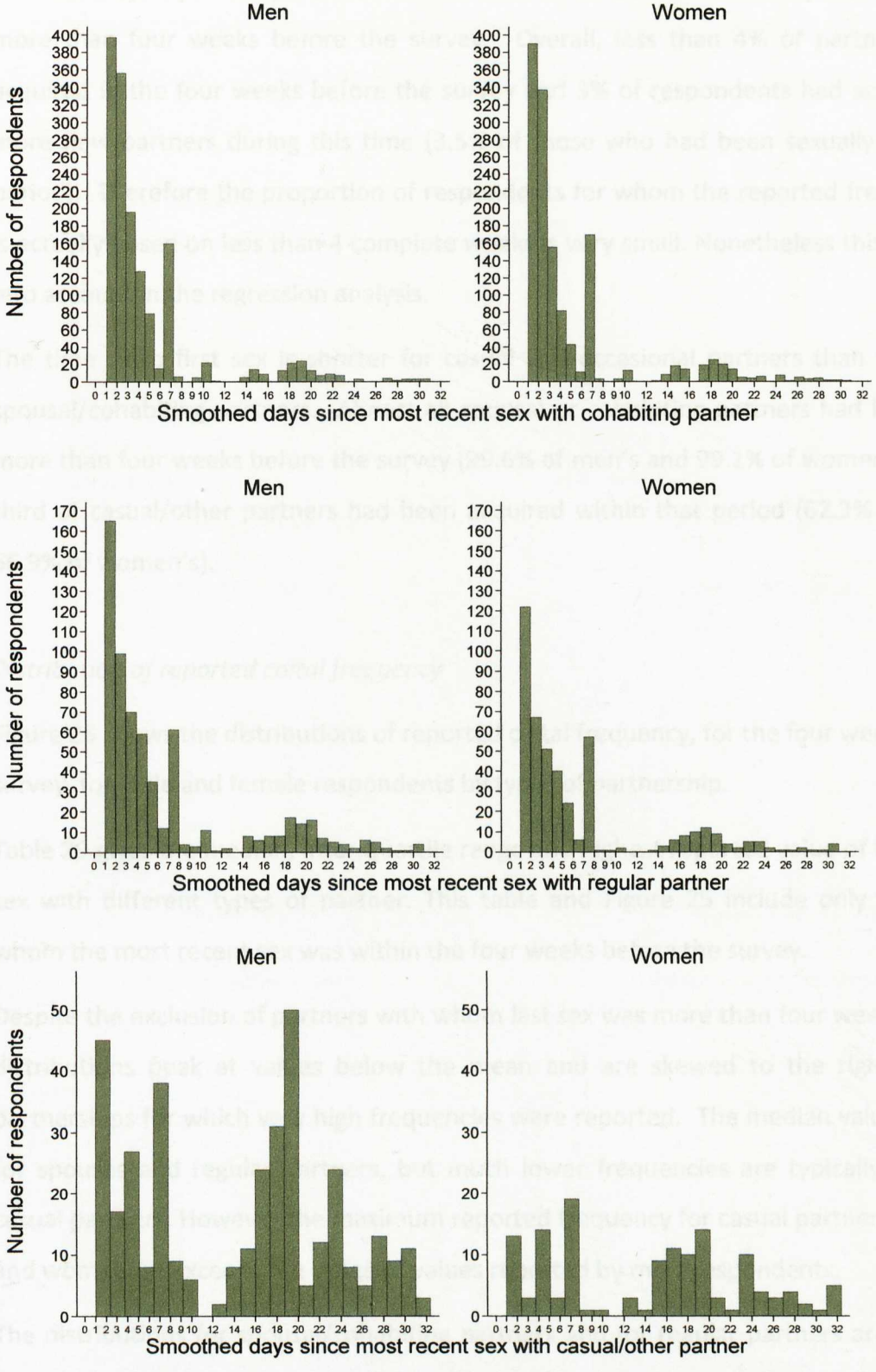


Figure 24: Histograms to show smoothed TSLS by relationship to partner (note that these figures show unweighted data).

Duration and type of relationship at the time of the survey

The vast majority of the partners from the four weeks before the survey had been acquired more than four weeks before the survey. Overall, less than 4% of partners had been acquired in the four weeks before the survey and 3% of respondents had acquired one or more new partners during this time (3.5% of those who had been sexually active in this period). Therefore the proportion of respondents for whom the reported frequency of sex is actually based on less than 4 complete weeks is very small. Nonetheless this will be taken into account in the regression analysis.

The time since first sex is shorter for casual and occasional partners than for regular or spousal/cohabiting partners. Almost all spousal or cohabiting partners had been acquired more than four weeks before the survey (99.6% of men's and 99.1% of women's) whereas a third of casual/other partners had been acquired within that period (62.3% of men's and 66.9% of women's).

Distribution of reported coital frequency

Figure 25 shows the distributions of reported coital frequency, for the four weeks before the survey, for male and female respondents by types of partnership.

Table 29 gives the median, inter-quartile range and highest reported value of frequencies of sex with different types of partner. This table and Figure 25 include only partners with whom the most recent sex was within the four weeks before the survey.

Despite the exclusion of partners with whom last sex was more than four weeks ago, all the distributions peak at values below the mean and are skewed to the right by the few partnerships for which very high frequencies were reported. The median values are similar for spouses and regular partners, but much lower frequencies are typically reported for casual partners. However the maximum reported frequency for casual partners of both men and women far exceeds the range of values reported by most respondents.

The distributions for spousal/cohabiting partners and for regular partners are uneven, this may reflect real patterns in the underlying frequencies, or digit preference in the respondents' reports. This unevenness obscures the shape of the distributions. The frequency of sex reported by men and women, for both spousal/cohabiting and regular

partners, could conform to a normal distribution, or to an exponential distribution. The distributions for casual partners are clearer, and follow an exponential distribution. It is important to note that a proportion of respondents were inconsistent in their reports about casual partners and said last sex was within the four weeks before the survey but reported a frequency of sex of zero.

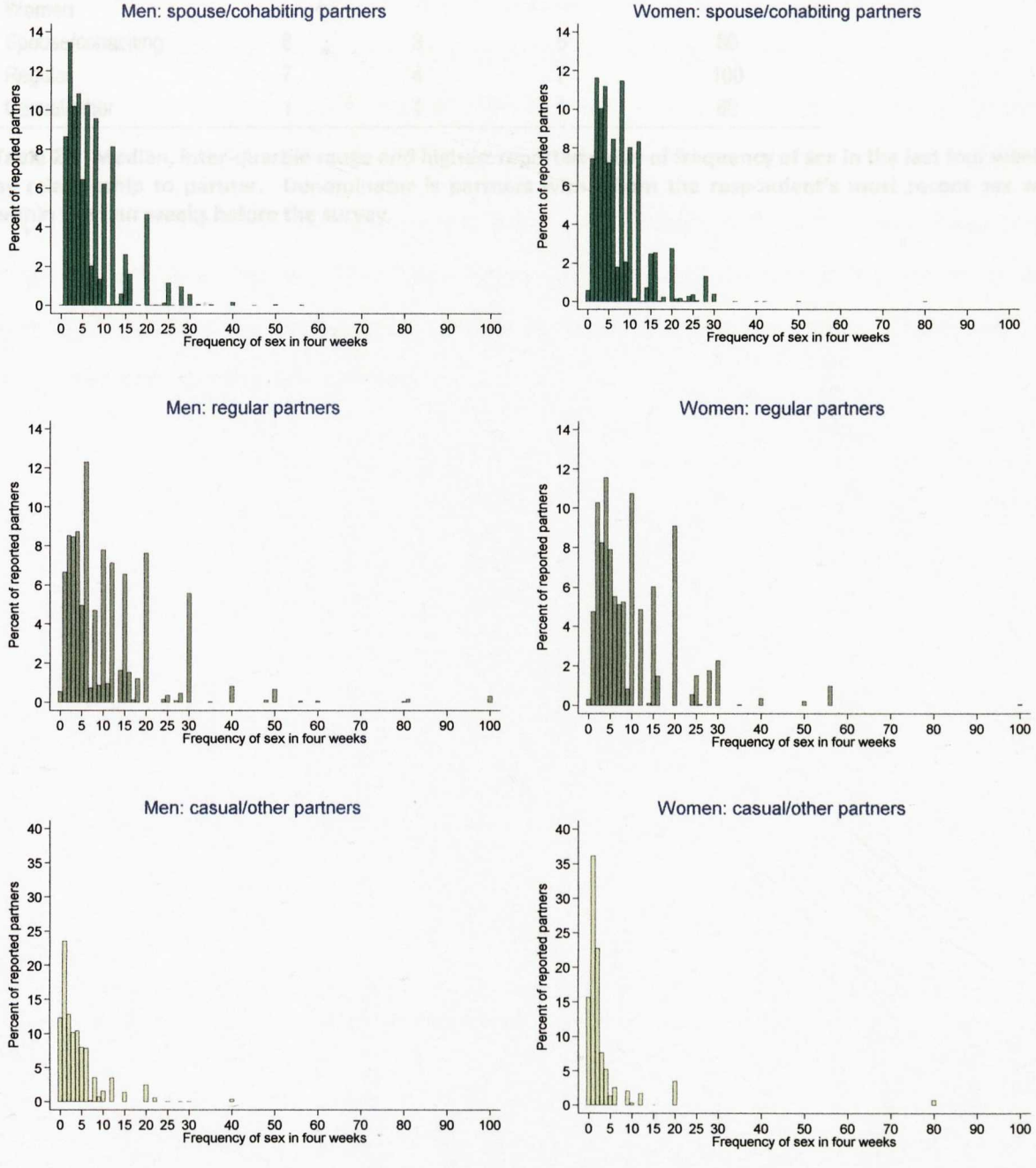


Figure 25: Distribution of reported frequency of sex, by relationship to the partner, for partners with whom most recent sex was within the four weeks before the survey. One night stands have been excluded.

Who	Median	25th percentile	75th percentile	Highest reported frequency
Men				
Spouse/cohabiting	6	3	6	56
Regular	6	4	6	100
Casual/other	3	1	3	40
Women				
Spouse/cohabiting	6	3	6	80
Regular	7	4	7	100
Casual/other	1	1	1	80

Table 29: Median, inter-quartile range and highest reported value of frequency of sex in the last four weeks, by relationship to partner. Denominator is partners with whom the respondent's most recent sex was within the four weeks before the survey.

Relationship between time since last sex and frequency of sex

Figure 26 shows the distribution of the number of reported sex acts based on the number of days since the most recent sex for men and women and for different types of partnership and shows that, for cohabiting and regular partners this shows the expected pattern of exponential decay, at least for the two weeks preceding the survey. There is little difference between the frequencies reported by men and women. At the higher values of time since last sex the pattern for spousal/cohabiting partners could be interpreted as a continuation of the decay curve. For regular partners this is less plausible and the relationship between frequency of sex and TSLS may be different after two weeks prior to the survey.

There is no pattern for casual/other partners, even though one night stands have been omitted from these figures. This is consistent with the high percentage that, although not one night stands, have been acquired only a short time before the survey. There may not have been time to establish a pattern.

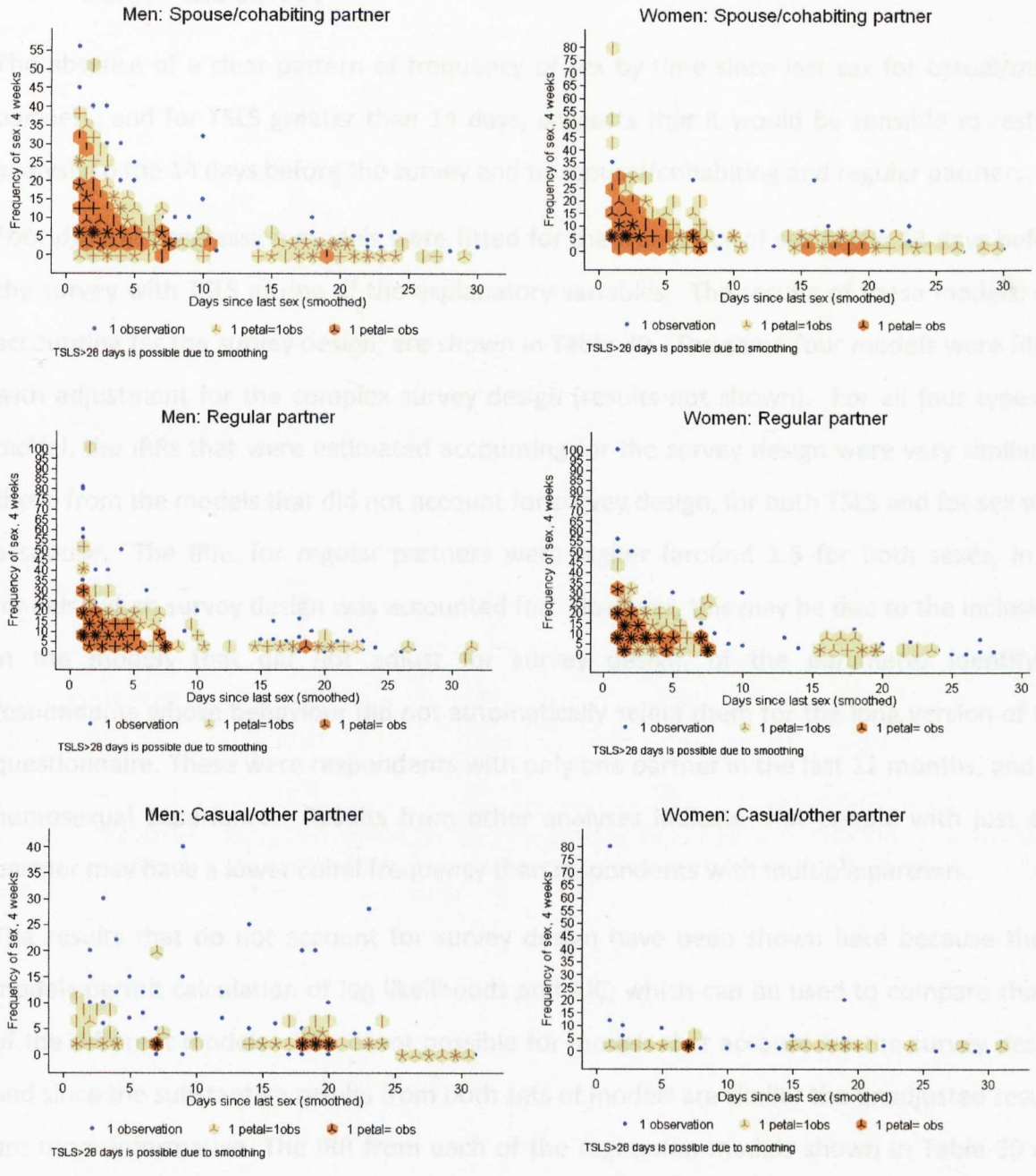


Figure 26: Sunflower plots of frequency of sex against time since last sex, for men and women, by type of partner. Excludes one night stands and partnerships for which last sex was more than four weeks before the survey.

5.3.4 Association between TSLS and frequency of sex during the 14 days before the survey

The absence of a clear pattern of frequency of sex by time since last sex for casual/other partners, and for TSLS greater than 14 days, suggests that it would be sensible to restrict analysis to the 14 days before the survey and to spousal/cohabiting and regular partners.

Four different regression models were fitted for the frequency of sex in the 14 days before the survey with TSLS as one of the explanatory variables. The results of these models, not accounting for the survey design, are shown in Table 30. The same four models were fitted with adjustment for the complex survey design (results not shown). For all four types of model, the IRRs that were estimated accounting for the survey design were very similar to those from the models that did not account for survey design, for both TSLS and for sex with a spouse. The IRRs for regular partners were higher (around 1.5 for both sexes, in all models) when survey design was accounted for. However, this may be due to the inclusion, in the models that did not adjust for survey design, of the parameter identifying respondents whose behaviour did not automatically select them for the long version of the questionnaire. These were respondents with only one partner in the last 12 months, and no homosexual experience. Results from other analyses indicate that people with just one partner may have a lower coital frequency than respondents with multiple partners.

The results that do not account for survey design have been shown here because those models permit calculation of log likelihoods and AIC, which can be used to compare the fit of the different models. This is not possible for models that account for the survey design and since the substantive results from both sets of models are similar the unadjusted results are more informative. The IRR from each of the regression models shown in Table 30 are very similar. The log likelihood and AIC both show that the generalised negative binomial model is the best fit to the data (the values are closest to 0), and the Poisson model is clearly the worst fit.

Regression for frequency of sex in the 14 days before the survey	Poisson		Negative Binomial (Mean dispersion)		Negative Binomial (Constant dispersion)		Generalised Negative Binomial	
	Crude IRR	**95% CI**	**Crude IRR**	**95% CI**	**Crude IRR**	**95% CI**	**Crude IRR**	**95% CI**
Frequency of sex in 14 days								
Days since last sex, smoothed	0.84	0.83-0.84	0.84	0.83-0.85	0.86	0.85-0.87	0.84	0.83-0.85
Men, spouse	1		1		1		1	
Women, spouse	0.98	0.95-1.02	0.99	0.94-1.05	0.99	0.94-1.05	0.99	0.94-1.05
Men, regular partner	1.27	1.21-1.34	1.29	1.19-1.39	1.21	1.12-1.30	1.28	1.18-1.40
Women, regular partner	1.23	1.17-1.30	1.27	1.17-1.38	1.20	1.11-1.30	1.27	1.16-1.39
Undersampled for long form of questionnaire	0.77	0.75-0.80	0.78	0.74-0.82	0.81	0.77-0.86	0.77	0.73-0.81
$ln(\alpha)$								
Regular partner v. spouse							1.73	1.45-2.08
Sex of respondent (female v. male)							0.92	0.77-1.10
Number of respondents	*3204*		*3204*		*3204*		*3204*	
Log likelihood	*-8640*		*-7710*		*-7816*		*-7691*	
AIC	*17292*		*15434*		*15645*		*15401*	

Table 30: Results from regression models of frequency of sex in the 14 days before the survey by days since last sex (smoothed), sex of respondent and relationship to partner. Model includes only those partners for whom last sex was in the 14 days before the survey.

Correlates of coital frequency within partnerships in the 14 days before the survey

Table 31 shows, for both men and women and all types of partner, results from the generalised negative binomial model of the factors associated with the number of sex acts reported for the 14 days before the survey.

There was no difference between women and men in the number of sex acts for the 14 days before the survey. There was also no difference by relationship to the partner or by marital status of the respondent.

There was a fall in the number of acts with increasing age, but there was not much evidence of a trend. Respondents in their twenties reported higher frequencies than younger and older respondents. Respondents with a partner five or more years older than themselves reported fewer acts than respondents whose partner was younger or of similar age. There was no interaction between age of the respondent and the age of their partner, so the effect of an older partner was evident for respondents of all ages.

Increasing duration of partnership was associated with lower number of acts: fewer acts were reported by people with partnerships of five or more years duration compared to those in newer partnerships.

Condom users reported fewer acts than non users. Contraceptive use and fertility intentions were not important in themselves or as effect modifiers. However, using a modern method apart from hormonal methods and the IUD was important. This was reported for just 23 partnerships, most of whom used a spermicide. Condom users who also reported this other method had an increased frequency compared to non-users who did not report using another modern method.

The total number of sexual partners for the year before the survey was important. Respondents with more than one partner during this time reported a higher number of acts per partner than respondents with only one partner. There is some evidence for a trend in the IRR as the number of partners increases.

Number of acts in the 14 days before the survey	Adjusted IRR	95% CI	p-value
Age			
15-19	0.83	0.68-1.00	0.0512
20-24	0.97	0.83-1.14	0.7366
25-29	1.00	1.00-1.00	.
30-34	0.85	0.74-0.98	0.0202
35-39	0.88	0.77-1.01	0.0633
40-44	0.84	0.73-0.97	0.0200
45-49	0.79	0.68-0.91	0.0017
50-54	0.80	0.68-0.93	0.0055
55-59	0.68	0.57-0.81	<0.0001
Partner's age			
Within 5 years of respondent's age	1.00	1.00-1.00	.
5+ years younger	1.03	0.94-1.13	0.5237
5+ years older	0.86	0.77-0.97	0.0099
Number of partners in last year			
0	0.70	0.62-0.80	<0.0001
1	1.00	1.00-1.00	.
2	1.30	1.15-1.48	<0.0001
3	1.49	1.22-1.82	0.0001
4	1.33	0.89-1.97	0.1652
5	1.30	0.92-1.85	0.1355
6-10	1.81	1.27-2.57	0.0010
11-100	1.73	0.88-3.38	0.1091
Don't know / refused	1.41	1.23-1.61	<0.0001
Condom use			
No condom, no other mod. method	1.00	1.00-1.00	.
No condom, used other mod. method	1.36	1.10-1.67	0.0046
Used condom, no other mod. method	0.80	0.72-0.90	0.0002
Used condom & other mod. method	2.04	1.71-2.42	<0.0001
DK condom, no other mod. method	0.92	0.74-1.15	0.4656
DK condom, used other mod. method	1.00	1.00-1.00	.
Duration of partnership			
<=1 year	1.00	1.00-1.00	.
1-4	1.07	0.91-1.25	0.3975
5-9	0.74	0.63-0.87	0.0003
10+	0.72	0.61-0.85	0.0001
ln(α)			
Relationship to partner (regular v. spouse)	1.94	1.48-2.54	<0.0001
Number of respondents	3204		

Table 31: Correlates of number of acts reported for the 14 days before the survey

Correlates of the total number of acts reported for the month prior to the survey.

Table 32 shows the results of a negative binomial regression model for the total number of sex acts per individual during one month. This outcome was modelled using a generalised negative binomial model, as above for the number of acts within partnerships. However, In this model for the total number of acts the parameterisation of α was based on the number and mix of partners reported for the year before the survey, rather than the relationship to the partner that was used in the analysis within partnerships.

This analysis required complete information on all the partners recorded in the partner history. For many respondents this was not available. 4,183 respondents had reported at least one partner during the year before the survey and had sex during the month before the survey. Of these, 523 had not given complete information about all of their partners in the year before the survey. Since this was a substantial proportion, these respondents were included in the models with a variable to indicate that their information was incomplete. These respondents reported lower numbers of sex acts than respondents with complete information. This is to be expected because for many of them, the missing information was the number of sex acts with that partner.

The other results from this model echo those found for individual partnerships. People in their twenties reported the highest numbers of acts overall. Unlike the per partnerships analysis, there was a steady decline with increasing age in the total number of sex acts per month.

Respondents who reported condom use at last sex with one or more partners during the year before the survey also reported lower numbers of sex acts compared to respondents who had not reported condom use at most recent sex with any of their partners. There is some evidence that respondents who had at least one partner who was 5 or more years older than them also had fewer sex acts than respondents without an older partner. This association may be due to chance but it is consistent with the earlier results and therefore plausible.

In the per partnership model it appeared that respondents with a higher number of partners in the year before the survey reported a greater number of sex acts with each partner. The

per partnership analysis was confined to spouses and regular partners. From those results, one might expect a straightforward relationship between the number of partners and the number of sex acts, such that those with more partners reported a higher total number of sex acts that respondents with only one partner. However, this is not observed and it appears that the association between number of partners and number of sex acts is modified by the relationship(s) with the partner(s). Compared to the 2,389 people with one spousal partner during the year before the survey, respondents with one regular partner (n 680) reported a higher number of acts, and those with a casual partner (n 232) reported fewer acts. On the whole, respondents with more than one partner reported more acts than respondents with only one spouse, the exceptions were those with two casual partners, three regular/casual partners and people with three partners in another combination to those given in the table[2]. For the other combinations the IRR does not show a predictable increase in line with the number of partners: twice the number of partners does not double the incidence rate of sex acts. Although the IRRs for those with four partners are mostly higher than the IRRs for people with two partners there is not a clear pattern and the IRR for the respondents with three partners were not intermediate.

The analysis was then repeated to examine behaviour in the month before the survey as correlates of the number of sex acts. Therefore number of partners and mix of different types, condom use and age gap between partners were all specified for the month before the survey, instead of the year before as in the previous model. These results are also shown in Table 32. The IRR are very similar to those obtained in the model for the year before the survey with three exceptions. The number and mix of partners was broadly similar but some combinations were not observed during the month before the survey so fewer categories were included in the model. Respondents with two or three partners in the month before the survey had an increased IRR compared to the model for the year before the survey. Respondents who had a partner of less than 6 months duration during the month before the survey had a higher overall number of sex acts during that time compared with respondents who had not had a new partner.

[2] Some combinations of partner number and mix were reported by only a few respondents and were therefore combined in an "other" category.

	Year before:			Month before:		
	Adj. IRR	95% CI	p-value	Adj. IRR	95% CI	p-value
Age group						
16-19 (160)	0.73	0.59-0.92	0.0061	0.78	0.63-0.96	0.0200
20-24 (433)	1.05	0.87-1.25	0.6199	1.05	0.88-1.25	0.5799
25-29 (543)	1			1		
30-34 (671)	0.85	0.73-0.98	0.0242	0.84	0.73-0.97	0.0175
35-39 (631)	0.80	0.70-0.93	0.0027	0.79	0.69-0.91	0.0009
40-44 (607)	0.74	0.64-0.87	0.0001	0.73	0.63-0.85	<0.0001
45-49 (458)	0.70	0.61-0.82	<0.0001	0.69	0.59-0.79	<0.0001
50-54 (364)	0.68	0.58-0.80	<0.0001	0.66	0.56-0.78	<0.0001
55-61 (316)	0.57	0.48-0.68	<0.0001	0.55	0.46-0.65	<0.0001
Partner numbers and mix						
One Spouse (2596, 2789)	1.00			1.00		
One Regular (423, 874)	1.19	1.04-1.38	0.0142	1.19	1.06-1.35	0.0051
One Casual (59, 255)	0.47	0.27-0.79	0.0049	0.37	0.26-0.52	<0.0001
Two spouse & regular (78, n/a)	3.19	2.39-4.26	<0.0001			
Two: spouse & casual (127, n/a)	1.83	1.46-2.29	<0.0001			
Two: regular & casual (235, 76)	1.44	1.22-1.70	<0.0001	1.35	1.05-1.72	0.0172
Two: regular (108, 22)	1.80	1.34-2.44	0.0001	1.97	1.35-2.89	0.0005
Two: casual (85, 51)	0.37	0.24-0.58	<0.0001	0.61	0.41-0.92	0.0185
Two: other combination (11, 67)	1.74	1.29-2.35	0.0003	2.80	2.02-3.89	<0.0001
Three: regular & casual (98, n/a)	0.50	0.32-0.77	0.0017			
Three: casual (33, n/a)	1.72	1.38-2.15	<0.0001			
Three: other combination (49, 49)	0.67	0.43-1.05	0.0801	3.57	2.10-6.05	<0.0001
Four plus: regular & casual (148,)	3.26	2.47-4.29	<0.0001			
Four plus: casual (80, n/a)	2.30	1.65-3.20	<0.0001			
Four plus: other combination (53,)	4.04	2.61-6.24	<0.0001			
Age gap between partners						
No partner 5+ years older (3566, 3684)	1			1		
≥ partner 5+ years older (617, 419)	0.89	0.80-0.99	0.0387	0.87	0.78-0.98	0.0180
Condom use						
No condom at last sex with any partner	1			1		
Used condom at last sex with any partner	0.81	0.72-0.91	0.0004	0.76	0.68-0.86	<0.0001
Acquisition of new partner						
No partner of <6 months duration				1		
≥ partner <6 months duration				1.25	1.06-1.48	0.0073
Reporting quality						
Complete data on all partners	1			1		
Some data incomplete	0.48	0.41-0.58	<0.0001	0.54	0.46-0.64	<0.0001
lnalpha						
Partner numbers and mix	1.04	1.03-1.05	<0.0001	1.03	1.02-1.05	<0.0001
N	4183			4183		

Table 32: Generalised negative binomial model of the total number of sex acts reported for the month and year before the survey. Parsimonious models are presented including all variables.

Time to failure: TSLS gamma model

Initial analysis of TSLS concentrated on finding an appropriate parameterisation of the model using the 8 alternatives outlined above. The first two models (independent fixed effects for `sex` and `who` with and without an interaction term) showed no significant effects for any coefficients. In the model stratified by sex, none of the stratum specific coefficients for the sex of the respondent were significantly different from zero. Stratifying by relationship to the partner showed more effect and the coefficients for the model (σ and κ) were both likely to be non-zero; the fixed effect for sex was not important in this model.

Unsurprisingly given the preceding results, fitting the values of σ to `sex` was not important but when the relationship to the partner was used to fit the values of σ this coefficient was 0.07 (p=0.04) indicating that the coefficient had an effect on the model. The fixed effect for the sex of the respondent remained unimportant. Accordingly two further models were fitted, without fixed effects, fitting only σ to `who` and fitting both σ and κ to `who`. Fitting the additional parameter κ to `who` resulted in larger p-values for the coefficients on both σ and κ compared to the model where only σ was fitted to `who` and so the latter was taken to be the best model for these data.

The crude effects of each covariate on time to event was estimated (results not shown). These models are estimated in accelerated failure time metric and hence a coefficient larger than 1 indicates a longer time to the event and a coefficient smaller than one shows a shorter time to event (and therefore a higher rate of events).

Few of the covariates showed an independent effect on time to event. Those that did show an effect were: relationship to partner, age, marital status, contraceptive use, time since first sex and questionnaire type.

There was some evidence that regular partners had a longer time to event than spouses (0.09, p=0.066) but the effect was borderline.

Respondents in two of the older age groups (45-49 and 55-61) had longer times to event than respondents aged 25-29 (0.19, p=0.003 and 0.21, p=0.005, respectively). There was no trend with increasing age, and other groups were not significantly different from those aged 25-29.

Respondents who were married at the time of the survey had a longer time to event that those who were single (0.11, p=0.005); those who were formerly married were not different to those who had never been married.

Respondents who were using a hormonal method of contraception or diaphragm had a shorter time to event (-0.08, p=0.043 and -0.44, p=0.005, respectively) compared to respondents who weren't using any contraception. Users of other methods (condoms, IUD, sterilisation & traditional methods) were no different to non-users.

Respondents whose first sex with the partner was between 1 and 4 years before the survey had a shorter time to event that respondents in the first year of their partnerships (-0.12, p=0.055). There was no trend with increasing duration of relationship and those whose partnership began more than 4 years before the survey were no different to those in the first year of their partnerships.

A clear effect was observed for the type of questionnaire used. Respondents who were under-sampled in the survey (those with just one partner in the year prior to survey and no homosexual experience) had longer times to event than other respondents (0.12, p=<0.00013). This model was adjusted for the survey design so this effect is probably due to individual characteristics of the respondents rather than merely an artefact of the way the survey was conducted. The data being modelled pertain to individual partners, so respondents with several partners would not necessarily have shorter times to event with any one partner when compared to respondents with one partner only.

In the model that included all covariates (not shown), no new associations were revealed and the effects of marital status, hormonal contraceptive use and time since first sex were diminished. Controlling for age group decreased the effect of marital status.

There was an interaction between marital status and use of a modern method of contraception apart from condoms. After initial analysis revealed this pattern of association, IUDs, sterilisation and other modern methods (used in less than five percent of partnerships) were combined with users of hormonal methods and diaphragms and compared to non-users. Unmarried users of non-condom modern methods had a shorter time to event than unmarried non-users. No other categories showed any association.

Variables that contributed nothing to the model were removed, one by one, and a more parsimonious model was constructed based on those results. Relationship to partner, age of respondent, marital status, fertility intentions in that partnership, recent acquisition of partner and type of questionnaire were all important factors and were retained. The variable that identified partners acquired in the year before the survey had no important independent effect but appeared to effect the other covariates in the model. The remaining covariates were investigated for interactions and one was identified: between fertility intentions and new partner.

Results from the most parsimonious model are shown in Table 33. Time to event was longer for regular partners than for spouses. Compared to respondents aged 25-29, those aged 35 and over had a longer time to event.

Married respondents reported a longer time to event than either single or ex-married respondents.

Fertility intentions showed an association with TSLS which differed for respondents with comparatively new relationships versus those in established (>1 year) partnerships. Compared to respondents in established relationships who did not want a child, time to event was shorter for respondents in established partnerships who reported that they were infertile, and for those who refused to answer the question about why they were not using contraception. Respondents in established partnerships who said they were not having sex (presumably no intercourse) had a longer time to event than those who didn't want a child. Pregnant respondents (or their partners) in new partnerships had a shorter time to event than respondents with established partners who wanted no children. Respondents with new partners who refused to answer the question about non-use of contraception and those who said they were not having sex had a longer time to event than those in established relationships who wanted no children.

Respondents who were under-represented in the survey had a longer time to event than respondents selected for the longer form of the survey because of their sexual history.

TSLS	Coefficient	95% CI	p-value
Relationship to partner			
Spouse/cohabiting partner	0		
Regular partner	0.31	0.18 - 0.44	<0.0001
Age of respondent			
16-19	-0.01	-0.19 - 0.17	0.8911
20-24	-0.06	-0.20 - 0.09	0.4637
25-29	0		
30-34	0.11	-0.02 - 0.23	0.0872
35-39	0.15	0.02 - 0.27	0.0219
40-44	0.09	-0.05 - 0.23	0.1949
45-49	0.25	0.11 - 0.40	0.0004
50-54	0.17	0.02 - 0.33	0.0311
55-61	0.27	0.10 - 0.44	0.0020
Marital status			
Never married	0		
Currently married	0.12	0.02 - 0.21	0.0212
Formerly married	-0.06	-0.20 - 0.07	0.3621
Duration of partnership & fertility preference			
Old partner† Doesn't want a child	0		
Old partner† Ambivalent/leave to fate	0.06	-0.14 - 0.25	0.5876
Old partner† Wants child	-0.03	-0.21 - 0.14	0.7064
Old partner† Pregnant	0.13	-0.11 - 0.36	0.2887
Old partner† Not fertile	-0.08	-0.17 - 0.00	0.0528
Old partner† Refused to answer	-0.48	-0.92 - -0.04	0.0310
Old partner† Not having sex§	0.90	0.57 - 1.22	<0.0001
New partner† Doesn't want a child	0.04	-0.12 - 0.19	0.6406
New partner† Ambivalent/leave to fate	-0.15	-0.42 - 0.12	0.2653
New partner† Wants child	-0.11	-0.67 - 0.45	0.7095
New partner† Pregnant	-0.57	-0.84 - -0.31	<0.0001
New partner† Not fertile	-0.04	-0.37 - 0.29	0.8025
New partner† Refused to answer	1.25	1.10 - 1.41	<0.0001
New partner† Not having sex§	0.61	0.45 - 0.78	<0.0001
Undersampled in long Q			
>1 partner/homosexual experience	0		
1 partner & no homosexual experience	0.15	0.08 - 0.22	<0.0001
Constant	0.38	0.25 - 0.51	<0.0001
Model fit parameters			
ln(σ)			
Spouse/cohabiting partner			
Regular partner	0.08	0.01 - 0.15	0.0312
constant	-0.44	-0.48 - -0.40	<0.0001
κ			
constant	-0.48	-0.66 - -0.31	<0.0001

Table 33: Results from survival time model using generalised gamma distribution of TSLS.

5.3.5 Comparison of frequency of sex predicted by gamma regression with the number of events reported by respondents

The regression model given in Table 33 was used to predict the number of events per partnership in a 14 day period. This estimate was compared to the number of acts reported by respondents for each partner. These results are shown in Figure 27 and Figure 28. Both graphs show that there is very little correlation between the predicted and reported numbers. Figure 27 shows that the predicted number of events is between 2 and 10 for most respondents, and this varies little by the frequency of sex actually reported for each partnership. Figure 28 shows that the predicted results have less variation and too few low values compared to the distribution of reported values.

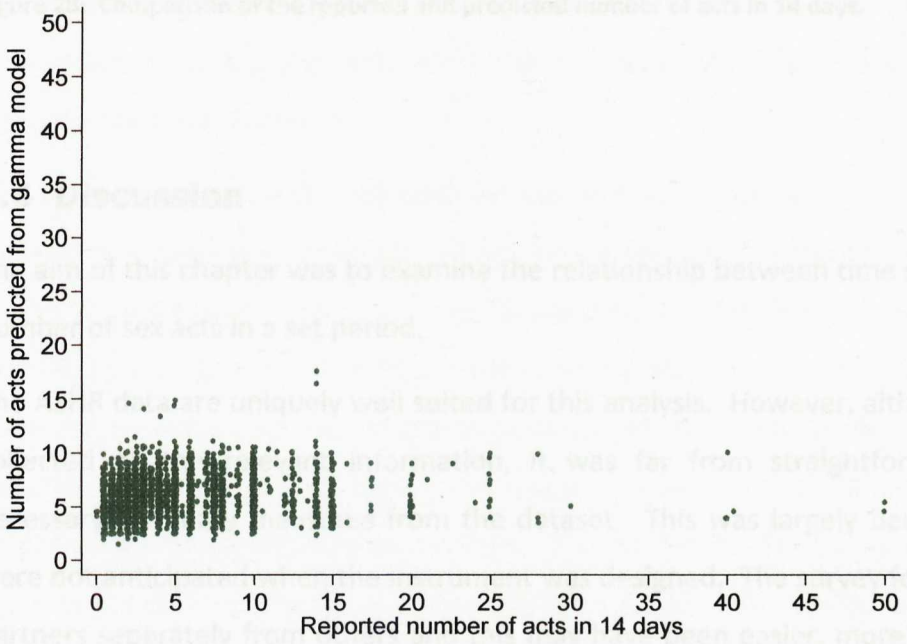


Figure 27: Scatterplot of the reported number of acts in the 14 days before the survey and the number predicted by the gamma regression model.

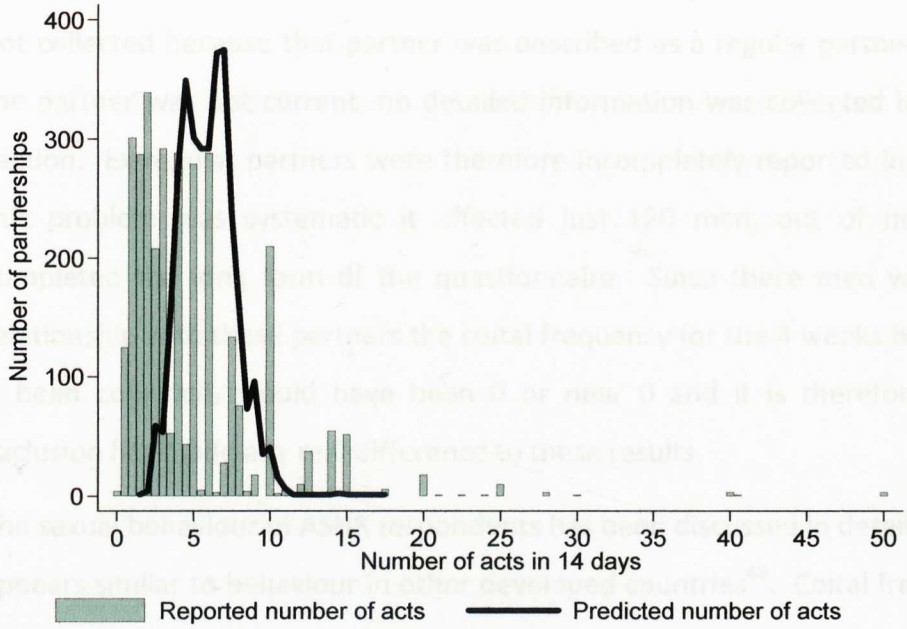


Figure 28: Comparison of the reported and predicted number of acts in 14 days.

5.4 Discussion

The aim of this chapter was to examine the relationship between time since last sex and the number of sex acts in a set period.

The ASHR data are uniquely well suited for this analysis. However, although the survey had collected all the relevant information, it was far from straightforward to derive the necessary summary measures from the dataset. This was largely because these analyses were not anticipated when the instrument was designed. The survey format tackled regular partners separately from others and this may have been easier, more user-friendly for the respondents and interviewers but generated problems for analysis. Information on regular partners was coded slightly differently to that collected for other partners and the position in the partner history of regular partners had to be deduced from the data. Although this made data preparation quite complicated it seems unlikely that any of these problems would have profoundly influenced the results in this chapter. Some respondents' partnerships were omitted: those had a regular partner during the 12 months before the survey but whose partnership was not current at the time of the interview. The existence of

the regular partner was recorded in the partner history section but detailed information was not collected because that partner was described as a regular partner. However, because the partner was not current, no detailed information was collected in the regular partner section. Ex-regular partners were therefore incompletely reported in the ASHR. Although this problem was systematic it affected just 120 men, out of more than 4000 who completed the long form of the questionnaire. Since these men were not in a current relationship with these partners the coital frequency for the 4 weeks before the survey, had it been collected, would have been 0 or near 0 and it is therefore unlikely that their exclusion has made any real difference to these results.

The sexual behaviour of ASHR respondents has been discussed in detail elsewhere[52 71-72] and appears similar to behaviour in other developed countries[48]. Coital frequency, as discussed in Chapter 3 is similar to that in Great Britain and France. The majority of reported partnerships were with spouses or cohabiting partners. A quarter of men's partners had been acquired during the year before the survey, and 10% were one-night stands. These figures were lower for women.

The regression models for the data on the number of sex acts in a fourteen day period showed that time since most recent sex was a predictor of the number of sex acts. The model fit statistics showed that the generalised negative binomial regression model was the best fit to the data and the Poisson model was the worst. The IRR obtained from the different variations on the negative binomial model were similar. In the generalised negative binomial model, the shape parameter was fitted to two variables: sex of respondent and relationship to partner. The coefficient for sex of respondent was not significantly different from 1 but the coefficient for the relationship to the partner (regular partner compared to a spouse/cohabiting partner) was 1.7 and the confidence interval did not include 1. Therefore the nature of the association between time since last sex and the number of acts in a period of time differs by type of partner.

The generalised negative binomial model was also used to investigate the correlates of number of acts during the 14 days before the survey. TSLS was not included in this model because it is thought to be a product of coital frequency rather than a correlate.

Older age and longer duration of partnerships were associated with lower numbers of acts. Condom users reported fewer acts than non-users, although this was not the case for condom users who also used spermicide. Use of condom as the main method of contraception may reduce coital frequency, or conversely people with a low coital frequency may opt for condoms as their contraceptive method. If the comparatively low efficacy of condoms compared to other methods has a suppressive effect on coital frequency, the improved efficacy when used with additional spermicide might have alleviated this effect.

Respondents with more than one partner in the past year had increased coital frequency during the 14 days before the survey compared to people with only one partner. This implies that people with multiple partners have more sex in total than those with just one partner. The relationship to the partner (regular compared to spouse) was not important. Casual partners were not included in this model because the number of acts for casual partners was not clearly related to TSLS, and this model was an extension of the model relating number of acts to TSLS.

The association between number of partners and number of acts was further investigated in a second generalised negative binomial model, this time of the total number of sex acts per respondent during the month before the survey. This model included all acts reported for all the partners in the month before the survey. Covariates were initially defined based on the information given for all partners reported during the year before the survey.

The total number of acts in the last month was negatively associated with increasing age of the respondent. Unlike in the per partner model, in this model there was a clear and steady decline in the IRR with increasing age.

Respondents who reported at least one partner who was five or more years older than themselves also reported fewer acts compared to respondents without an older partner. Having had a new partner during the month before the survey (one acquired within the past 6 months) was not associated with number of sex acts during that time, unlike in the per partner model. Respondents who used a condom at last sex with at least one partner in the year before the survey reported fewer acts than people who did not. Therefore, on the whole, the associations shown within partnerships also hold true when considering the total

number of acts per person. The effect of having had more than one partner in the year before the survey was clear in this model. People with more partners in the year before the survey reported more acts during the preceding month than people with only one partner. However the size of the increase differed by the types of partner reported. There wasn't a clear pattern to this difference: there was a low IRR for two casual partners (0.37) but a high IRR for three and four casual partners (1.72 and 2.3 respectively). This may have been because the partnerships described by this measure were not necessarily in existence during the month before the survey.

The model was repeated using covariates defined for the month before the survey. The numbers and mix of partners was respecified for the month before the survey. There were fewer combinations of partners observed for this period but the IRR were very similar to those observed for the year before. There was a decrease in the IRR for people with four partners including both regular and casual partners. There was an increase in the IRR for people with four casual partners. In this model a higher coital frequency was apparent for people with a new partner, echoing the finding from the per-partnership model and from the literature.

The similarity in the results of these two models, for the total number of sex acts in a month with covariates defined for the year before the survey and the month before is partly an artefact of the way in which data were collected. Number of sex acts during the month before the survey was collected only for current spousal & regular partners whereas for other sorts of partner the data were collected whether or not the partnership was ongoing. This means that this dataset is biased towards more recent partners and is why the most difference between the two models is in relation to casual partners, the only category for which there are retrospective estimates of coital frequency.

Success of regression models for TSLS and resulting estimates of number of sex acts

Comparison of the different parameterisations of the gamma regression models for the data on time since last sex showed that the best option was to fit the parameter σ to the relationship to the partner. Sex of the respondent was not important. This echoes the results of the analysis above.

After establishing the best version of the gamma model for these data, a larger model was fitted to the data. In the final model (Table 33) there were few covariates (relationship to partner, age of respondent, marital status, questionnaire type and whether this was a new partnership and the fertility intentions with this partner).

The predicted numbers of sex acts, based on the gamma model, showed little correlation with the reported frequencies. The distribution of the predicted values was too narrow and too symmetrical despite the fact that the gamma model allows for unobserved heterogeneity. Therefore the fitted covariates have not captured some of the important differences between individual partnerships that dictate coital frequency. It may be that these unmeasured covariates are not actually measureable or indeed tangible.

Chapter 4 showed that there was a good correspondence between observed and predicted number of sex acts based on models in which 90% of observations were correctly allocated to their underlying frequency group. If fewer than 90% if observations were correctly allocated the correspondence was poor. Subjectively, the results in Figure 27 appear to resemble those from Figure 20 in Chapter 4 in which 50% of observations were allocated to the correct group of underlying frequency.

Are these predicted numbers of sex acts useful? Certainly they are not useful at the individual level. It would be possible to take averages by sub-group of respondents and these could be compared between groups. This may well reveal differences but, since we don't know how the important, unmeasured, underlying determinants are distributed among the population it would be impossible to judge how distorted these predicted estimates may be.

Therefore it is not possible to use TSLS, as reported in surveys, to estimate the number of sex acts per unit time for survey respondents.

TSLS is a predictor of the number of sex acts per unit time, which confirms that there is a relationship between the two measures but the nature of the relationship is not in itself very useful. TSLS is useful, in addition to reported number of sex acts, in determining the underlying rate. TSLS can be used as the time denominator since the reported number of sex acts in a set period is known to have taken place in that period minus the TSLS.

Questionnaire design issues

This analysis, like those elsewhere in this thesis, was limited by the design of the survey instrument and demonstrated the benefit of asking exactly the same questions about all types of partner in a partner history.

For this particular analysis it was important to have accurate information on the durations of relationship with all partners, especially those of short duration. Although most spouses and regular partners will not have been acquired recently it is important to capture this information for those partners that are new. If the questions, and results categories, are sufficiently detailed and the same for all partners it is possible to accurately classify the exposure times for sex acts during the recent past. This is also important for analyses of partner acquisition and turnover, something that is of particular interest to concurrency analyses.

Analysis of recent behaviour is impossible unless one knows whether a partnership is ongoing or has finished. A direct question yields what may be a subjective response from the respondent who cannot know for sure whether they will have sex with that partner in the future. However, in the absence of that information, the analyst must make assumptions about whether or not the partnership is ongoing, and that is bound to be less accurate than the respondents' assessments.

Limitations of this analysis

Could any of the deficiencies in the data, or any of the analytical decisions, have precluded finding a practical way to predict the number of sex acts per unit time from TSLS?

By limiting the analysis to a period of 14 days before the survey, and to respondents who had had sex at least once during this time, the analysis focussed on the more active respondents. Consequently there is a deficit of low frequency predictions. This is because it is not possible to distinguish those partnerships that have finished and those that are ongoing. The reported number of sex acts in partnerships in which last sex was also the final sex should only apply to the interval bounded by 14 days before the survey and TSLS since it is only during that period that the partnerships was "at-risk" of sex occurring. Ongoing partnerships are "at risk" for the whole 14 day period. Without information on the

status of partnerships all were assumed to be ongoing and "at risk" for 14 days and this potentially over-estimated the denominator.

Other factors that were not measured, such as spousal separation, would also have enabled more accurate estimation of the exposure time for each partnership and therefore a more accurate estimate of the denominator for the rate of coitus.

However, the predicted numbers of sex acts are not only lacking sufficient low frequency estimates but also sufficient high frequency predictions. This cannot stem from underestimation of the denominator since everyone was given 14 days and this lack of variation therefore suggests more fundamental problems with the modelling approach.

A further complication of using the 14 days before the survey was that the reported number of acts during this time was based on half of the number reported for the four weeks before the survey. For some people this would not have been correct: anyone who had a different pattern in the 14 days prior to the survey than in the 15 to 28 days before the survey. However, the analysis was also conducted using the full 28 days before the survey and the results were broadly similar.

Some of the partnerships reported by the most active respondents were omitted from this analysis because the partner history section was limited to a maximum of three partners. Potentially this omission leads to under-representation of the behaviours of the most interesting respondents. The extent to which this is true is uncertain because we have no information about the number of partners in the month before the survey. This might have affected the absolute estimates of coital frequency but will not have affected this analysis which is based on the relationship between TSLS and number of sex acts within partnerships.

Chapter 6 Analysis of coital frequency data from sero 5

6.1 Background

The Tazama project[73], based in North-Western Tanzania carries out demographic surveillance in a census ward, Kisesa ward, which is part of Magu district in the Mwanza region of Tanzania.

Kisesa ward is to the East of Mwanza City, Tanzania's second largest city, and the main road to Kenya runs through the ward. In the 2002 census[74] 27,473 men and women were enumerated in Kisesa ward distributed between 5 rural villages and the urban Kisesa trading centre.

A demographic surveillance system (DSS) began in the ward in 1994, under the auspices of the TANESA programme[75]. 25 rounds of household-based demographic surveys have been conducted. Sero-surveys, community based surveys of resident adults, have been carried out in the ward at regular intervals. These have combined a detailed questionnaire on socio-demographic characteristics, sexual behaviour, fertility and HIV knowledge with the results of anonymous HIV tests[76-77]. To date, five rounds of sero-surveys have been completed, the first in 1994/5 and the most recent in 2007. A sixth round is current being processed. This chapter is based on the results from the fifth survey: Sero 5.

Fieldwork started in November 2006 and finished in July 2007 and covered 3,884 men and 5,574 women. The survey team visited each village and the trading centre in turn. The survey was, as in previous years, accompanied by a mobile clinic and a mobile VCT centre. All Kisesa residents aged 15 and above were eligible for the survey and those known to the DSS had previously been given an invitation slip explaining the survey and the facilities available. Every survey participant was offered free VCT, medical consultation and treatment, where necessary, for themselves and any accompanying children. In each village, central huts were constructed as a venue for private interviews, VCT and medical examinations. The onus was therefore on the respondents, identified from the DSS records, to attend when invited for the survey.

Ethical clearance was obtained from LSHTM and MRCC.

Residents who attended the survey and gave consent were registered and identified to establish a link to the surveillance system records and then allocated an anonymous study number. Interviews were carried out in private by specially trained interviewers. The questionnaire (see http://www.tazamaproject.org/forms/Draft9EnglishQuestionnaireSero5withStickerPage.pdf) covered background characteristics, marital status, sexual behaviour, family planning and fertility, HIV knowledge, health service use, awareness and use of VCT and knowledge of ART. A dried blood spot was then taken for anonymous HIV testing using Uniform and Enzygnost as a confirmatory test[78-79]. HIV testing was carried out at the National Institute for Medical Research (NIMR) laboratory in Mwanza. Respondents had the option of VCT immediately after the survey. There is a permanent, free VCT clinic in Kisesa trading centre and people who tested positive in the sero-survey clinic were referred there for follow-up which included referral for anti-retroviral treatment (ART). Data entry and processing were done at NIMR Mwanza and LSHTM. Data from each sero-survey are linked with HIV status and to DSS records.

Anonymized questionnaire data from Sero 5, together with some background information from the DSS, are used in this chapter to describe the patterns of coital frequency with respect to age, duration of marriage, duration of other relationship, type of relationship, childbearing (parity, pregnancy, recent birth), residence of partner, and number of partners. In the next chapter, the same data are used to assess what impact coital frequency has on measures of condom use. Sero 5 did not collect time since last sex so it is not possible to compare the frequency reports with time elapsed since most recent sex. Relevant sections of the questionnaire are given in Appendix 1 page 16.

6.2 Data and Methods

A clean dataset containing the data from the DSS merged with that from all five sero-surveys was provided by Milly Marston and recoded for this analysis. The initial dataset contained 10,775 records of which 9,475 observations contained data from Sero 5 and these were retained for analysis. After examination of the data, 17 records were dropped. Nine

were blank and 8 contained registration information and HIV test results but no questionnaire responses.

Dates of interview appeared to have been recorded wrongly for 15 people. Twelve of these records had an interview month that was consistent with the others in their village but the year was wrong. These were corrected to the same year as the other respondents. Three records had a month of interview recorded that was outside the data collection period. Their interview date was changed to the first or last month of the survey in that village, depending on whether the recorded date was before or after the data collection period.

Sex of the respondent was available from the Sero 5 data, from previous sero-surveys and from DSS rounds. Sex was not reported for 5 respondents in Sero 5 but was assigned based on data from previous sero-surveys. There was a discrepancy in reports at different sero-surveys for 16 respondents. In nine cases these were resolved before Sero 5 and Sero 5 confirmed the sex. In one case the sex reported in Sero 5 differed from that reported consistently in the four previous surveys and so the Sero 5 report was ignored. In three cases Sero 5 data resolved the ambiguity and the most commonly reported sex was assigned to the respondent. In three cases there was one report of each sex but the respondents had answered the women's section of the Sero 5 questionnaire and so they were assumed to be women.

Coital Frequency Data

Coital frequency questions were addressed to respondents who reported having a current spouse and/or regular partner at the time of the survey. Respondents who reported both a spouse and a regular partner were asked about the coital frequency with each partner. Respondents who reported more than one partner of each type were asked to report their coital frequency with their main wife, their other wives if applicable and/or their most recent regular partner. To overcome the problem of zero reports in the reference period, respondents were asked to report the number of times they had sex with each of their partners within a week, or a month or a year if the shorter reference periods elicited a zero response. When a non-zero number was reported the interviewer skipped the rest of the reference periods and moved on to the next question.

The design of the questionnaire meant that the time denominator for the reported frequency of sex differed between respondents. For descriptive analysis, the frequencies which had been reported in months or years were transformed to weekly frequencies. For regression analysis, the reported number of acts was used and an additional variable was derived to describe the period of time that the frequency applied to. For most respondents this was simply the period of reporting (week, month or year; all expressed in weeks).

It was possible that some respondents had not been in their partnerships for the whole of the period for which they reported a coital frequency. If the respondent had reported a weekly or monthly frequency it was assumed that they had been with their partner for the whole of this period. For respondents who reported a yearly frequency this assumption seemed less plausible.

For two types of partner (main spouses and regular partners) additional information was available on the duration of the relationship. For a small number of respondents (9 respondents with main spouse, 58 respondents with regular partners) the duration of the relationship was reported to be shorter than the whole year for which frequency of sex was reported. Therefore, for these respondents, the time exposed to sex was not the full year and needed to be reduced to correspond to the duration of the relationship.

For regular partners, the duration of relationships had been collected in the questionnaire in months for durations of less than one year and this information was used as reported to correct the reference period. For main spouses however, the duration of the relationship was collected in years and so there was no information on the length of relationships that had begun in the year before the survey. However, cohabitation histories can be reconstructed from the ongoing demographic surveillance in Kisesa ward. These histories had already been constructed and the dataset was provided for this analysis by Milly Marston. By cross-referencing this information with that from Sero 5 it was possible to ascertain an approximate date for the start of cohabitation for the one of the nine individuals who had been married for less than a year at the time when they were interviewed for Sero 5. This date was used to derive a duration of marriage and this was used to correct the time denominator for the frequency report. Another respondent reported in Sero 5 that he had been married for less than a year. This contradicted the information in the partnership file which indicated he had been married to the same spouse

since 1994. This respondent's duration of marriage was changed to be greater than one year. For the remaining 7 respondents, the exposure to sex variable was changed to half a year.

The duration of relationship with the additional wives of polygamous men had not been collected so this correction was not possible for the 17 men who reported frequencies of sex with their other wives for the year before the survey. However, this is not a problem because the other wives were, by definition, acquired before the most recent wife and 16 of these 17 men had been married to their most recent wife for more than one year at the time of the survey. The other man did not report a duration for his current marriage.

6.2.1 Statistical methods

For the descriptive analysis data were tabulated and graphed using Stata 11[59]. All analyses were carried out separately for men and women. Coital frequencies with the three different types of partner (main/only spouse, other spouse, regular partner) were analysed separately. Summary measures of the sample characteristics were calculated. Descriptive analysis involved graphing the distributions by background characteristics and calculating mean and median frequencies by the same characteristics. Histograms were used to show the distributions of frequencies reported for each partner. To show the distributions of frequencies reported by background characteristics, two plots were drawn for each partner type: i) the mean and median weekly frequencies and inter-quartile ranges were plotted against each background variable; ii) the individual frequency reports were plotted by background characteristic using a sunflower plot to indicate the density of observations in certain areas of the plot, something which is not apparent using a conventional scatter plot[80].

Multivariate analysis was then conducted to investigate the factors associated with coital frequency.

Poisson regression models were fitted, for men and for women, to model coital frequency with a) spouses and b) regular partners, but goodness of fit tests indicated that the Poisson models were not appropriate. Therefore negative binomial regression was used to estimate crude rate ratios, 95% confidence intervals and p-values for coital frequency with a) main

spouse and b) regular partner by each of these background characteristics, for men and women separately.

Multivariate negative binomial models were then constructed for men and women.

All variables were initially included in the regression models and those that did not have an independent effect on the model were sequentially removed, and after each model information criteria were calculated (Akaike's Information criterion (AIC) and Bayesian Information Criterion (BIC)). The model with the smallest value on these criteria was selected. The best models for each sex and partner combination were assessed to see if the negative binomial model was still more appropriate than a Poisson model. The results from likelihood ratio tests of the null hypothesis that $\alpha=0$ were used to assess this. If $\alpha=0$ a Poisson model would suffice.

The predicted number of events based on each model was estimated and dot plots drawn to compare the distributions of the predicted and reported number of events. The observed and predicted weekly coital frequencies for each sex were plotted against each other on a scatter plot to assess the extent to which the models captured the variance in the original data.

Many of these analyses were carried out for just two of the three coital frequency outcomes: with main spouse and with regular partner. Coital frequency with other wives, applicable to polygamous men only, could not be disaggregated by relationship duration because the information was not available. The sample of polygamous men was too small for meaningful analysis by numbers of other partners.

Histograms were also drawn for the frequencies of sex with spouses reported by groups of respondents disaggregated by sex and selected background characteristics. This was done to investigate the shape of the coital frequency distributions amongst more homogenous groupings.

The following characteristics were explored for association with coital frequency: five-year age group, duration of relationship in years, residence of partner, polygamous versus monogamous marriage, number of times the respondent had been married, the age difference between partners, the numbers of sexual partners in the last year (0,1, 2, 3, 4+) and in the last month (0,1,2,3+), whether the respondent had sex with a spouse in the last

year (for regular partners only), whether the respondent had had a regular partner in the last year (for marital sex only), whether they had had a casual partner in last year, age at first sex, reason for first sex, condom use at most recent sex with that partner and current method of contraception. In addition, for women only: parity, time since last birth in years and pregnancy status at interview.

6.3 Results

Data were available for 3,844 men and 5,574 women aged between 13 and 98.

A complete case analysis was carried out. Respondents who were missing key socio-demographic information (n=94) were excluded. A further 96 people who reported sex with a spouse in the year before the survey were excluded because they did not provide complete information about their spouse.

Two men who were in polygamous marriages did not provide information about the other spouse and were excluded. Lastly 11 respondents who did not provide complete information about their regular partners were excluded.

This left 5,031 complete reports about spouses, 127 complete reports about other spouses and 1,726 complete reports about regular partners for inclusion in the analysis.

Since the numbers of people with incomplete information on specific partners were fairly small, anyone who did not provide complete information was excluded from all the analyses, even though for most analyses the different partners were considered separately. This left 3,821 men and 5,438 women with complete data for analysis.

Summary characteristics of respondents are given in Table 34. Most respondents were under 30 and had a primary school education. Slightly more than half the men and 80% of the women had been married and 49% and 59% respectively were married at the time of the survey. Polygamous marriage was reported by 3% of men and 10% of women. 120 of the polygamously married men reported two wives, 8 men reported three and one man reported four wives. Around a quarter of respondents had been married more than once; for men this includes both remarriage and polygamous marriages. 16% of men and 12% of women had never had sex and 13% of sexually experienced men and 20% of women had not had sex during the year before the survey. Spouses were the most common type of sexual

partners reported by 49% of men and 58% of women during the year before the survey. Just 3% of men had had sex with a second or higher order wife in this period. Around a quarter of male respondents (28%) and 12% of female respondents reported a regular partner during the year prior to survey. High risk partners, defined by occupation (truck drivers, bar girls), were reported by 5% of men and 8% of women. Most spousal relationships had been in existence for more than five years, whereas less than 10% of regular partnerships had been ongoing for more than three years.

The vast majority of sexually active respondents reported only one partner during the year before the survey. 19% of men and 6% of women reported more than one partner during that period and 9% of men and 2% of women had had more than one in the month before the survey.

Characteristics	Men Number Respon -dents	%	Women Number Respon -dents	%
Five year age group (sero 5) 80+ open				
15-19	1108	29	1073	19.7
20-24	569	14.9	803	14.8
25-29	406	10.6	770	14.2
30-34	347	9.1	605	11.1
35-39	266	7	448	8.2
40-44	242	6.3	395	7.3
45-49	215	5.6	341	6.3
50-54	154	4	228	4.2
55-59	146	3.8	219	4
60-64	115	3	172	3.2
65-69	80	2.1	127	2.3
70-74	70	1.8	123	2.3
75-79	51	1.3	50	.9
80+	52	1.4	84	1.5
Highest level of education attended				
None	691	18.1	2106	38.7
Primary	2533	66.3	2902	53.4
Secondary	469	12.3	331	6.1
Tertiary	116	3	87	1.6
Other	12	.3	11	.2
Ever been married in sero 5				
Never married	1720	45	1110	20.4
Ever married	2100	55	4328	79.6
Currently married				
Not married	1947	51	2220	40.8
Married	1874	49	3218	59.2
In polygamous marriage in sero5				
No	3693	96.7	4890	89.9
Yes	128	3.3	548	10.1
Married more than once				
Never	1720	45	1110	20.4
Once	1172	30.7	2894	53.2
More than once	929	24.3	1434	26.4
Parity grouped				
0			1147	21.1
1			594	10.9
2			595	10.9
3			500	9.2
4-8			1614	29.7
9+			452	8.3
N/A			536	9.9
Sexual activity				
Never had sex	596	15.6	627	11.5
No sex last year	476	12.5	1045	19.2
Sex in last year	2749	71.9	3766	69.3
Had sex with (main) spouse in last year				
No	1964	51.4	2264	41.6
Yes	1857	48.6	3174	58.4
Had sex with other wife in last year				
No	3694	96.7		
Yes	127	3.3		
Had sex with regular partner in last year				
No	2756	72.1	4777	87.8
Yes	1065	27.9	661	12.2
Had sex with a high-risk partner in last year				
No	3633	95.1	4993	91.8
Yes	188	4.9	445	8.2

Characteristics	Men Number Respon-dents	%	Women Number Respon-dents	%
Number of partners in last year, grouped				
0	916	24	1543	28.4
1	2162	56.6	3584	65.9
2	474	12.4	237	4.4
3	141	3.7	52	1
4+	128	3.3	22	.4
Number of partners in last month, grouped				
0	1207	31.6	1914	35.2
1	2255	59	3410	62.7
2	296	7.7	106	1.9
3+	63	1.6	8	.1
Age at first sex, grouped*				
10-13	146	4.5	133	2.8
14	149	4.6	224	4.7
15	496	15.4	674	14
16	454	14.1	713	14.8
17	388	12	524	10.9
18	485	15	804	16.7
19+	393	12.2	718	14.9
DK	714	22.1	1021	21.2
Reason for first sex*				
Got married	76	2.4	1663	34.6
Wanted to	3040	94.3	2548	53
Tricked	25	.8	245	5.1
Needed money	0	0	67	1.4
Forced	0	0	48	1
Can't remember	84	2.6	240	5
Current method of FP				
None	3728	97.6	5164	95
Hormonal	28	.7	211	3.9
Condom	40	1	38	.7
Sterilised	3	.1	9	.2
IUD	0	0	1	0
Abstinence	12	.3	1	0
Rhythm	4	.1	4	.1
Traditional	6	.2	10	.2
Duration of marriage, grouped				
0	70	3.7	80	2.5
1	73	3.9	182	5.7
2	104	5.5	206	6.4
3	120	6.4	199	6.2
4	108	5.8	188	5.8
5-9	372	19.9	773	24
10+	936	49.9	1277	39.7
Don't know/missing	91	4.9	313	9.7
Duration regular partnership in years, grouped				
1/12	76	7.1	41	6.2
2/12	124	11.6	42	6.4
3/12	106	10	39	5.9
4/12	79	7.4	32	4.8
5/12	32	3	13	2
6/12	106	10	27	4.1
6-12/12	97	9.1	91	13.8
1	163	15.3	111	16.8
2	178	16.7	154	23.3
3	66	6.2	55	8.3
4-30	38	3.6	56	8.5

Table 34: Characteristics of Sero 5 respondents

* Respondents who had ever had sex only.

At the time of the survey, 28% of men (1,065) and 12% of women (661) reported that they had a regular partner. 9% of both men and women reported partners of more than one type (spousal, regular, casual) in the year before the survey. The combinations of these types of partner, for male and female respondents, are shown in Table 35. The majority of respondents reported having only spousal partners in the last year. Among the sexually active the second largest group was those with only regular partner(s). Among those who had sex with a spouse in the last year, 15% of men and 12% of women also reported either regular or casual partners during the same period.

Partner combinations:	Men		Women	
	N	%	N	%
Never had sex	596	15.6	627	16.4
No sex last year	476	12.5	1,045	27.3
Casual partner(s) only	35	0.9	12	0.3
Regular partner(s) only	793	20.8	468	12.2
Regular and casual partner(s)	64	1.7	112	2.9
Spouse(s) only	1,579	41.3	2,800	73.3
Spouse(s) and casual partner(s)	70	1.8	293	7.7
Spouse(s) and regular partner(s)	189	4.9	53	1.4
Spouse(s), regular and casual partners	19	0.5	28	0.7
Total	3,821		5,438	

Table 35: Mix of partner types during the year before the survey, by sex

6.3.1 Reporting of coital frequency

Table 36 shows the units in which respondents reported coital frequency. The series of questions on coital frequency was designed so that respondents reported in weeks, months or years according to the recency of their most recent sex. For all types of partner, most respondents reported in weeks. Reports of coital frequency all apply only to current partners, nevertheless between 8% and 15% of respondents in each group reported an annual frequency, which means their most recent sex was more than one month before the survey.

Reporting unit	Main spouse	Other wife	Regular partner
Men			
Week	76.6	68.5	61.6
Month	14.6	18.9	30.1
Year	8.8	12.6	8.3
N Men	*1857*	*127*	*1065*
Women			
Week	75.2		48.3
Month	15.3		36.6
Year	9.5		15.1
N women	*3174*		*661*

Table 36: Percentage distribution of frequency reports by unit of reporting.

6.3.2 Distributions of reported coital frequency

Figure 29 shows the distribution of reported weekly coital frequencies, by sex, for main spouses, other wives for polygamous men and for regular partners for both sexes. The modal frequency reported with a main spouse is two times a week for both men and women and once a week for other wives and for regular partners. Respondents reported coital frequencies in whole numbers. Those who reported a weekly frequency therefore have an integer weekly coital frequency whereas respondents who reported in months or years may not.

All distributions are skewed to the right. The distributions of frequencies reported by married people who had had sex with their main spouse in the week before the survey are the closest to a normal distribution (see Figure 30, top panel). Looking only at people who reported their coital frequency for the week before the survey, there is a difference between the distributions of frequencies for main spouses and for regular partners. This suggests there may be an underlying difference in coital frequency between spouses and

regular partners, even in active relationships, and the distribution is consistent with that expected from a Poisson process at low frequencies.

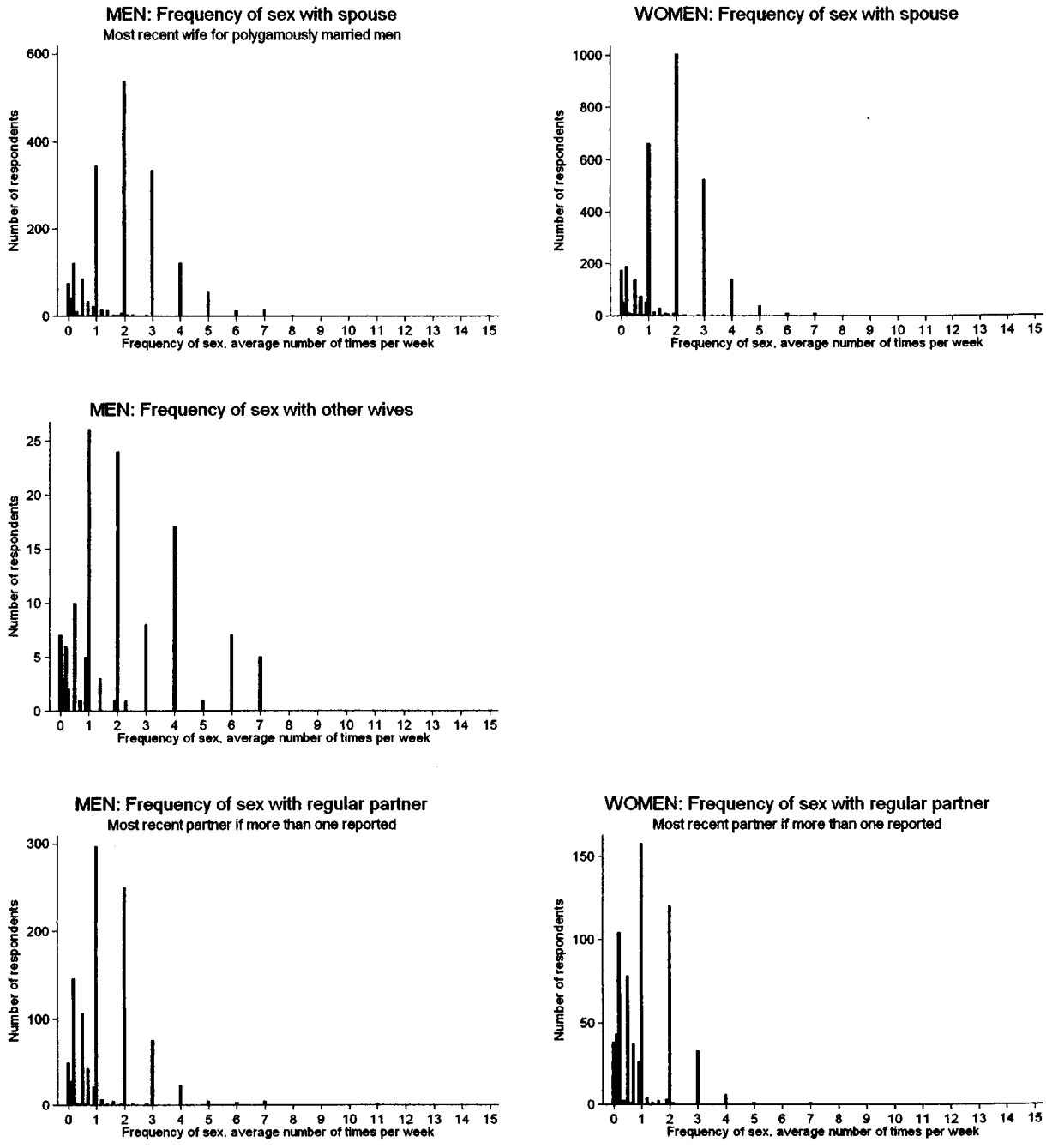
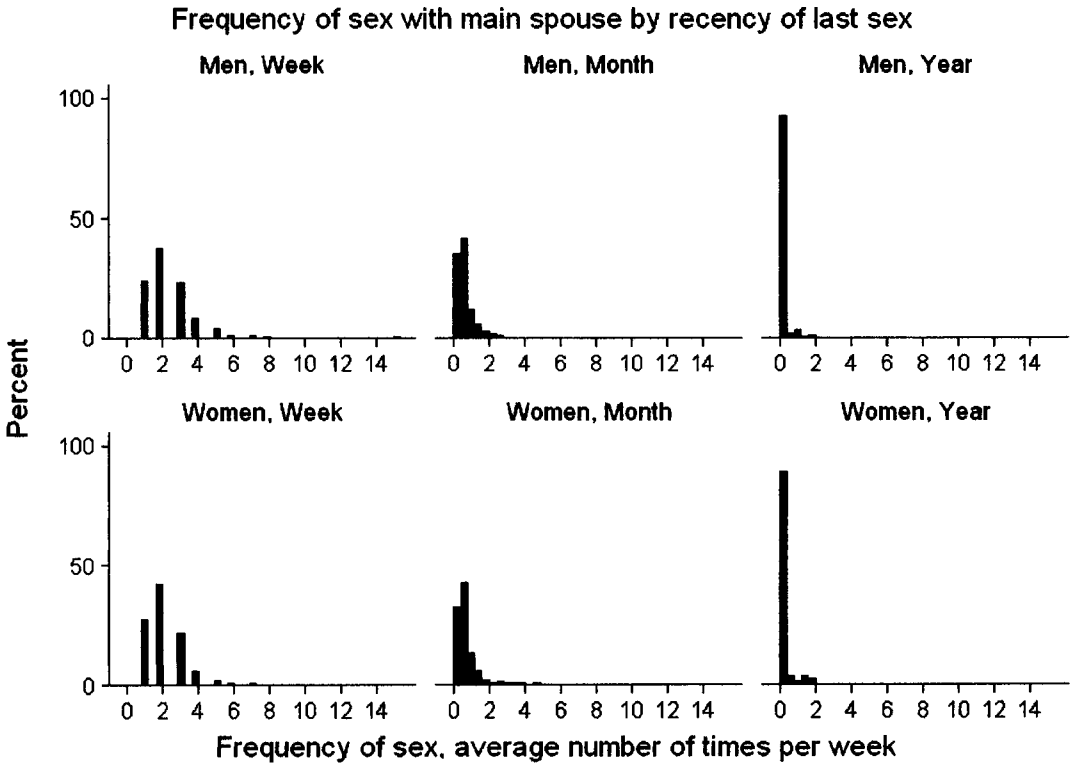


Figure 29: Frequency distributions for coital frequencies reported by men and women for different types of partner. All frequencies have been transformed to a weekly frequency.



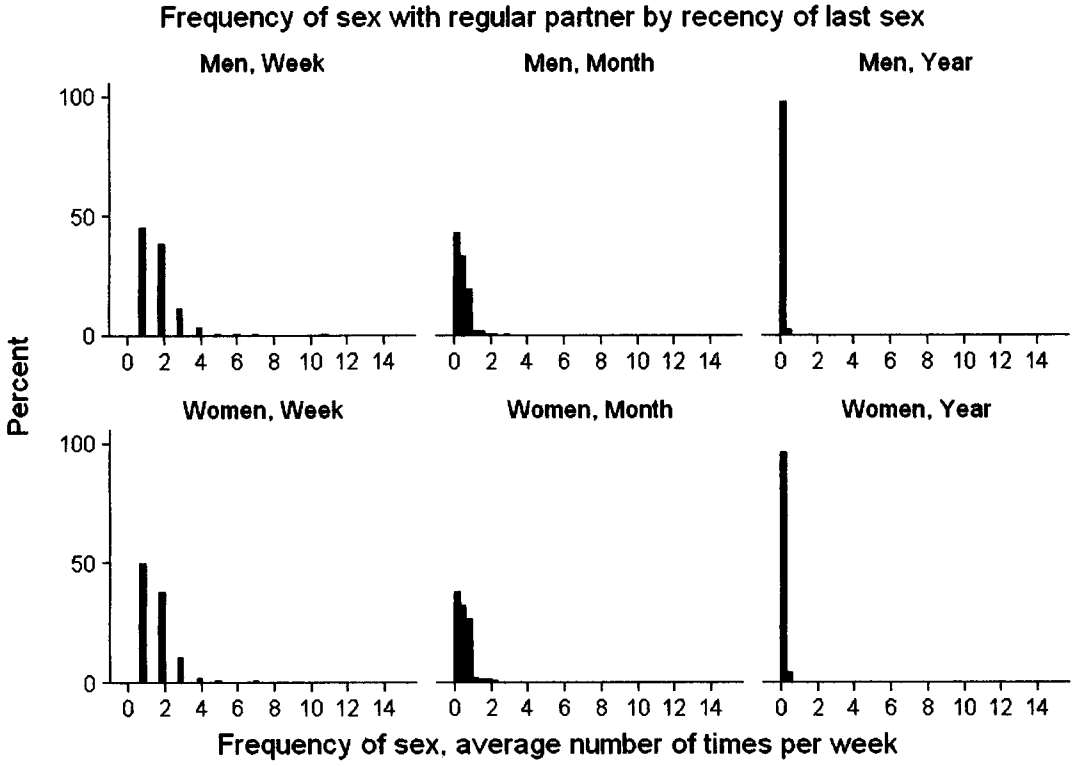


Figure 30: Frequency distributions for coital frequencies with different types of partner, by time since last sex. All frequencies have been transformed to a weekly frequency.

Type of partner	Median weekly frequency	Mean weekly frequency	Variance	Coefficient of variation
Men				
Main spouse	2.00	1.93	1.93	72.08
Other wife	1.90	2.12	3.51	88.50
Regular partner	1.00	1.26	1.19	86.42
Women				
Main spouse	2.00	1.73	1.37	67.51
Regular partner	0.90	1.01	0.80	88.74

Table 37: Summary measures of the distributions of coital frequencies reported by men and women for different types of partners.

Table 37 shows the median and mean coital frequencies and the variance reported by men and women for the different types of partner. The average frequencies are higher for men than women for both spouses and regular partners. The mean frequency reported by polygamous men with their other wives is higher than that reported by all married men with their main spouses. Comparing the frequencies with main spouse and other spouse reported by men in polygamous marriages shows that this is because polygamous men tend to report more frequent sex: the mean weekly frequency is 2.12 with both the main wife and with the other wife. The mean weekly frequency for monogamous men with their spouse is 1.91.

Table 37 also shows the coefficient of variation, which is the standard deviation expressed as a percentage of the mean, and describes the amount of heterogeneity in the distribution net of the differences in the size of the mean. It shows that there is the least variance in coital frequency for women with their spouses (67%) and most for women with their regular partners (89%). Men's coital frequency with their regular partners is similarly variable (87%).

The variance is less than or approximately equal to the mean coital frequency reported in each category with the exception of polygamous men's coital frequency with their other wives. This latter distribution appears over-dispersed because the variance is much higher than the mean.

6.3.3 Patterns by age and sex

Main spouse

The median weekly coital frequency with the main spouse remains stable at 2 for both men and women between the ages of 15 to 39 (Figure 31). The weekly frequency reported by women starts to decline from the age of 40. None of the 86 women aged over 80 in these data reported being married. The weekly frequency reported by men does not decline until the early 60s and remains higher than the women's at subsequent ages. The sunflower plots (Figure 32) show that at all ages more women than men report lower frequencies, and this difference becomes more pronounced in the older ages.

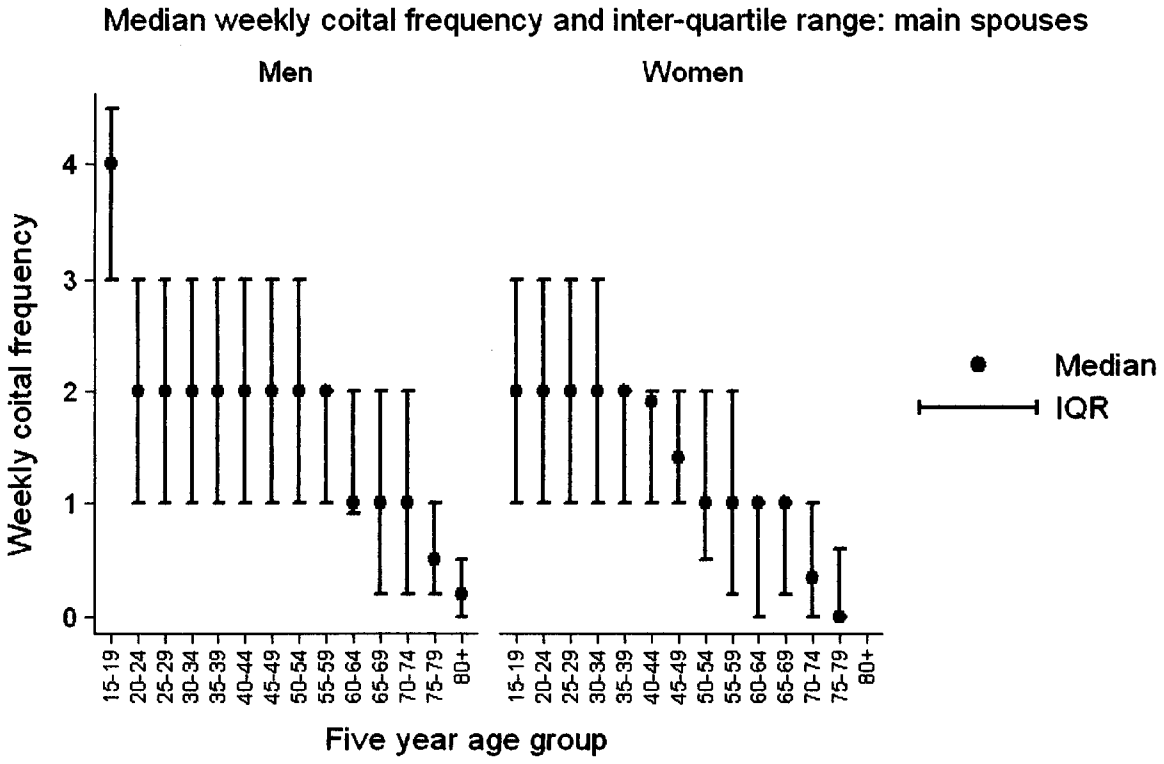


Figure 31: Median weekly coital frequency with main spouse by age group and sex.

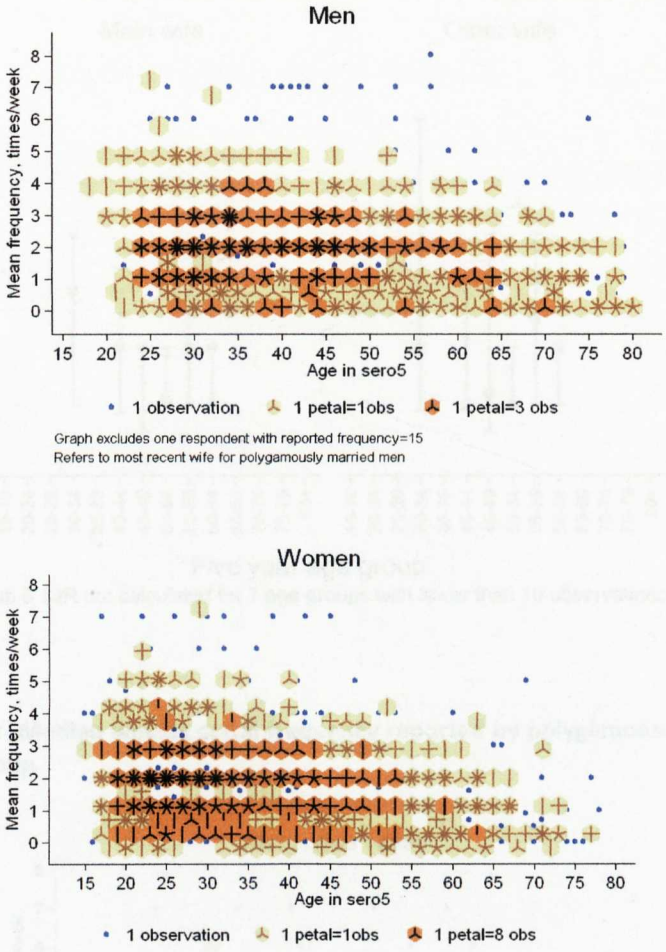


Figure 32: Sunflower plots showing distribution of frequency of sex with main spouse by age.

Other wife (polygamously married men)

The frequency reported by men with their main and other wives does not show the same clear declining trend with increasing age. Coital frequencies reported by polygamous men with main wives and other wives show no pattern with age (Figure 33). This is partly due to small numbers: the frequencies reported by all men with main wives showed heterogeneity and a pattern with age may be more apparent if there were more polygamous men in these data. The sunflower plot (Figure 34) shows the sparseness of the data. It may also reflect a different dynamic of polygamous marriages since these begin, on average, at an older age when a hitherto monogamous marriage becomes polygynous.

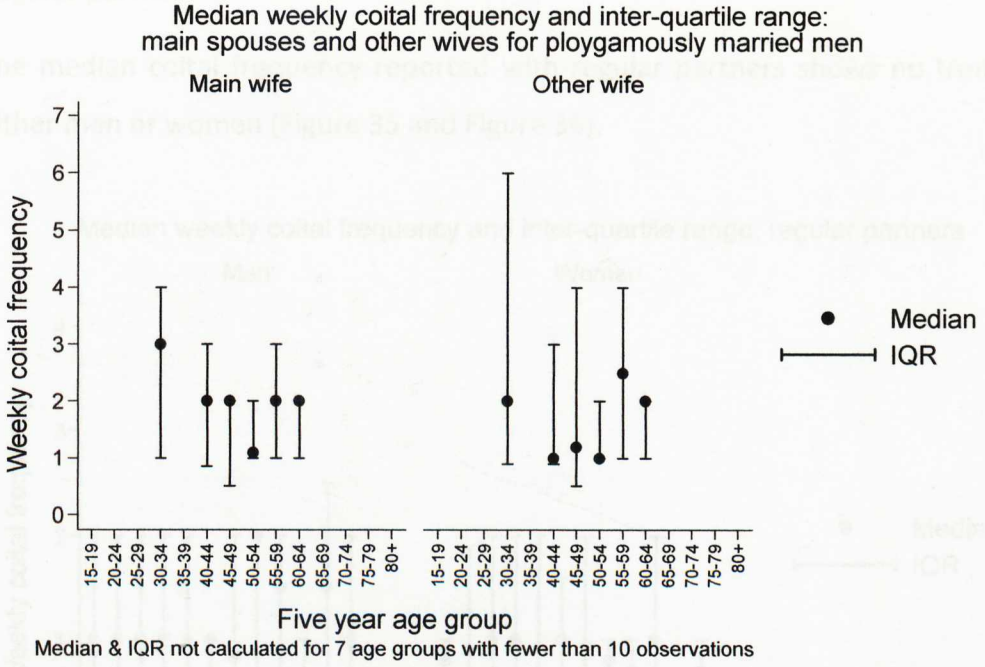


Figure 33: Median weekly coital frequency reported by polygamous men with their main and other wives, by age group

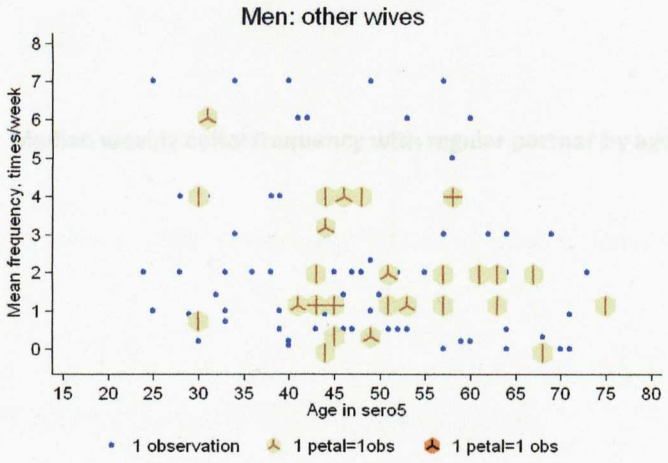


Figure 34: Sunflower plot showing weekly coital frequency reported by polygamous men with their other wives

Regular partner

The median coital frequency reported with regular partners shows no trend with age for either men or women (Figure 35 and Figure 36).

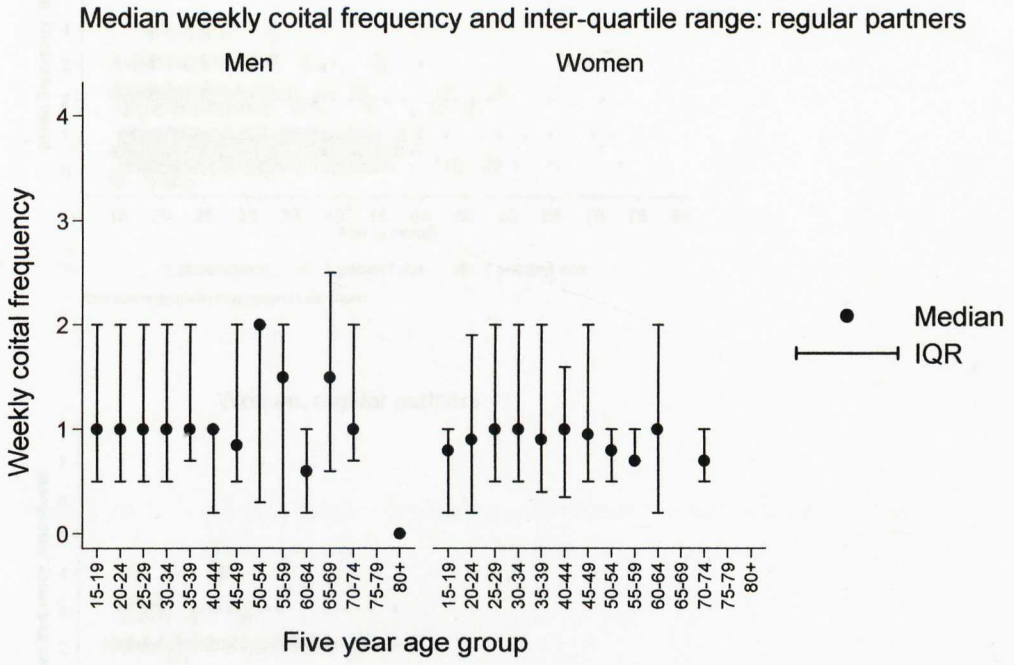
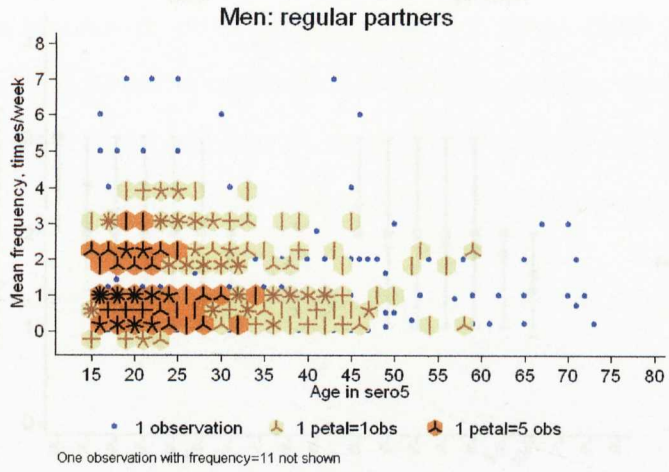


Figure 35: Median weekly coital frequency with regular partner by age group and sex.



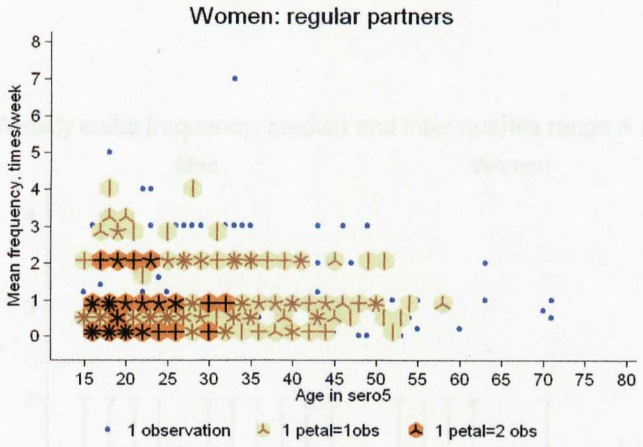
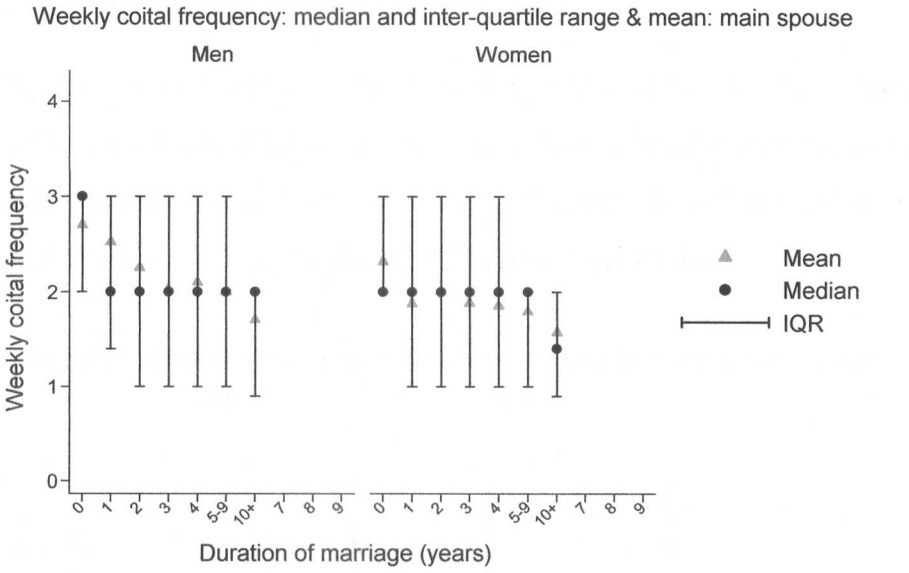


Figure 36: Sunflower plots showing distribution of coital frequencies with regular partners for men and women.

6.3.4 Patterns by duration of relationship

Duration of relationship was reported for marriages and regular partnerships. Polygamous men were asked for the time elapsed since they married their most recent wife. The mean and median frequency of sex by length of relationship is shown in Figure 37. Means are shown for these groups because, at the lower durations, the distributions of reported frequencies are approximately normal. There is no trend in the median frequency with increasing duration of relationship. The mean frequency reported with a main spouse does decline with increasing duration of marriage but no trend is apparent with regular partners.



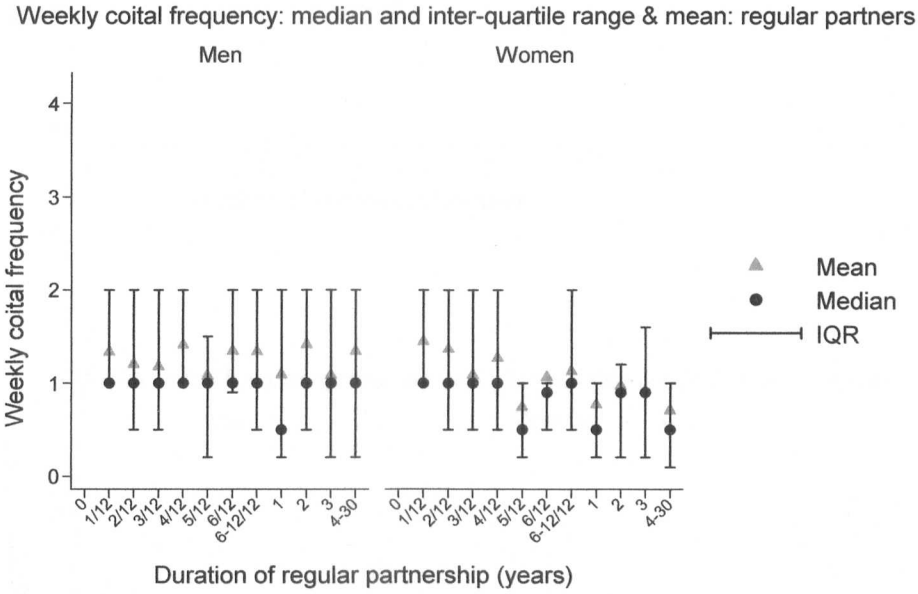


Figure 37: Coital frequency by duration of relationship.

6.3.5 Patterns by number of partners

The number of other partners may influence coital frequency. Mean coital frequencies, reported for main spouses and the most recent regular partner, are higher for those who reported more partners in the last year (Figure 38) and the last month (Figure 39). This trend is not as obvious for the median coital frequencies.

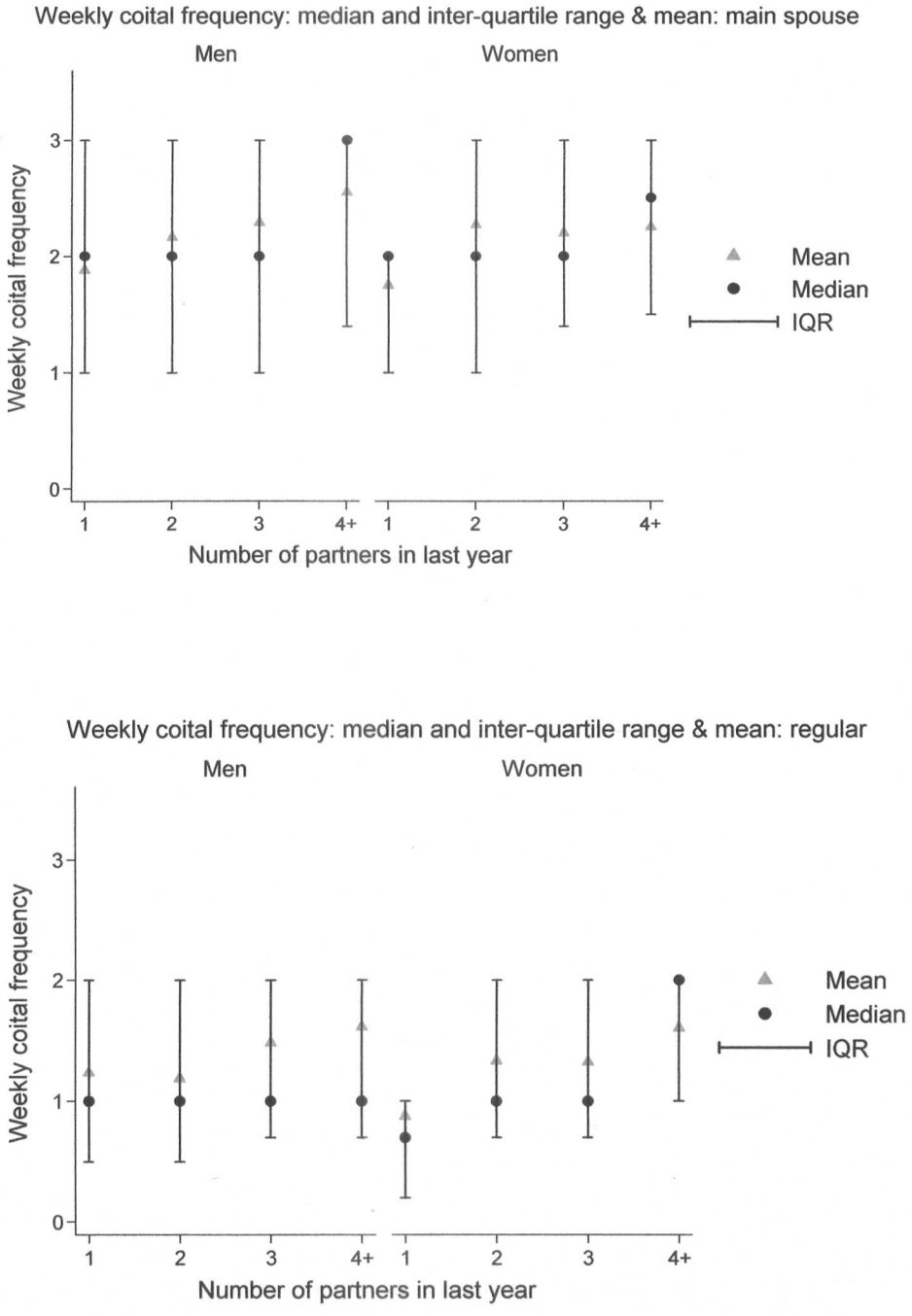
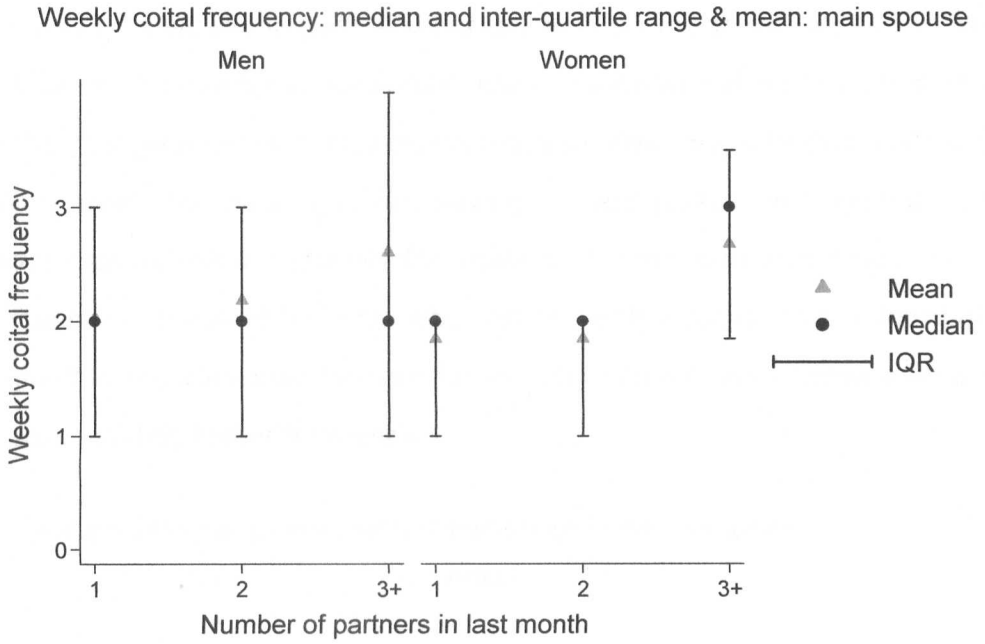


Figure 38: Coital frequency by number of partners in the last year



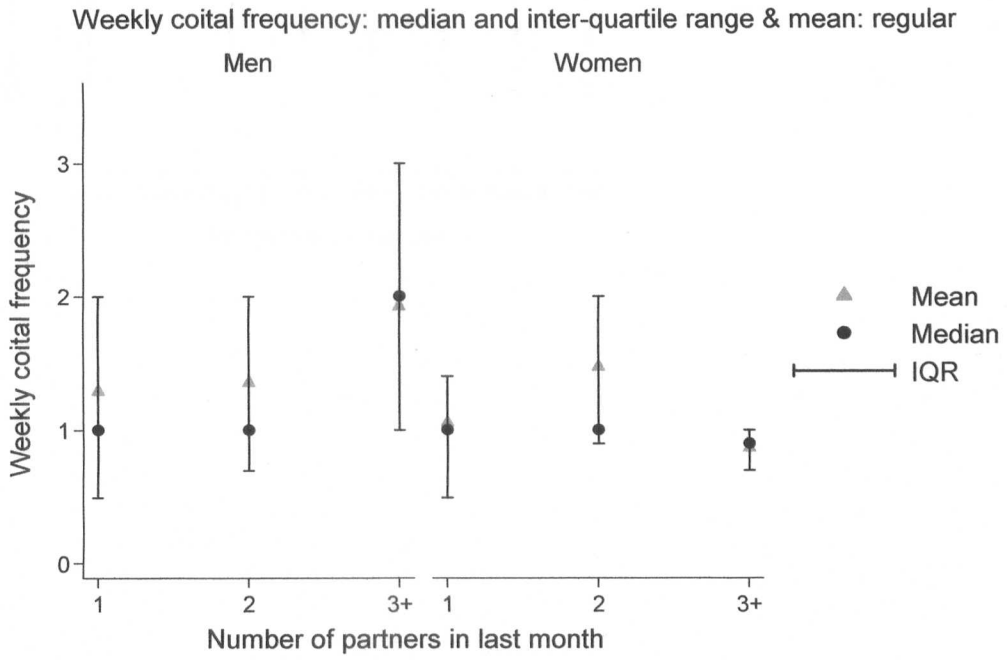
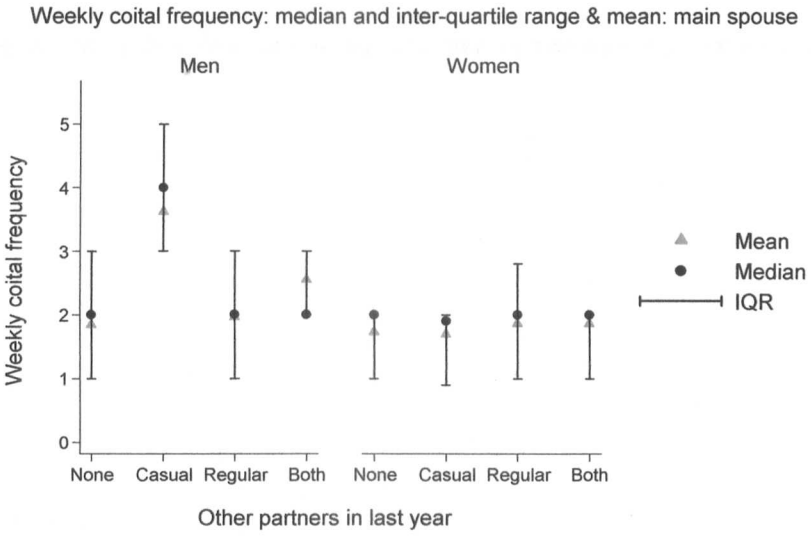


Figure 39: Coital frequencies by number of partners in last month.

6.3.6 Patterns by types of other partners

Figure 43 shows the impact of other partners on the frequency of sex with main spouse and/or regular partner as applicable. Married men who also had at least one casual partner in the year prior to the survey report more frequent sex with their main wife. This effect is not apparent for women, in fact having a casual partner may even be associated with a lower spousal coital frequency for women. Among men with casual partners the lowest frequency is reported by those who had sex with a spouse in the year before the survey. Again the opposite may be true for married women since those with a regular partner report a slightly higher frequency.



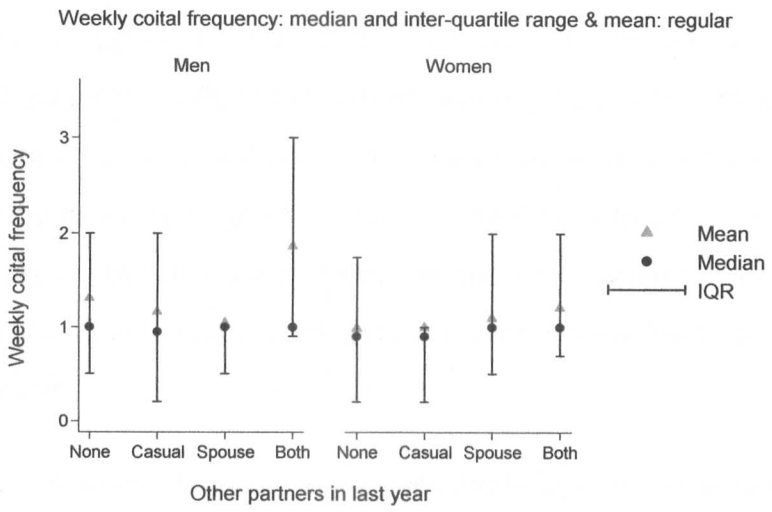


Figure 40: Coital frequencies by whether respondent had other types of partner in the last year

Patterns by childbearing: parity

Parity appears to have little effect on coital frequency, except at the very high parities (Figure 41). Nulliparous women with regular partners report less frequent sex that parous women with regular partners. Questions on childbearing were supposed to be addressed only to women aged between 15 and 49 but in practice, quite a few older women were asked these questions. However, the vast majority of women with no information were aged 50 and above which probably explains the lower coital frequencies reported by this group.

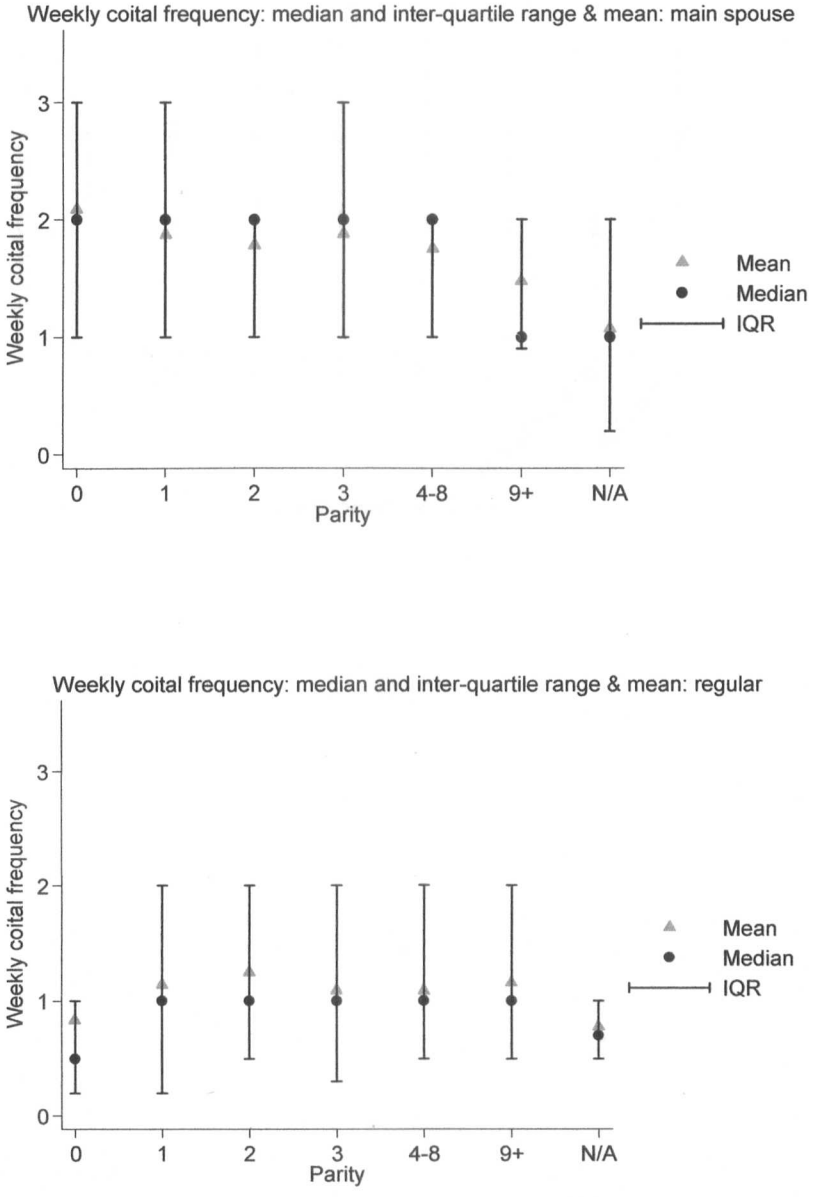
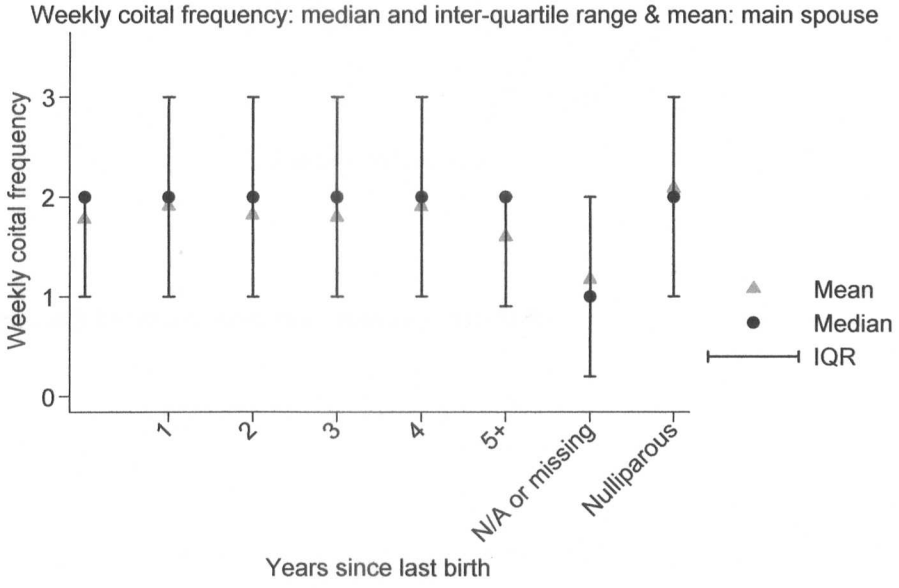


Figure 41: Coital frequencies by parity. N/A: not asked; these questions were supposed to be addressed only to women aged 15-49.

6.3.7 Patterns by childbearing: time since last birth

Time since last birth seems to have little impact on coital frequency with a regular partner (Figure 42) but there appears to be a decline in frequency among women whose last birth was more than 5 years ago. Time since last birth in this population is correlated with age and women reporting more than 5 years since their last birth have mostly reached the end of their childbearing, very few younger women report this length of interval.



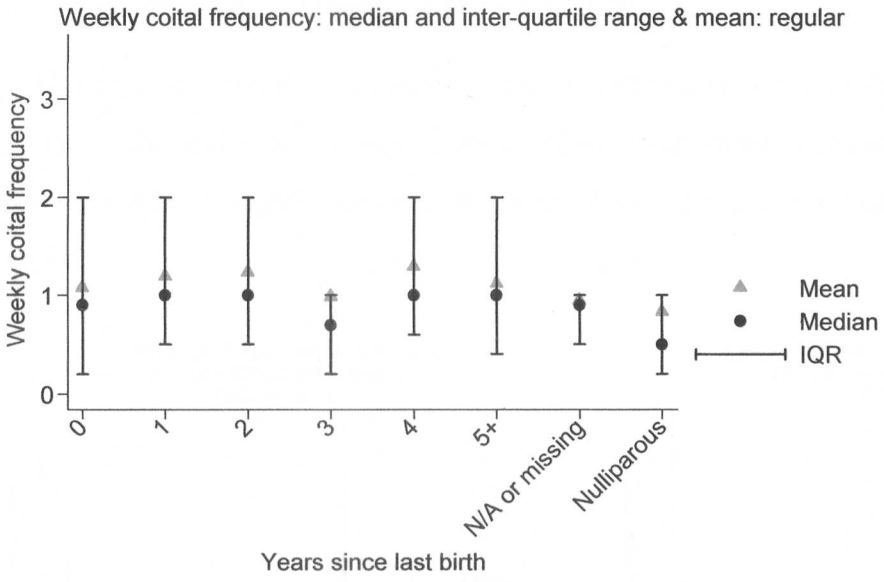


Figure 42: Coital frequencies by time since last birth

6.3.8 Patterns by childbearing: pregnancy

Coital frequency reduces somewhat during pregnancy with both spouses and regular partners. The difference in mean frequencies is not marked (Figure 43) but the median frequency with a regular partner is lower among pregnant compared to non-pregnant women.

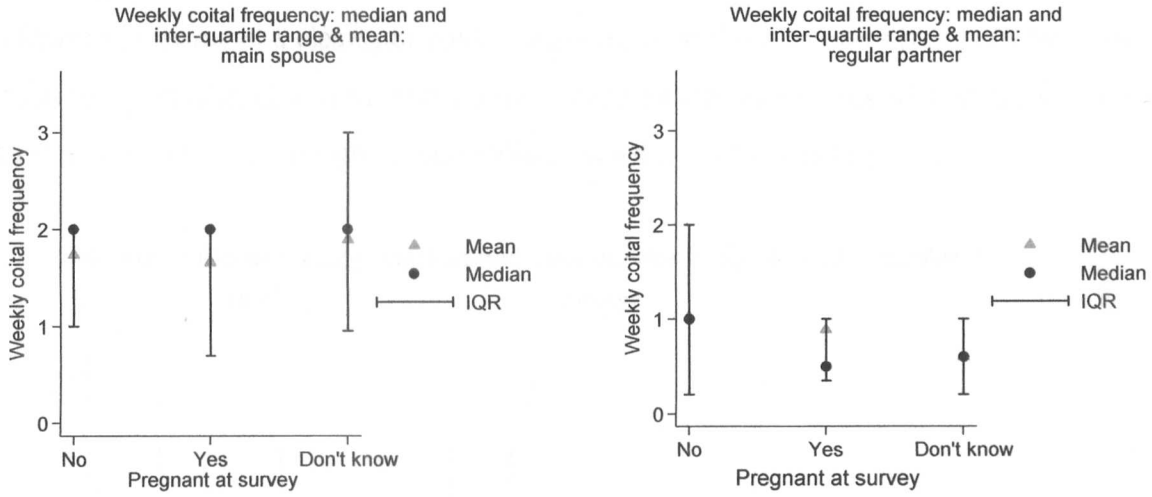


Figure 43: Coital frequencies by whether respondent was pregnant at the time of the survey

6.3.9 Residence of regular partner

Figure 44 shows that median weekly coital frequency with a regular partner is affected by where the partner lives. Sex is most frequent with partners who live in the same villages and there is a decline with increasing distance. However, men whose partners live in Mwanza city report more frequent sex than men whose regular partner lives elsewhere in Magu district. For women there is no difference between these two categories. Partners in Mwanza City may be closer, or easier to get to, than those in other parts of Magu district. Much of Magu district is rural and poorly served by transport networks whereas there is a good road and buses operate between Kisesa ward and Mwanza City.

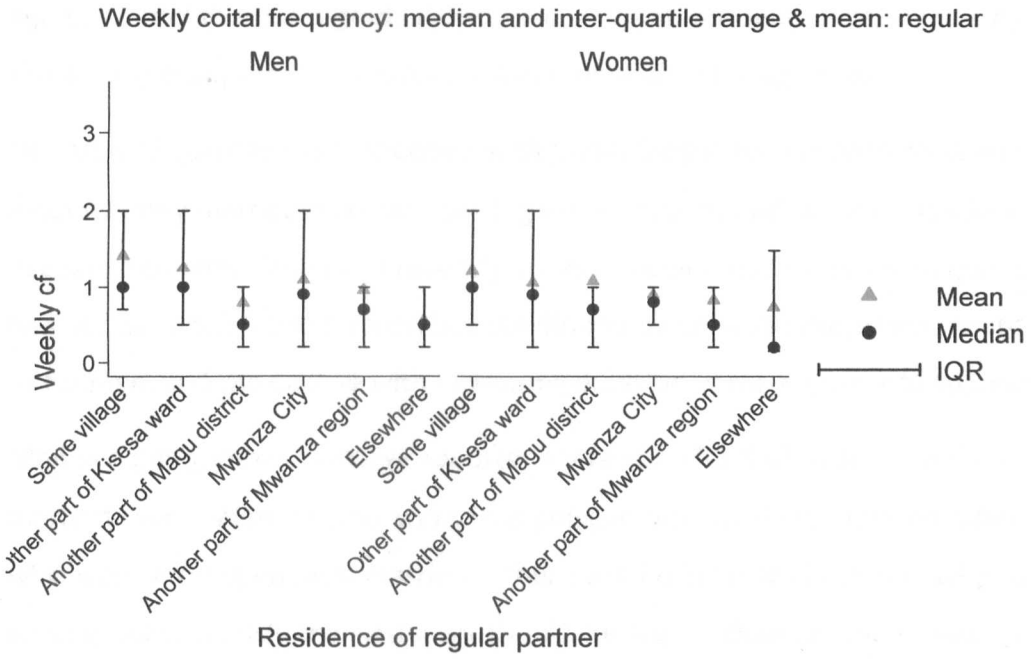


Figure 44: Coital frequency with regular partner by partner's residence

6.3.10 Negative binomial regression models

Coital frequency with spouse: bivariate analysis

Summary measures of coital frequency with the main spouse are shown for men in Table 38 (by background characteristics) and Table 39 (by sexual behaviour variables) and for women in Table 40 (by background characteristics) and Table 41 (by sexual behaviour variables). These tables give the mean and median coital frequencies and the crude rate ratios, 95% confidence intervals and p-values form negative binomial regression models.

Married men and women aged 25 and above appear to have less frequent sex with their spouses than those aged 20-24. For women, this difference becomes significant after the age of 40 and there is a gradual decrease in coital frequency with increasing age. For men the decline is apparent, but not significant, until after the age of 60.

Duration of marriage is associated with coital frequency for both men and women. The most recently married men have the highest frequency and there is a gradual and consistent decline thereafter. The most recently married women have a higher frequency than women married between 5 and 9 years, but the difference between these two groups is not as large as for men, and the decline with increasing duration of marriage is not apparent.

Men in a polygamous marriage reported more sex with their main wife than monogamously married men. Women who were in a polygamous marriage were no different to women who were monogamously married. There are no structural reasons why coital frequency among polygamously married men should be higher than among monogamously married men. This effect may be due to confounding, perhaps by duration of marriage since the main wife for the purposes of the survey was defined as the most recently married wife for polygamously married men. The cultural requirement for polygamously married men not to favour one wife over another might lead to a higher coital frequency with the first wife, to keep pace with the coital frequency with the more recent wife. Alternatively, this cultural expectation could lead to a reporting bias amongst polygamists.

Women who had been married more than once reported a higher coital frequency than those married once only. There was no association observed for men.

The age of the partner is likely to influence coital frequency, as are other characteristics of the partner that have not been measured in these data. However no associations were apparent between the age of the spouse, relative to the respondent, and coital frequency.

Parity, and time since last birth, are both associated with coital frequency for women, but the directions of the crude associations suggest that the effects are confounded by age. The group with the highest parity (9+) and women who were not asked the time since their recent birth (mostly those aged 50+) have lower coital frequencies than the reference categories. There was no association between pregnancy at the time of the survey and coital frequency, but again these results are probably confounded by age.

A number of aspects of sexual behaviour are also associated with spousal coital frequency. Men and women who reported more partners in the year before the survey had more frequent sex with their spouses than people who had just one partner in that time. The association was not as clear for women as for men. There was no association between the number of partners in the month before the survey and coital frequency. The numbers of partners in both these time frames were based on answers to direct questions. It is therefore possible for a respondent to report a number of partners that contradicts information they provided later in the questionnaire about specific partners. A number of respondents denied having any sexual partners during the year before the survey, but then provided complete and coherent reports of recent sexual activity with their spouse. Respondents who had been sexually active in the year but not the month before the survey are not necessarily inconsistent because coital frequency data were collected for anyone who had sex in the year before the survey and who had a current partner at the time of the survey.

Men who reported a casual partner in the year before the survey reported higher coital frequencies with their spouses than respondents who did not have a casual partner during this period. There was no association between coital frequency and having a regular partner, and the association with casual partners was not observed for women.

Men and women whose first sex was at 14 years of age reported higher marital coital frequencies than those whose first sex was at 18. Men whose first sex was later than 18 reported lower coital frequencies than those who first had sex at 18. Women whose first sex coincided with marriage had lower frequencies than the baseline group- people whose

first sex happened because they wanted to have sex. The effects of the circumstances of first sex are likely to be conditional on the age at which first sex occurred and these crude results may be misleading.

Condom use and other contraceptive method use were not associated with marital coital frequency.

Coital frequency with main spouse: results obtained from adjusted negative binomial model

The results from adjusted negative binomial regression models for coital frequency with main spouse for men and women are shown in Table 42.

The preferred models for both men and women were those which included all of the covariates used in the bivariate analysis.

In the adjusted model the effects of age and duration of marriage were attenuated compared to the crude analysis for both men and women. Adjusting for other factors has removed some of the association observed between these variables and marital coital frequency. The pattern of decline with age persisted with women, but the difference became significant only after the age of 45. For men, no decline by age was observed until the last two age groups, men aged 65 and over.

The nature of the association with duration of marriage remained the same: coital frequency was higher in those recently married than in those married for 5-9 years. Men in the first three years of their marriages reported higher coital frequencies compared to the baseline whereas only women in the first year of marriage were significantly different to women married between 5 and 9 years.

After controlling for other factors, including age and duration of marriage, polygamously married men had higher coital frequencies with their main wife than monogamously married men (Incidence Rate Ratio (IRR) 1.28, 95% CI 1.01-1.61). Women in polygamous marriages were no different to women in monogamous marriages.

The number of marriages was associated with marital coital frequency for women but not for men. Women who reported more than one marriage had a higher coital frequency than those who had been married only once (IRR 1.13 95% CI 1.04-1.24).

In the adjusted models, even after controlling for age of the respondent, the age difference between the spouses showed no independent effect on coital frequency for either men or women.

The number of partners in the year before the survey remained associated with coital frequency; respondents who had had more than one partner in the last year reported higher spousal coital frequencies. The increased rates are not seen in all groups. Among men, those who reported three partners in the last year had an adjusted IRR of 1.5 (95% CI 1.2-1.9) but those with 2 or 4+ partners were not significantly different from men with only one partner. For women, those who reported two partners in the last year had an adjusted IRR of 1.4 (95% CI 1.1-1.8) compared to those with only one partner, the IRR for those with more partners were similar but the p-values were large. Since the IRR are in the same direction for the other categories, for both sexes, these are unlikely to be spurious findings. Respondents who reported no partners had very small IRR, suggesting that these respondents were having very little sex during this period, which might explain the lack of coherent answers in the questionnaire.

Partners in the month before the survey were not associated with marital coital frequency, except for the group of respondents who reported no sex during that period who, inevitably, had a lower coital frequency than respondents who reported one partner during that time.

Men who had sex with a regular partner during the year before the survey had lower coital frequencies with their spouses than men who did not report a regular partner during that period (IRR 0.76 95% CI 0.61-0.95). The effect was in the same direction for women (IRR 0.81), but that p-value was large (0.3) so the result may be mere chance. Men who had sex with a casual partner in the year before the survey reported higher coital frequencies with their spouses than men who had no such partner (IRR 1.7 95% CI 1.4-2.0). No effect was observed for women.

The effect of age at first sex noted in the crude analysis persisted after adjustment for other factors. Men and women who first had sex at 14 reported higher coital frequencies than those whose first sex was at 18. No other patterns of association were evident for age at first sex.

After adjusting for other factors, including age at first sex, women whose first sex was at marriage reported lower coital frequencies (0.83 95% CI 0.76-0.9).

There was little association between coital frequency and contraceptive use. The four women who reported using the rhythm method had lower coital frequency than women not using any contraception. Men whose spouse was using a hormonal method also reported lower coital frequencies than non-users.

The adjusted model revealed that women who were pregnant at survey reported lower coital frequencies (IRR 0.8 95% CI 0.7-0.9). Parity and time since last birth were not associated with coital frequency once other factors were controlled for.

Coital frequency with main spouse: adequacy of adjusted negative binomial model

The likelihood ratio test of the hypothesis that the negative binomial parameter α=0 yielded very small p-values for both men's and women's models, supporting the conclusion from the preliminary analysis that Poisson models were not appropriate for these data.

The dot plots and sunflower plots shown in Figure 45 show the observed coital frequency reported by Sero 5 respondents with their main spouse and that predicted by the adjusted negative binomial models.

The dot plots show that the distribution of predicted values resembles that of the reported values more closely for men than for women. The sunflower plots show that the predicted values are higher than the reported values at the frequencies below two acts per week, and that at the higher frequencies the values predicted from the regression models are too low. The adjusted negative binomial models do not therefore capture all of the heterogeneity in coital frequency with a spouse.

MEN: coital frequency by background characteristics (N 1857)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
Five year age group (sero 5) 70+ open						
15-19	8	5.13 (4.05)	4.0 (3.0-4.5)	2.333	1.15 -4.75	0.0194
20-24	94	2.30 (1.36)	2.0 (1.0-3.0)	1		
25-29	276	2.18 (1.43)	2.0 (1.0-3.0)	0.937	0.73 -1.21	0.6180
30-34	296	2.10 (1.34)	2.0 (1.0-3.0)	0.937	0.73 -1.21	0.6140
35-39	224	2.09 (1.40)	2.0 (1.0-3.0)	0.876	0.67 -1.14	0.3261
40-44	217	1.98 (1.30)	2.0 (1.0-3.0)	0.836	0.64 -1.09	0.1848
45-49	184	1.97 (1.25)	2.0 (1.0-3.0)	0.824	0.63 -1.08	0.1641
50-54	140	1.95 (1.34)	2.0 (1.0-3.0)	0.797	0.60 -1.06	0.1232
55-59	122	1.81 (1.35)	2.0 (1.0-2.0)	0.844	0.63 -1.13	0.2575
60-64	103	1.48 (1.13)	1.0 (0.9-2.0)	0.578	0.42 -0.80	0.0008
65-69	65	1.37 (1.08)	1.0 (0.2-2.0)	0.493	0.34 -0.72	0.0002
70+	128	0.83 (0.96)	0.5 (0.1-1.0)	0.212	0.15 -0.30	<0.0001
Duration of marriage, grouped						
0	70	2.70 (1.94)	3.0 (2.0-3.0)	1.438	1.09 -1.90	0.0110
1	73	2.52 (1.44)	2.0 (1.4-3.0)	1.310	0.99 -1.73	0.0568
2	103	2.25 (1.39)	2.0 (1.0-3.0)	1.166	0.91 -1.49	0.2217
3	120	2.03 (1.40)	2.0 (1.0-3.0)	1.024	0.81 -1.30	0.8427
4	108	2.10 (1.19)	2.0 (1.0-3.0)	1.080	0.85 -1.38	0.5383
5-9	372	2.01 (1.35)	2.0 (1.0-3.0)	1		
10+	935	1.71 (1.32)	2.0 (0.9-2.0)	0.847	0.74 -0.97	0.0196
Don't know/missing	76	2.17 (1.44)	2.0 (1.0-3.0)	1.073	0.81 -1.42	0.6254
Residence of spouse						
Married and cohab	1839	1.92 (1.38)	2.0 (1.0-3.0)	1		
Married not cohab	5	2.20 (1.30)	3.0 (2.0-3.0)	1.112	0.40 -3.07	0.8372
Cohab not married	13	2.86 (2.31)	2.0 (1.0-3.0)	1.543	0.85 -2.80	0.1531
In polygamous marriage in sero5						
Not polygamously married	1729	1.91 (1.36)	2.0 (1.0-3.0)	1		
In polygamous marriage	128	2.13 (1.79)	2.0 (1.0-3.0)	1.220	1.00 -1.49	0.0514
Married more than once						
Once	1015	1.97 (1.42)	2.0 (1.0-3.0)	1		
More than once	842	1.88 (1.35)	2.0 (1.0-3.0)	0.954	0.86 -1.06	0.3810
Age difference with main spouse						
Partner within 5 years	390	2.06 (1.52)	2.0 (1.0-3.0)	1		
Partner 5+ yrs younger	849	1.86 (1.25)	2.0 (1.0-3.0)	0.927	0.81 -1.06	0.2804
Partner 5+ yrs older	3	2.00 (1.73)	3.0 (0.0-3.0)	0.844	0.21 -3.32	0.8083
Partner same age (estimated)	20	1.56 (1.16)	2.0 (0.4-2.0)	0.681	0.39 -1.19	0.1754
Partner younger (estimated)	581	1.96 (1.49)	2.0 (1.0-3.0)	0.920	0.79 -1.07	0.2710
Partner older (estimated)	14	1.89 (1.11)	2.0 (1.0-3.0)	0.920	0.49 -1.71	0.7916

Table 38: Men's coital frequency with spouse. Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by selected background characteristics.

MEN: coital frequency with spouse by sexual behaviour (N 1857)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
Number of partners in last year, grouped						
0	43	0.15 (0.47)	0.0 (0.0-0.0)	0.004	0.00 -0.01	<0.0001
1	1361	1.88 (1.32)	2.0 (1.0-3.0)	1		
2	317	2.16 (1.50)	2.0 (1.0-3.0)	1.159	1.02 -1.32	0.0266
3	67	2.29 (1.49)	2.0 (1.0-3.0)	1.494	1.17 -1.91	0.0013
4+	69	2.55 (1.50)	3.0 (1.4-3.0)	1.414	1.10 -1.81	0.0065
Number of partners in last month, grouped						
0	127	0.23 (0.71)	0.1 (0.0-0.2)	0.079	0.07 -0.09	<0.0001
1	1464	2.02 (1.31)	2.0 (1.0-3.0)	1		
2	235	2.18 (1.41)	2.0 (1.0-3.0)	1.068	0.93 -1.23	0.3581
3+	31	2.61 (2.03)	2.0 (1.0-4.0)	1.242	0.88 -1.76	0.2238
Had sex with regular partner in last year						
No	1649	1.92 (1.39)	2.0 (1.0-3.0)	1		
Yes	208	2.02 (1.36)	2.0 (1.0-3.0)	1.039	0.88 -1.23	0.6546
Had sex with a high-risk partner in last year						
No	1768	1.86 (1.34)	2.0 (1.0-3.0)	1		
Yes	89	3.39 (1.55)	3.0 (2.0-5.0)	1.953	1.56 -2.45	<0.0001
Age at first sex, grouped						
10-13	46	2.07 (1.48)	2.0 (1.0-3.0)	0.964	0.68 -1.37	0.8370
14	44	2.96 (2.51)	2.0 (1.2-4.0)	1.430	1.02 -2.01	0.0394
15	199	1.88 (1.31)	2.0 (1.0-3.0)	0.859	0.70 -1.05	0.1397
16	199	2.00 (1.17)	2.0 (1.0-3.0)	0.938	0.77 -1.15	0.5310
17	228	2.15 (1.27)	2.0 (1.0-3.0)	1.087	0.90 -1.31	0.3900
18	327	2.07 (1.48)	2.0 (1.0-3.0)	1		
19+	277	1.83 (1.27)	2.0 (1.0-2.1)	0.835	0.69 -1.00	0.0551
DK	537	1.70 (1.36)	2.0 (0.5-3.0)	0.738	0.63 -0.86	0.0002
Reason for first sex						
Got married	65	1.72 (1.28)	2.0 (0.5-3.0)	0.801	0.59 -1.08	0.1441
Wanted to	1721	1.95 (1.40)	2.0 (1.0-3.0)	1		
Tricked	11	1.65 (1.02)	1.2 (1.0-3.0)	0.840	0.41 -1.71	0.6311
Can't remember	60	1.57 (1.25)	1.6 (0.2-3.0)	0.694	0.50 -0.96	0.0256
Condom use at last sex with spouse						
No	1832	1.93 (1.39)	2.0 (1.0-3.0)	1		
Yes	25	1.93 (1.66)	2.0 (0.7-3.0)	0.964	0.61 -1.53	0.8749
Current method of FP						
None	1784	1.93 (1.39)	2.0 (1.0-3.0)	1		
Hormonal	27	1.52 (1.10)	1.0 (0.9-2.0)	0.740	0.46 -1.18	0.2074
Condom	21	1.84 (1.69)	1.0 (1.0-2.0)	0.942	0.57 -1.56	0.8157
Sterilised	3	2.00 (1.00)	2.0 (1.0-3.0)	1.111	0.30 -4.12	0.8746
Abstinence	12	2.45 (1.68)	2.0 (1.5-3.5)	1.278	0.68 -2.42	0.4509
Rhythm	4	1.63 (0.75)	2.0 (1.3-2.0)	0.825	0.25 -2.67	0.7480
Traditional	6	2.03 (1.02)	2.0 (2.0-3.0)	1.068	0.42 -2.70	0.8896

Table 39: Men's coital frequency with spouse: Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by selected sexual behaviour variables.

Table 40: Women's coital frequency with spouse. Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by selected background characteristics.

WOMEN: Coital frequency with spouse by background characteristics (N 3174)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
Five year age group (sero 5) 70+ open						
15-19	174	1.85 (1.20)	2.0 (1.0-3.0)	0.927	0.76 -1.12	0.4439
20-24	610	1.96 (1.22)	2.0 (1.0-3.0)	1		
25-29	641	1.86 (1.14)	2.0 (1.0-3.0)	0.936	0.82 -1.06	0.3034
30-34	500	1.81 (1.17)	2.0 (1.0-3.0)	0.900	0.79 -1.03	0.1286
35-39	358	1.81 (1.11)	2.0 (1.0-2.0)	0.900	0.77 -1.05	0.1671
40-44	296	1.62 (1.08)	1.9 (1.0-2.0)	0.855	0.73 -1.00	0.0537
45-49	219	1.59 (1.11)	1.4 (1.0-2.0)	0.774	0.65 -0.93	0.0057
50-54	133	1.29 (1.01)	1.0 (0.5-2.0)	0.568	0.45 -0.72	<0.0001
55-59	97	1.09 (0.92)	1.0 (0.2-2.0)	0.433	0.33 -0.57	<0.0001
60-64	69	0.93 (1.02)	1.0 (0.0-1.0)	0.322	0.23 -0.45	<0.0001
65-69	39	0.91 (1.04)	1.0 (0.2-1.0)	0.321	0.20 -0.51	<0.0001
70+	38	0.63 (0.89)	0.2 (0.0-1.0)	0.103	0.06 -0.18	<0.0001
Duration of marriage, grouped						
0	80	2.32 (1.32)	2.0 (2.0-3.0)	1.342	1.03 -1.74	0.0274
1	182	1.88 (1.22)	2.0 (1.0-3.0)	1.053	0.87 -1.27	0.5913
2	204	2.01 (1.16)	2.0 (1.0-3.0)	1.158	0.97 -1.38	0.1085
3	198	1.89 (1.16)	2.0 (1.0-3.0)	1.065	0.89 -1.28	0.5010
4	188	1.85 (1.03)	2.0 (1.0-3.0)	1.039	0.86 -1.25	0.6903
5-9	773	1.79 (1.15)	2.0 (1.0-2.0)	1		
10+	1276	1.57 (1.14)	1.4 (0.9-2.0)	0.857	0.77 -0.95	0.0043
Don't know/missing	273	1.61 (1.22)	2.0 (1.0-2.0)	0.840	0.71 -0.99	0.0421
Parity grouped						
0	145	2.09 (1.36)	2.0 (1.0-3.0)	1.170	0.95 -1.45	0.1494
1	404	1.87 (1.20)	2.0 (1.0-3.0)	1.042	0.89 -1.21	0.6029
2	487	1.78 (1.08)	2.0 (1.0-2.0)	1		
3	413	1.88 (1.13)	2.0 (1.0-3.0)	1.056	0.91 -1.23	0.4868
4-8	1222	1.75 (1.18)	2.0 (1.0-2.0)	0.972	0.86 -1.10	0.6509
9+	280	1.48 (1.09)	1.0 (0.9-2.0)	0.772	0.65 -0.92	0.0043
N/A	223	1.07 (0.99)	1.0 (0.2-2.0)	0.464	0.38 -0.57	<0.0001
Time since last birth, years						
0	894	1.78 (1.12)	2.0 (1.0-2.0)	0.980	0.85 -1.13	0.7842
1	642	1.91 (1.18)	2.0 (1.0-3.0)	1.068	0.92 -1.25	0.3992
2	334	1.82 (1.16)	2.0 (1.0-3.0)	1		
3	153	1.80 (1.18)	2.0 (1.0-3.0)	1.003	0.80 -1.25	0.9805
4	100	1.90 (1.22)	2.0 (1.0-3.0)	1.062	0.82 -1.37	0.6476
5+	547	1.60 (1.09)	2.0 (0.9-2.0)	0.885	0.75 -1.04	0.1330
N/A or missing	359	1.17 (1.08)	1.0 (0.2-2.0)	0.524	0.44 -0.63	<0.0001
Nulliparous	145	2.09 (1.36)	2.0 (1.0-3.0)	1.160	0.93 -1.45	0.1939
Pregnant now sero5						
No	2800	1.74 (1.17)	2.0 (1.0-2.0)	1		
Yes	338	1.66 (1.11)	2.0 (0.7-2.0)	0.929	0.81 -1.06	0.2853
Don't know	36	1.89 (1.33)	2.0 (0.9-3.0)	1.090	0.74 -1.60	0.6616
Residence of spouse						
Married and cohab	3140	1.73 (1.17)	2.0 (1.0-2.0)	1		
Married not cohab	6	1.67 (1.03)	2.0 (1.0-2.0)	0.940	0.35 -2.53	0.9018
Cohab not married	28	1.77 (1.17)	2.0 (1.0-2.5)	1.006	0.64 -1.58	0.9800

Table 32: Women's coital frequency with spouse. Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by selected background characteristics.

WOMEN: Coital frequency with spouse by background characteristics (N 3174)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
In polygamous marriage in sero5						
Not polygamously married	2626	1.73 (1.17)	2.0 (1.0-2.0)	1		
In polygamous marriage	548	1.72 (1.16)	2.0 (1.0-2.0)	0.976	0.87 -1.09	0.6610
Married more than once						
Once	2150	1.68 (1.16)	2.0 (1.0-2.0)	1		
More than once	1024	1.85 (1.18)	2.0 (1.0-3.0)	1.148	1.05 -1.25	0.0022
Age difference with main spouse						
Partner within 5 years	706	1.78 (1.19)	2.0 (1.0-2.0)	1		
Partner 5+ yrs younger	11	2.20 (1.37)	2.0 (1.0-3.0)	1.311	0.66 -2.59	0.4374
Partner 5+ yrs older	1024	1.73 (1.14)	2.0 (1.0-2.0)	0.986	0.88 -1.10	0.8028
Partner same age (estimated)	133	1.53 (1.10)	2.0 (0.7-2.0)	0.816	0.65 -1.02	0.0802
Partner younger (estimated)	22	1.81 (1.17)	2.0 (1.0-3.0)	1.016	0.61 -1.69	0.9504
Partner older (estimated)	1278	1.72 (1.18)	2.0 (1.0-2.0)	0.948	0.85 -1.06	0.3409

WOMEN: coital frequency with spouse by sexual behaviour (N 3174)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
Number of partners in last year, grouped						
0	101	0.32 (0.87)	0.0 (0.0-0.0)	0.009	0.01 -0.01	<0.0001
1	2905	1.75 (1.14)	2.0 (1.0-2.0)	1		
2	130	2.27 (1.19)	2.0 (1.0-3.0)	1.377	1.15 -1.65	0.0006
3	26	2.20 (1.44)	2.0 (1.4-3.0)	1.296	0.86 -1.95	0.2120
4+	12	2.25 (1.36)	2.5 (1.5-3.0)	1.268	0.69 -2.33	0.4437
Number of partners in last month, grouped						
0	276	0.54 (0.94)	0.1 (0.0-0.7)	0.206	0.18 -0.24	<0.0001
1	2825	1.84 (1.13)	2.0 (1.0-2.0)	1		
2	69	1.84 (0.97)	2.0 (1.0-2.0)	1.014	0.78 -1.32	0.9136
3+	4	2.67 (1.40)	3.0 (1.8-3.5)	1.457	0.53 -4.02	0.4673
Had sex with regular partner in last year						
No	3093	1.73 (1.17)	2.0 (1.0-2.0)	1		
Yes	81	1.86 (1.04)	2.0 (1.0-2.0)	1.118	0.87 -1.44	0.3935
Had sex with a high-risk partner in last year						
No	2853	1.73 (1.16)	2.0 (1.0-2.0)	1		
Yes	321	1.71 (1.23)	1.9 (0.9-2.0)	0.984	0.86 -1.13	0.8202
Age at first sex, grouped						
10-13	92	1.99 (1.02)	2.0 (1.0-3.0)	1.234	0.96 -1.59	0.1072
14	131	2.07 (1.25)	2.0 (1.0-3.0)	1.408	1.14 -1.74	0.0016
15	450	1.80 (1.19)	2.0 (1.0-3.0)	1.053	0.91 -1.22	0.4877
16	486	1.85 (1.17)	2.0 (1.0-2.0)	1.097	0.95 -1.26	0.1968
17	389	1.79 (1.23)	2.0 (1.0-3.0)	1.049	0.90 -1.22	0.5329
18	599	1.72 (1.10)	2.0 (1.0-2.0)	1		
19+	495	1.65 (1.08)	2.0 (1.0-2.0)	0.960	0.83 -1.11	0.5677
DK	532	1.48 (1.21)	1.0 (0.5-2.0)	0.786	0.68 -0.91	0.0009
Reason for first sex						
Got married	1109	1.46 (1.11)	1.0 (0.6-2.0)	0.706	0.64 -0.77	<0.0001
Wanted to	1743	1.88 (1.16)	2.0 (1.0-3.0)	1		
Tricked	130	2.00 (1.15)	2.0 (1.0-3.0)	1.077	0.88 -1.32	0.4771
Needed money	47	2.09 (1.29)	2.0 (1.0-2.0)	1.167	0.84 -1.63	0.3625
Forced	28	1.71 (1.11)	2.0 (0.8-3.0)	0.877	0.57 -1.36	0.5588
Can't remember	117	1.60 (1.29)	2.0 (0.5-2.0)	0.765	0.61 -0.96	0.0219
Condom use at last sex with spouse						
No	3129	1.73 (1.16)	2.0 (1.0-2.0)	1		
Yes	45	1.88 (1.48)	2.0 (1.0-2.0)	1.103	0.78 -1.56	0.5781
Current method of FP						
None	2960	1.73 (1.17)	2.0 (1.0-2.0)	1		
Hormonal	177	1.73 (1.11)	2.0 (1.0-2.0)	1.001	0.84 -1.20	0.9909
Condom	15	1.38 (0.94)	1.0 (0.5-2.0)	0.809	0.44 -1.49	0.4962
Sterilised	8	1.88 (0.64)	2.0 (1.5-2.0)	1.186	0.52 -2.69	0.6827
Abstinence	1	1.00 (.)	1.0 (1.0-1.0)	0.633	0.04 -9.14	0.7367
Rhythm	4	0.55 (0.33)	0.5 (0.4-0.8)	0.296	0.08 -1.04	0.0583
Traditional	9	2.04 (1.01)	2.0 (2.0-3.0)	1.252	0.61 -2.59	0.5447

Table 41: Women's coital frequency with spouse: Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by selected sexual behaviour variables.

Table 42: Adjusted rate ratios from Poisson regression models for coital frequency with main spouse, by sex. Parsimonious model, all covariates shown.

Adjusted results from negative binomial models: coital frequency with SPOUSE	MEN			WOMEN		
	adj. IRR	95% CI	p-value	adj. IRR	95% CI	p-value
Five year age group (sero 5) 70+ open						
15-19	1.44	0.78-2.66	0.2398	0.82	0.68-1.00	0.0482
20-24	1			1		
25-29	1.03	0.82-1.29	0.7915	0.94	0.83-1.07	0.3739
30-34	1.09	0.86-1.38	0.4702	0.90	0.77-1.06	0.2050
35-39	1.16	0.90-1.50	0.2620	0.90	0.75-1.08	0.2430
40-44	1.01	0.77-1.33	0.9350	0.94	0.76-1.15	0.5349
45-49	1.01	0.77-1.34	0.9341	0.78	0.61-0.99	0.0403
50-54	0.95	0.71-1.27	0.7321	0.69	0.50-0.96	0.0266
55-59	0.96	0.71-1.30	0.8013	0.54	0.38-0.79	0.0012
60-64	0.79	0.57-1.08	0.1427	0.57	0.38-0.85	0.0053
65-69	0.70	0.48-1.00	0.0483	0.40	0.25-0.65	0.0002
70+	0.40	0.29-0.56	<0.0001	0.26	0.15-0.46	<0.0001
Duration of marriage, grouped						
0	1.56	1.21-2.00	0.0006	1.37	1.07-1.76	0.0112
1	1.28	1.01-1.63	0.0380	1.05	0.87-1.25	0.6305
2	1.30	1.05-1.60	0.0145	1.10	0.93-1.30	0.2580
3	0.94	0.77-1.15	0.5350	1.09	0.92-1.29	0.3077
4	1.03	0.84-1.27	0.7758	1.05	0.88-1.24	0.6004
5-9	1			1		
10+	0.95	0.83-1.09	0.4858	1.04	0.92-1.17	0.5187
Don't know/missing	1.37	1.05-1.78	0.0189	1.50	1.26-1.80	<0.0001
In polygamous marriage in sero5						
Not polygamously married	1			1		
In polygamous marriage	1.28	1.01-1.61	0.0428	0.98	0.89-1.08	0.6624
Married more than once						
Once	1			1		
More than once	0.93	0.84-1.04	0.1966	1.13	1.04-1.24	0.0052
Age difference with main spouse						
Partner within 5 years	1			1		
Partner 5+ yrs younger	1.01	0.90-1.14	0.8434	1.36	0.72-2.56	0.3410
Partner 5+ yrs older	1.51	0.47-4.79	0.4874	0.98	0.89-1.09	0.7238
Partner same age (estimated)	1.38	0.89-2.15	0.1483	0.84	0.69-1.04	0.1065
Partner younger (estimated)	1.07	0.93-1.22	0.3452	0.93	0.59-1.46	0.7462
Partner older (estimated)	0.90	0.52-1.55	0.6996	0.99	0.90-1.10	0.8831
Number of partners in last year, grouped						
0	0.03	0.02-0.07	<0.0001	0.04	0.03-0.06	<0.0001
1	1			1		
2	1.10	0.93-1.30	0.2669	1.39	1.11-1.75	0.0042
3	1.50	1.18-1.90	0.0009	1.38	0.91-2.09	0.1310
4+	1.17	0.89-1.54	0.2482	1.29	0.67-2.52	0.4474
Number of partners in last month, grouped						
0	0.11	0.09-0.13	<0.0001	0.30	0.26-0.34	<0.0001
1	1			1		
2	0.99	0.79-1.24	0.9222	0.88	0.54-1.45	0.6165
3+	1.05	0.70-1.59	0.8021	1.20	0.44-3.26	0.7268
Had sex with regular partner in last year						
No	1			1		
Yes	0.76	0.61-0.95	0.0163	0.81	0.51-1.28	0.3666
Had sex with a high-risk partner in last year						
No	1			1		
Yes	1.68	1.38-2.03	<0.0001	0.93	0.82-1.05	0.2402

Continued on next page

Table 34: Adjusted rate ratios from Poisson regression models for coital frequency with main spouse, by sex. Parsimonious model, all covariates shown. (continued)

Adjusted results from negative binomial models: coital frequency with SPOUSE	MEN			WOMEN		
	adj. IRR	95% CI	p-value	adj. IRR	95% CI	p-value
Age at first sex, grouped						
10-13	0.86	0.64-1.16	0.3189	1.13	0.89-1.42	0.3167
14	1.41	1.06-1.88	0.0176	1.53	1.27-1.84	<0.0001
15	0.86	0.73-1.02	0.0806	1.01	0.89-1.15	0.8426
16	0.87	0.74-1.03	0.1154	1.02	0.90-1.16	0.7509
17	1.06	0.91-1.25	0.4451	1.02	0.90-1.17	0.7212
18	1			1		
19+	0.85	0.73-0.99	0.0384	1.02	0.90-1.15	0.8135
DK	0.88	0.77-1.01	0.0794	0.93	0.81-1.07	0.3117
Reason for first sex						
Got married	1.03	0.80-1.34	0.8083	0.83	0.76-0.90	<0.0001
Wanted to	1			1		
Tricked	0.72	0.40-1.28	0.2609	1.01	0.85-1.22	0.8753
Needed money		-		1.05	0.78-1.41	0.7623
Forced		-		0.81	0.54-1.19	0.2809
Can't remember	0.89	0.69-1.16	0.4015	0.89	0.72-1.10	0.2932
Condom use at last sex with (most recent) spouse						
No	1			1		
Yes	0.93	0.63-1.38	0.7238	1.02	0.72-1.44	0.9284
Current method of FP						
None	1			1		
Hormonal	0.67	0.45-0.99	0.0471	0.91	0.77-1.07	0.2357
Condom	0.98	0.64-1.50	0.9325	0.74	0.40-1.39	0.3545
Sterilised	1.14	0.38-3.43	0.8150	1.20	0.58-2.50	0.6230
Abstinence	1.15	0.69-1.93	0.5903	0.49	0.04-5.62	0.5662
Rhythm	0.81	0.30-2.18	0.6796	0.31	0.10-0.97	0.0436
Traditional	0.93	0.43-2.05	0.8643	1.00	0.53-1.87	0.9980
Parity grouped						
0				1.16	0.92-1.47	0.2043
1				1.02	0.88-1.17	0.8268
2				1		
3				1.07	0.94-1.24	0.3084
4-8				1.06	0.92-1.21	0.4181
9+				0.95	0.78-1.17	0.6304
N/A				1.10	0.81-1.50	0.5388
Time since last birth, years						
0				0.98	0.85-1.12	0.7554
1				1.03	0.89-1.18	0.7226
2				1		
3				0.98	0.80-1.19	0.8348
4				1.12	0.89-1.41	0.3310
5+				0.97	0.82-1.13	0.6785
N/A or missing				0.93	0.72-1.19	0.5634
Pregnant now sero5						
No				1		
Yes				0.80	0.70-0.91	0.0006
Don't know				0.82	0.58-1.16	0.2629

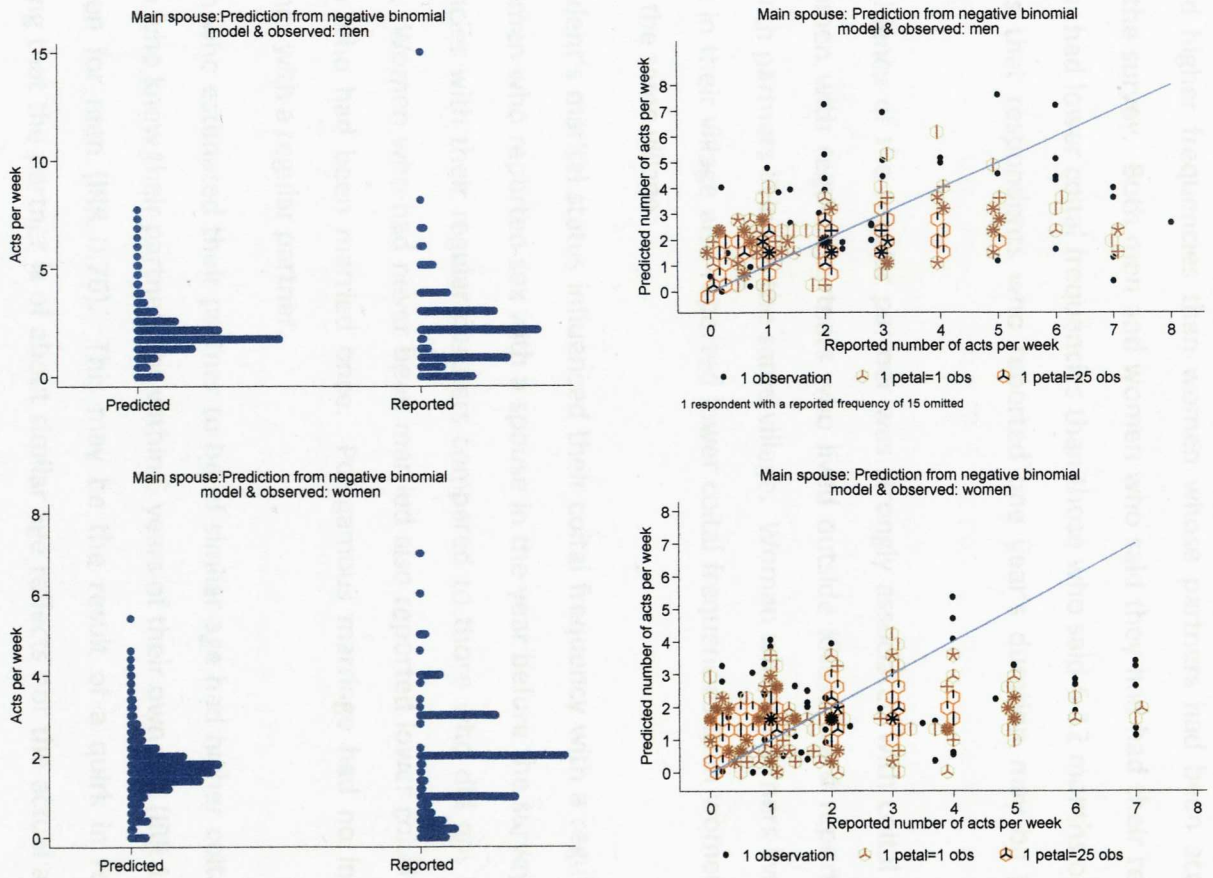


Figure 45: Reported weekly coital frequencies with main spouse and those predicted by negative binomial regression models for men and women.

Coital frequency with regular partners: results from crude negative binomial models

Results from crude negative binomial regression of covariates on reported coital frequencies with regular partners are shown, for men, in Table 43 (by background characteristics) and Table 44 (by sexual behaviour) and for women in Table 45 (by background characteristics) and Table 46 (by sexual behaviour).

Background characteristics

Age was not associated with coital frequency with a regular partner.

Duration of the relationship was associated with coital frequency but there was not a clear pattern. Women whose partner was acquired one or two months before the survey reported higher frequencies than women whose partners had been acquired two years before the survey. Both men and women who said they had had their regular partner for one year had lower coital frequencies than those who said 6-12 months or two years. This suggests that respondents who reported one year's duration may be peculiar in some respect.

The residence of the regular partner was strongly associated with coital frequency. Men and women with regular partners who lived outside Kisesa ward reported less sex than those with partners living in the same village. Women whose partners lived in Kisesa ward but not in their village also reported lower coital frequencies than women whose partners lived in the same village.

Respondent's marital status influenced their coital frequency with a regular partner. Men and women who reported sex with a spouse in the year before the survey had lower coital frequencies with their regular partners compared to those who did not report sex with a spouse. Women who had never been married also reported lower coital frequencies than women who had been married once. Polygamous marriage had no influence on coital frequency with a regular partner.

Women who estimated their partner to be of similar age had higher coital frequency than women who knew their partner was within 5 years of their own age (IRR 1.4). The opposite was seen for men (IRR 0.76). This may be the result of a quirk in reporting: perhaps reporting that the partner is of about similar age reflects not the actual age difference but something else about the nature of the relationship with that partner.

Nulliparous women reported lower coital frequencies with their regular partners than women who had begun childbearing. Time since last birth and pregnancy status were not associated with coital frequency.

Sexual behaviour

For both men and women, reporting more partners was associated with higher coital frequencies with the regular partner. This was observed both for the total number of partners in the last year and for partners in the month before the survey. Once controlled for the number of partners, reporting sex with a casual partner in the year before the survey was not associated with coital frequency with regular partners.

Age at first sex was not associated with coital frequency for women but men whose first sex took place after the age of 18 reported lower frequencies with their regular partners than men whose first sex was at 18. The reason for first sex was not associated with coital frequency for men or women.

Men and women who reported using a condom at last sex with their regular partner reported lower coital frequencies than those who did not use a condom at most recent sex. This effect was also apparent for women who reported using condoms for contraception and who had lower frequencies than women who were not using any method of contraception. For men, there was no association between contraceptive use and coital frequency with a regular partner.

Coital frequency with regular partners: results from adjusted negative binomial models

Adjusted IRR, 95% confidence intervals and p-values from negative binomial models are shown in Table 47 for men and in Table 48 for women.

Residence of the regular partner remained important once adjusted for other factors. People with regular partners that lived in the same village had more frequent sex than those whose partners lived further away. Compared to those with partners in the same village, there was a gradual decline in frequency for people whose partners lived in: Kisesa ward, another part of Magu district, Mwanza City.

Numbers of partners in the year and in the month before the survey remained associated with coital frequency for both sexes. Those with more partners reported more frequent sex with their (most recent) regular partner.

This effect was not confounded by age. In the crude analysis, age was not associated with coital frequency and models for both sexes fitted better (had a smaller AIC) once age was removed. In the men's model identifying never married men was more important than adjusting for age group. Never married men had a lower coital frequency. In the women's model, nulliparous women had a lower coital frequency than parous women, and this was a better fit to the data than age group. It may be that life stage rather than chronological age is a more important determinant of coital frequency with a regular partner.

After adjusting for other factors the association between reported age difference and coital frequency was the same for both sexes. People who estimated their regular partner to be of a similar age had lower coital frequencies than people who knew their partner's age to be within 5 years of their own age. The direction of this effect has reversed for women after controlling for all the other factors.

The association between duration of the relationship with regular partners and coital frequency that was observed for men in the crude analysis persisted in the adjusted model. Men who said they had been with their regular partner for one year had lower coital frequency than men who gave durations either side of this.

Women who were pregnant at the time of the survey reported lower coital frequencies than women who were not pregnant. This effect was not apparent in the crude analysis.

Sex with a spouse in the year before the survey remained negatively associated with coital frequency in both the men's and the women's models. Sex was a casual partner was included in the men's model but showed no association with coital frequency with a regular partner.

Condom use at last sex was negatively associated with coital frequency for both men and women. Men who reported using condoms for contraception actually reported higher coital frequencies than men who were not using any methods with their regular partner. However this effect could have been seen by chance because the confidence interval includes 1.

The lower coital frequency observed for men whose first sex was at age 19 or above, compared to men whose first sex was at 18, persisted once controlled for other factors. Reason for first sex was included in the model but was not associated with coital frequency.

Coital frequency with regular partners: adequacy of adjusted negative binomial models

The likelihood ratio test of the hypothesis that the negative binomial parameter α=0 yielded very small p-values for both men's and women's models, supporting the conclusion from the preliminary analysis that Poisson models were not appropriate for these data.

The dot plots and sunflower plots shown in Figure 46 show the observed coital frequency reported by Sero 5 respondents with their regular partners and that predicted by the adjusted negative binomial models.

The dot plots show that the distribution of predicted values resembles that of the reported values at the lower frequencies. However neither model has captured the tail of the distribution. The sunflower plots reflect this, there is a fairly close correspondence between the reported and predicted values the lower frequencies but the predicted values are too low for respondents who reported more than 1.5 acts per week with their regular partner.

MEN: coital frequency with regular partner by background characteristics (N 1065)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
Five year age group (sero 5) 70+ open						
15-19	373	1.20 (0.97)	1.0 (0.5-2.0)	0.935	0.78 -1.12	0.4764
20-24	308	1.30 (1.21)	1.0 (0.5-2.0)	1		
25-29	136	1.41 (1.16)	1.0 (0.5-2.0)	1.121	0.88 -1.43	0.3545
30-34	93	1.31 (1.09)	1.0 (0.5-2.0)	1.024	0.77 -1.35	0.8697
35-39	54	1.19 (0.83)	1.0 (0.7-2.0)	0.946	0.67 -1.34	0.7561
40-44	39	1.09 (1.22)	1.0 (0.2-1.0)	0.842	0.57 -1.25	0.3919
45-49	26	1.24 (1.37)	0.8 (0.5-2.0)	0.904	0.56 -1.46	0.6770
50-54	11	1.37 (0.98)	2.0 (0.3-2.0)	0.967	0.46 -2.04	0.9293
55-59	12	1.21 (0.87)	1.5 (0.2-2.0)	0.874	0.43 -1.79	0.7127
60-64	2	0.60 (0.57)	0.6 (0.2-1.0)	0.435	0.06 -3.05	0.4024
65-69	4	1.55 (1.22)	1.5 (0.6-2.5)	1.301	0.41 -4.16	0.6573
70+	7	1.13 (1.05)	1.0 (0.2-2.0)	0.817	0.32 -2.10	0.6750
Duration regular partnership in years, grouped						
1/12	76	1.33 (1.01)	1.0 (1.0-2.0)	1.012	0.74 -1.39	0.9412
2/12	124	1.20 (0.90)	1.0 (0.5-2.0)	0.874	0.66 -1.15	0.3374
3/12	106	1.18 (0.88)	1.0 (0.5-2.0)	0.846	0.64 -1.13	0.2519
4/12	79	1.41 (0.97)	1.0 (1.0-2.0)	1.071	0.78 -1.46	0.6668
5/12	32	1.08 (0.94)	1.0 (0.2-1.5)	0.706	0.44 -1.12	0.1414
6/12	106	1.35 (0.79)	1.0 (0.9-2.0)	0.998	0.75 -1.33	0.9899
6-12/12	97	1.34 (1.48)	1.0 (0.5-2.0)	0.875	0.65 -1.17	0.3722
1	163	1.09 (1.25)	0.5 (0.2-2.0)	0.652	0.50 -0.84	0.0011
2	178	1.42 (1.04)	1.0 (0.5-2.0)	1		
3	66	1.08 (0.97)	1.0 (0.2-2.0)	0.660	0.47 -0.94	0.0194
4-30	38	1.34 (1.71)	1.0 (0.2-2.0)	0.820	0.54 -1.25	0.3569
Residence of regular partner						
Same village	774	1.35 (1.10)	1.0 (0.5-2.0)	1		
Other part of Kisesa ward	152	1.19 (1.05)	1.0 (0.5-2.0)	0.843	0.69 -1.04	0.1044
Another part of Magu district	58	0.77 (0.78)	0.5 (0.2-1.0)	0.511	0.37 -0.71	0.0001
Mwanza City	38	1.01 (1.05)	0.8 (0.1-2.0)	0.567	0.37 -0.86	0.0078
Another part of Mwanza region	36	0.88 (1.23)	0.6 (0.2-1.0)	0.548	0.37 -0.82	0.0035
Elsewhere	7	0.43 (0.42)	0.2 (0.1-1.0)	0.190	0.06 -0.57	0.0030
In polygamous marriage in sero5						
Not polygamously married	1057	1.27 (1.09)	1.0 (0.5-2.0)	1		
In polygamous marriage	8	0.80 (0.65)	1.0 (0.2-1.0)	0.502	0.18 -1.37	0.1778
Married more than once						
Never	761	1.27 (1.09)	1.0 (0.5-2.0)	0.974	0.80 -1.19	0.7945
Once	170	1.27 (1.01)	1.0 (0.5-2.0)	1		
More than once	134	1.24 (1.23)	1.0 (0.5-2.0)	0.930	0.71 -1.22	0.6016
Age difference with regular partner						
Partner within 5 years	444	1.31 (1.07)	1.0 (0.5-2.0)	1		
Partner 5+ yrs younger	220	1.29 (1.08)	1.0 (0.5-2.0)	0.969	0.80 -1.18	0.7485
Partner 5+ yrs older	2	0.60 (0.57)	0.6 (0.2-1.0)	0.418	0.06 -2.92	0.3790
Partner same age (estimated)	82	1.06 (0.89)	0.9 (0.5-2.0)	0.758	0.57 -1.01	0.0575
Partner younger (estimated)	298	1.25 (1.18)	1.0 (0.2-2.0)	0.907	0.76 -1.08	0.2850
Partner older (estimated)	19	1.07 (0.99)	1.0 (0.2-2.0)	0.698	0.38 -1.28	0.2481

Table 43: Men's coital frequency with regular partner. Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by selected background characteristics.

MEN: coital frequency with regular partner by sexual behaviour (N 1065)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
Number of partners in last year, grouped						
0	22	0.85 (1.20)	0.6 (0.0-1.0)	0.440	0.23 -0.84	0.0126
1	610	1.23 (0.96)	1.0 (0.5-2.0)	1		
2	255	1.19 (1.14)	1.0 (0.5-2.0)	0.965	0.81 -1.15	0.6909
3	96	1.48 (1.25)	1.0 (0.7-2.0)	1.253	0.98 -1.61	0.0777
4+	82	1.61 (1.46)	1.0 (0.7-2.0)	1.382	1.06 -1.80	0.0174
Number of partners in last month, grouped						
0	65	0.15 (0.41)	0.0 (0.0-0.1)	0.093	0.07 -0.12	<0.0001
1	761	1.29 (1.04)	1.0 (0.5-2.0)	1		
2	188	1.35 (1.11)	1.0 (0.7-2.0)	1.077	0.91 -1.28	0.4027
3+	51	1.92 (1.48)	2.0 (1.0-3.0)	1.621	1.21 -2.17	0.0012
Had sex with (main) spouse in last year						
No	857	1.30 (1.10)	1.0 (0.5-2.0)	1		
Yes	208	1.12 (1.06)	1.0 (0.5-1.2)	0.830	0.69 -1.00	0.0475
Had sex with a high-risk partner in last year						
No	982	1.26 (1.07)	1.0 (0.5-2.0)	1		
Yes	83	1.32 (1.30)	1.0 (0.5-2.0)	1.028	0.79 -1.34	0.8388
Age at first sex, grouped						
10-13	66	1.51 (1.75)	1.0 (0.5-2.0)	1.219	0.86 -1.73	0.2646
14	81	1.15 (1.01)	1.0 (0.5-2.0)	0.885	0.63 -1.23	0.4708
15	237	1.26 (1.06)	1.0 (0.5-2.0)	1.041	0.81 -1.34	0.7607
16	207	1.41 (0.93)	1.0 (0.7-2.0)	1.184	0.91 -1.54	0.2039
17	123	1.36 (0.99)	1.0 (0.5-2.0)	1.128	0.84 -1.51	0.4214
18	134	1.25 (1.05)	1.0 (0.5-2.0)	1		
19+	103	1.02 (1.20)	0.7 (0.2-1.0)	0.683	0.50 -0.94	0.0187
DK	114	1.08 (0.98)	1.0 (0.2-2.0)	0.786	0.58 -1.07	0.1288
Reason for first sex						
Got married	4	0.73 (0.86)	0.4 (0.2-1.3)	0.507	0.15 -1.72	0.2758
Wanted to	1046	1.27 (1.09)	1.0 (0.5-2.0)	1		
Tricked	9	1.56 (1.42)	1.0 (1.0-2.0)	1.354	0.62 -2.97	0.4499
Needed money	0					
Forced	0					
Can't remember	6	0.60 (0.77)	0.2 (0.2-1.0)	0.316	0.10 -1.03	0.0559
Condom use at last sex with (most recent) regular						
No	869	1.32 (1.10)	1.0 (0.5-2.0)	1		
Yes	196	1.01 (1.03)	1.0 (0.2-1.0)	0.682	0.56 -0.83	0.0001
Current method of FP						
None	1034	1.26 (1.09)	1.0 (0.5-2.0)	1		
Hormonal	5	0.78 (0.41)	1.0 (0.5-1.0)	0.687	0.25 -1.93	0.4749
Condom	25	1.34 (1.42)	1.0 (0.5-1.0)	1.077	0.68 -1.71	0.7548
Traditional	1			0.961	0.07 -12.72	0.9759

Table 44: Men's coital frequency with regular partner. Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by sexual behaviour.

Table 45: Women's coital frequency with regular partner. Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by selected background characteristics.

WOMEN: coital frequency with regular partner by background characteristics (N 661)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
Five year age group (sero 5) 70+ open						
15-19	212	0.96 (0.90)	0.8 (0.2-1.0)	0.991	0.75 -1.31	0.9476
20-24	135	0.96 (0.91)	0.9 (0.2-1.9)	1		
25-29	102	1.07 (0.90)	1.0 (0.5-2.0)	1.177	0.85 -1.63	0.3260
30-34	72	1.22 (1.09)	1.0 (0.5-2.0)	1.386	0.96 -1.99	0.0780
35-39	47	0.98 (0.74)	0.9 (0.4-2.0)	1.084	0.71 -1.65	0.7065
40-44	40	0.98 (0.75)	1.0 (0.4-1.6)	1.061	0.67 -1.67	0.7976
45-49	24	1.13 (0.85)	0.9 (0.5-2.0)	1.261	0.74 -2.16	0.3994
50-54	18	0.83 (0.53)	0.8 (0.5-1.0)	0.961	0.52 -1.79	0.8999
55-59	5	0.72 (0.33)	0.7 (0.7-1.0)	0.914	0.30 -2.76	0.8731
60-64	3	1.07 (0.90)	1.0 (0.2-2.0)	1.253	0.28 -5.62	0.7687
65-69	0	. (.)	. (.- .)	1		
70+	3	0.73 (0.25)	0.7 (0.5-1.0)	0.926	0.23 -3.67	0.9124
Duration regular partnership in years, grouped						
1/12	41	1.45 (1.03)	1.0 (1.0-2.0)	1.749	1.15 -2.65	0.0086
2/12	42	1.36 (1.20)	1.0 (0.5-2.0)	1.511	1.00 -2.28	0.0490
3/12	39	1.08 (0.73)	1.0 (0.5-2.0)	1.244	0.80 -1.94	0.3342
4/12	32	1.27 (0.91)	1.0 (0.5-2.0)	1.410	0.88 -2.27	0.1561
5/12	13	0.75 (0.67)	0.5 (0.2-1.0)	0.741	0.35 -1.56	0.4308
6/12	27	1.06 (0.95)	0.9 (0.5-1.0)	1.185	0.73 -1.93	0.4967
6-12/12	91	1.13 (0.91)	1.0 (0.5-2.0)	1.217	0.89 -1.67	0.2264
1	111	0.77 (0.87)	0.5 (0.2-1.0)	0.708	0.52 -0.97	0.0293
2	154	0.97 (0.80)	0.9 (0.2-1.2)	1		
3	55	0.92 (0.86)	0.9 (0.2-1.6)	0.904	0.61 -1.33	0.6107
4-30	56	0.71 (0.68)	0.5 (0.1-1.0)	0.591	0.40 -0.88	0.0096
Parity grouped						
0	256	0.83 (0.78)	0.5 (0.2-1.0)	0.557	0.40 -0.78	0.0006
1	118	1.14 (1.04)	1.0 (0.2-2.0)	0.824	0.57 -1.19	0.3022
2	66	1.25 (1.14)	1.0 (0.5-2.0)	1		
3	48	1.09 (0.87)	1.0 (0.3-2.0)	0.839	0.53 -1.32	0.4492
4-8	125	1.09 (0.84)	1.0 (0.5-2.0)	0.809	0.56 -1.16	0.2537
9+	27	1.16 (0.85)	1.0 (0.5-2.0)	0.902	0.52 -1.56	0.7146
N/A	21	0.78 (0.40)	0.7 (0.5-1.0)	0.636	0.35 -1.15	0.1366
Time since last birth, years						
0	89	1.08 (0.93)	0.9 (0.2-2.0)	0.816	0.54 -1.24	0.3442
1	78	1.19 (0.89)	1.0 (0.5-2.0)	1.005	0.66 -1.54	0.9818
2	54	1.24 (1.05)	1.0 (0.5-2.0)	1		
3	46	0.99 (0.89)	0.7 (0.2-1.0)	0.779	0.48 -1.27	0.3147
4	12	1.29 (1.09)	1.0 (0.6-2.0)	1.114	0.51 -2.45	0.7889
5+	95	1.12 (1.04)	1.0 (0.4-2.0)	0.915	0.60 -1.39	0.6759
N/A or missing	31	0.95 (0.59)	0.9 (0.5-1.0)	0.788	0.46 -1.37	0.3962
Nulliparous	256	0.83 (0.78)	0.5 (0.2-1.0)	0.594	0.41 -0.86	0.0057

Continued on next page

Table 37: Women's coital frequency with regular partner. Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by selected background characteristics.

WOMEN: coital frequency with regular partner by background characteristics (N 661)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
Pregnant now sero5						
No	621	1.02 (0.89)	1.0 (0.2-2.0)	1		
Yes	36	0.88 (0.95)	0.5 (0.4-1.0)	0.868	0.57 -1.32	0.5110
Don't know	4	0.60 (0.46)	0.6 (0.2-1.0)	0.511	0.12 -2.09	0.3493
Residence of regular partner						
Same village	367	1.15 (0.87)	1.0 (0.5-2.0)	1		
Other part of Kisesa ward	126	0.97 (0.99)	0.8 (0.2-1.2)	0.760	0.59 -0.98	0.0320
Another part of Magu district	47	0.86 (1.02)	0.5 (0.2-1.0)	0.582	0.39 -0.86	0.0066
Mwanza City	62	0.74 (0.68)	0.6 (0.2-1.0)	0.543	0.38 -0.77	0.0005
Another part of Mwanza region	44	0.64 (0.74)	0.3 (0.2-0.9)	0.417	0.28 -0.62	<0.0001
Elsewhere	15	0.47 (0.67)	0.2 (0.1-0.6)	0.258	0.14 -0.48	<0.0001
In polygamous marriage in sero5						
Not polygamously married	643	1.00 (0.89)	0.9 (0.2-1.4)	1		
In polygamous marriage	18	1.20 (0.85)	1.0 (0.5-2.0)	1.279	0.71 -2.29	0.4085
Married more than once						
Never	342	0.89 (0.84)	0.7 (0.2-1.0)	0.704	0.57 -0.88	0.0017
Once	204	1.12 (0.90)	1.0 (0.5-2.0)	1		
More than once	115	1.14 (0.98)	1.0 (0.5-2.0)	0.998	0.75 -1.33	0.9913
Age difference with regular partner						
Partner within 5 years	192	0.98 (0.93)	1.0 (0.2-1.5)	1		
Partner 5+ yrs younger	5	0.68 (0.83)	0.2 (0.2-1.0)	0.522	0.14 -2.00	0.3437
Partner 5+ yrs older	113	0.85 (0.79)	0.7 (0.2-1.0)	0.837	0.62 -1.13	0.2478
Partner same age (estimated)	104	1.20 (0.83)	1.0 (0.5-2.0)	1.442	1.07 -1.94	0.0160
Partner younger (estimated)	22	0.83 (0.91)	0.2 (0.2-2.0)	0.683	0.37 -1.27	0.2295
Partner older (estimated)	225	1.05 (0.93)	0.9 (0.2-2.0)	1.141	0.89 -1.46	0.2937

WOMEN: coital frequency with regular partner by sexual behaviour (N 661)	N	Mean (sd)	Median (IQR)	Crude IRR	95% CI	p-value
Number of partners in last year, grouped						
0	28	0.62 (0.89)	0.1 (0.0-1.0)	0.280	0.15 -0.52	<0.0001
1	431	0.88 (0.82)	0.7 (0.2-1.0)	1		
2	157	1.33 (0.95)	1.0 (0.7-2.0)	1.803	1.45 -2.24	<0.0001
3	36	1.32 (1.00)	1.0 (0.7-2.0)	1.796	1.20 -2.69	0.0043
4+	9	1.60 (0.79)	2.0 (1.0-2.0)	2.383	1.13 -5.03	0.0228
Number of partners in last month, grouped						
0	79	0.15 (0.33)	0.1 (0.0-0.1)	0.139	0.11 -0.17	<0.0001
1	479	1.05 (0.88)	1.0 (0.5-1.4)	1		
2	100	1.47 (0.82)	1.0 (0.9-2.0)	1.631	1.31 -2.03	<0.0001
3+	3	0.87 (0.15)	0.9 (0.7-1.0)	1.074	0.36 -3.16	0.8969
Had sex with (main) spouse in last year						
No	580	0.99 (0.91)	0.9 (0.2-1.2)	1		
Yes	81	1.14 (0.75)	1.0 (0.5-2.0)	1.293	0.97 -1.73	0.0817
Had sex with a high-risk partner in last year						
No	521	1.00 (0.89)	1.0 (0.2-1.9)	1		
Yes	140	1.04 (0.90)	0.9 (0.5-1.0)	1.065	0.84 -1.35	0.6028
Age at first sex, grouped						
10-13	33	1.38 (1.13)	1.0 (0.5-2.0)	1.459	0.90 -2.36	0.1244
14	69	1.18 (0.91)	1.0 (0.5-2.0)	1.251	0.85 -1.83	0.2496
15	120	1.11 (0.99)	1.0 (0.2-2.0)	1.108	0.79 -1.55	0.5511
16	105	0.92 (0.72)	1.0 (0.2-1.0)	0.914	0.64 -1.30	0.6157
17	75	0.84 (0.74)	0.7 (0.2-1.0)	0.806	0.55 -1.18	0.2639
18	104	1.03 (0.99)	0.9 (0.2-2.0)	1		
19+	109	0.83 (0.77)	0.7 (0.2-1.0)	0.761	0.54 -1.08	0.1224
DK	46	1.06 (0.92)	1.0 (0.2-2.0)	1.088	0.70 -1.69	0.7067
Reason for first sex						
Got married	113	1.13 (0.96)	1.0 (0.5-2.0)	1.248	0.96 -1.62	0.0922
Wanted to	439	1.01 (0.89)	0.9 (0.2-2.0)	1		
Tricked	75	0.91 (0.92)	0.7 (0.2-1.0)	0.900	0.66 -1.22	0.5032
Needed money	11	0.65 (0.44)	1.0 (0.1-1.0)	0.532	0.22 -1.31	0.1699
Forced	8	0.91 (0.85)	0.6 (0.2-1.8)	0.957	0.40 -2.27	0.9214
Can't remember	15	0.81 (0.62)	1.0 (0.2-1.0)	0.780	0.38 -1.58	0.4919
Condom use at last sex with (most recent) regular						
No	521	1.09 (0.93)	1.0 (0.4-2.0)	1		
Yes	140	0.70 (0.66)	0.5 (0.2-1.0)	0.557	0.43 -0.71	<0.0001
Current method of FP						
None	594	1.01 (0.89)	1.0 (0.2-1.9)	1		
Hormonal	42	1.24 (1.02)	1.0 (0.5-2.0)	1.292	0.87 -1.92	0.2052
Condom	23	0.46 (0.31)	0.5 (0.2-0.7)	0.490	0.29 -0.82	0.0066
Sterilised	1	0.90	0.9	1.188	0.16 -8.96	0.8674
IUD	1	0.10	0.1	0.098	0.01 -0.74	0.0244

Table 46: Women's coital frequency with regular partner. Numbers of respondents, mean and median coital frequency and crude rate ratio, 95% confidence intervals and p-values from negative binomial regression models by sexual behaviour.

Table 47: MEN – Adjusted rate ratios, 95% confidence intervals and p-values from negative binomial regression models for coital frequency with regular partner. Parsimonious model, all covariates shown.

Adjusted results from negative binomial models: coital frequency with REGULAR PARTNER	MEN adj. IRR	95% CI	p-value
Duration regular partnership in years, grouped			
1/12	1.05	0.79-1.39	0.7469
2/12	0.95	0.75-1.21	0.6935
3/12	0.80	0.63-1.02	0.0752
4/12	1.07	0.82-1.39	0.6391
5/12	0.96	0.65-1.40	0.8255
6/12	0.98	0.77-1.25	0.8723
6-12/12	0.95	0.74-1.21	0.6568
1	0.65	0.53-0.81	0.0001
2	1		
3	0.71	0.53-0.96	0.0239
4-30	0.88	0.61-1.25	0.4687
Residence of regular partner			
Same village	1		
Other part of Kisesa ward	0.77	0.64-0.92	0.0044
Another part of Magu district	0.59	0.44-0.78	0.0002
Mwanza City	0.53	0.37-0.75	0.0004
Another part of Mwanza region	0.59	0.41-0.83	0.0028
Elsewhere	0.28	0.11-0.72	0.0077
In polygamous marriage in sero5			
Not polygamously married	1		
In polygamous marriage	0.33	0.14-0.79	0.0135
Married more than once			
Never	0.76	0.60-0.95	0.0179
Once	1		
More than once	1.20	0.94-1.53	0.1438
Age difference with regular partner			
Partner within 5 years	1		
Partner 5+ yrs younger	1.04	0.87-1.25	0.6304
Partner 5+ yrs older	0.33	0.06-1.76	0.1932
Partner same age (estimated)	0.75	0.59-0.96	0.0214
Partner younger (estimated)	0.85	0.72-1.00	0.0524
Partner older (estimated)	1.01	0.63-1.64	0.9554
Number of partners in last year, grouped			
0	0.54	0.32-0.91	0.0208
1	1		
2	1.06	0.88-1.29	0.5250
3	1.40	1.09-1.79	0.0082
4+	1.29	0.97-1.73	0.0804
Number of partners in last month, grouped			
0	0.11	0.08-0.14	<0.0001
1	1		
2	1.60	1.27-2.00	0.0001
3+	2.12	1.49-3.00	<0.0001

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Table 39: MEN – Adjusted rate ratios, 95% confidence intervals and p-values from negative binomial regression models for coital frequency with regular partner. Parsimonious model, all covariates shown. (continued)

Adjusted results from negative binomial models: coital frequency with REGULAR PARTNER	MEN		
	adj. IRR	95% CI	p-value
Had sex with (main) spouse in last year			
No	1		
Yes	0.42	0.32-0.56	<0.0001
Had sex with a high-risk partner in last year			
No	1		
Yes	0.88	0.70-1.12	0.3049
Age at first sex, grouped			
10-13	1.19	0.88-1.62	0.2594
14	0.99	0.74-1.32	0.9462
15	0.88	0.70-1.10	0.2486
16	1.01	0.81-1.27	0.9303
17	1.06	0.83-1.37	0.6353
18	1		
19+	0.73	0.56-0.96	0.0235
DK	0.80	0.61-1.05	0.1074
Reason for first sex			
Got married	0.50	0.17-1.43	0.1967
Wanted to	1		
Tricked	1.24	0.61-2.53	0.5530
Can't remember	0.68	0.24-1.93	0.4742
Condom use at last sex with regular partner			
No	1		
Yes	0.75	0.63-0.90	0.0013
Current method of FP			
None	1		
Hormonal	0.97	0.39-2.45	0.9520
Condom	1.47	0.99-2.18	0.0543
Traditional	1.40	0.14-14.47	0.7759

Adjusted results from negative binomial models: coital frequency with REGULAR PARTNER	WOMEN adj. IRR	95% CI	p-value
Residence of regular partner			
Same village	1		
Other part of Kisesa ward	0.72	0.59-0.89	0.0020
Another part of Magu district	0.70	0.52-0.95	0.0224
Mwanza City	0.64	0.49-0.83	0.0009
Another part of Mwanza region	0.66	0.49-0.89	0.0060
Elsewhere	0.82	0.52-1.28	0.3724
Age difference with regular partner			
Partner within 5 years	1		
Partner 5+ yrs younger	0.64	0.22-1.88	0.4180
Partner 5+ yrs older	0.73	0.58-0.92	0.0074
Partner same age (estimated)	1.04	0.80-1.35	0.7890
Partner younger (estimated)	0.61	0.39-0.95	0.0302
Partner older (estimated)	0.87	0.71-1.06	0.1571
Number of partners in last year, grouped			
0	0.48	0.30-0.75	0.0015
1	1		
2	1.44	1.16-1.79	0.0012
3	1.52	1.05-2.20	0.0280
4+	2.06	1.03-4.10	0.0408
Number of partners in last month, grouped			
0	0.16	0.13-0.20	<0.0001
1	1		
2	1.51	1.10-2.07	0.0104
3+	0.74	0.26-2.16	0.5865
Had sex with (main) spouse in last year			
No	1		
Yes	0.51	0.37-0.71	<0.0001
Condom use at last sex with regular partner			
No	1		
Yes	0.69	0.56-0.84	0.0003
Parity grouped			
0	0.69	0.53-0.90	0.0068
1	1.06	0.79-1.41	0.7098
2	1		
3	0.92	0.64-1.32	0.6442
4-8	0.89	0.67-1.20	0.4536
9+	0.79	0.50-1.23	0.2916
N/A	0.54	0.33-0.89	0.0161
Pregnant now sero5			
No	1		
Yes	0.72	0.52-0.99	0.0459
Don't know	0.23	0.07-0.70	0.0094

Table 48: WOMEN – Adjusted rate ratios, 95% confidence intervals and p-values from negative binomial regression models for coital frequency with regular partner. Parsimonious model, all covariates shown.

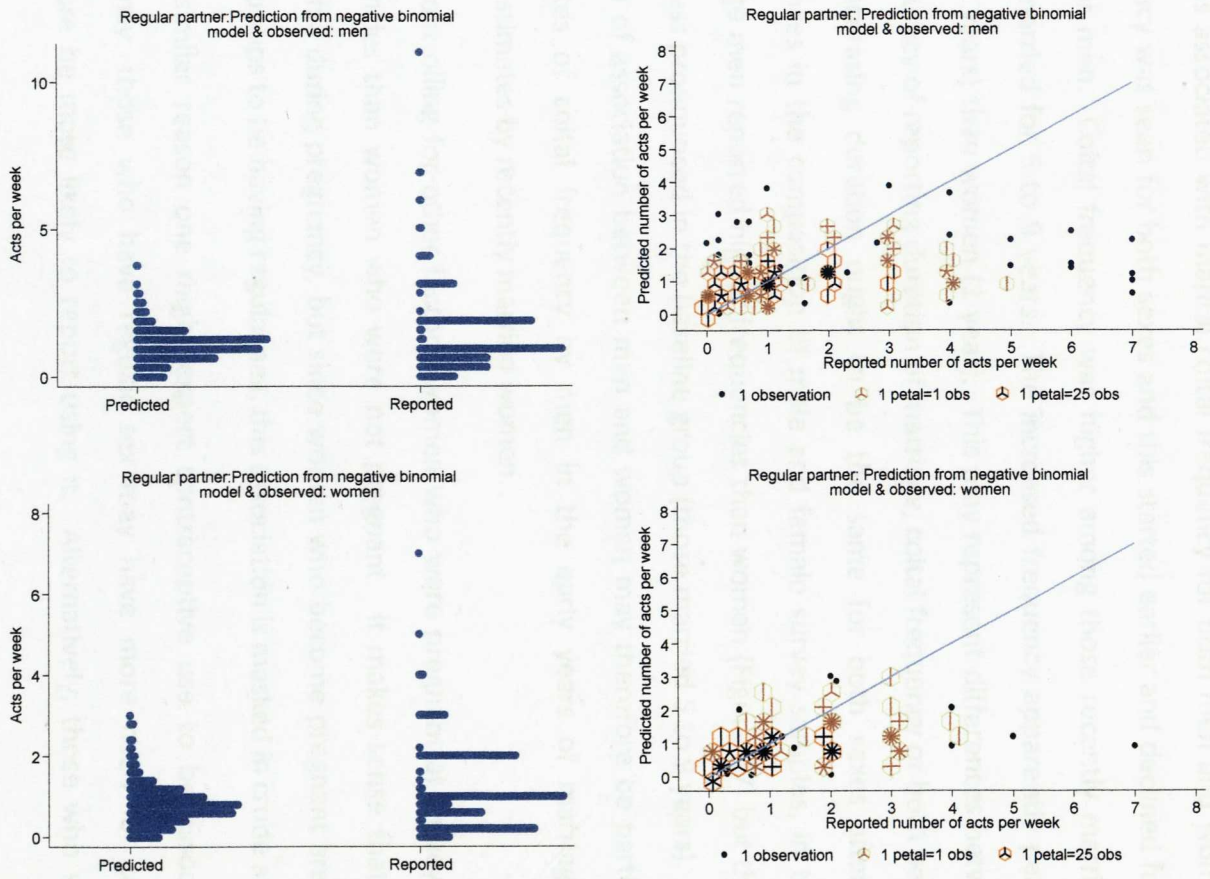

Figure 46: Reported weekly coital frequencies with regular partner and those predicted by negative binomial regression models for men and women.

6.4 Discussion

What factors emerge as associated with coital frequency

There were two common factors associated both with spousal coital frequency and frequency of sex with regular partners. These were number of sexual partners and pregnancy status at survey. The other factors either showed different patterns of association with the two types of partner or were not associated with frequency of sex with one type of partner.

Main spouse

Age was associated with marital coital frequency for both men and women. A decline in frequency was seen for both sexes and this started earlier and declined further for women than for men. Coital frequency was higher among those recently married, compared to those married for 5 to 9 years. The increased frequency apparently persisted longer for men (3 years) than women (1 year). This may represent differences between the sexes in the accuracy of reporting duration of marriage, coital frequency or both because the decline with increasing duration ought to be the same for both sexes after adjustment for differences in the composition of male and female survey samples. In the early years of marriage men reported higher frequencies than women (Figure 37) but this difference was much less pronounced in the baseline group (those married 5 to 9 years). The difference in pattern of association between men and women may therefore be partly due to inflated estimates of coital frequency by men in the early years of marriage, or conversely underestimates by recently married women.

After controlling for other factors, women who were pregnant at survey had lower coital frequencies than women who were not pregnant. It makes sense that coital frequency would fall during pregnancy, but since women who become pregnant are more likely than other groups to be having regular sex, this association is masked in crude analysis.

For a similar reason one might expect contraceptive use to be associated with coital frequency: those who have regular sex may have more need for contraception and therefore be more likely to report using it. Alternatively, those who successfully use a

contraceptive method may increase their coital frequency once the risk of unwanted pregnancy is reduced. However no associations were seen in these data. Contraceptive use is comparatively rare in this population and does not appear to have a role in affecting coital frequency or vice versa.

Two factors connected to the circumstances of first sex were associated with marital coital frequency. People whose first sex was at age 14, compared to those whose first sex was at 18, had higher coital frequencies with their spouses. It has previously been shown in this population that later age at first sex was associated with lower numbers of partners later in life[81].

Women whose first sex occurred in marriage reported lower frequencies of sex with their spouse than women whose first sex was because they wanted it. This could stem from a lack of sexual attraction prior to the marriage, which precluded pre-marital sex and frequent sex within marriage.

Polygamous men reported higher frequencies of sex with their spouses than monogamous men. Remarried women reported higher spousal coital frequencies than women who had been married only once. Both associations remained after controlling for duration of marriage.

People with a higher number of partners in the year before the survey reported higher coital frequencies with their spouses than people who had only one partner in that time. However, for men, this association was qualified by partner type: men who had at least one regular partner in the last year had less sex with their spouse whereas men who reported a casual partner in that time had higher coital frequencies.

Regular partners

Age was not associated with coital frequency with regular partners, unlike the association for spouses. However, for both sexes, characteristics that are strongly correlated with age were associated with coital frequency with regular partners and were a better fit in the models than age. These were null parity for women (v. parity 2) and never married for men (v. married once only). Life stage, or living circumstances, may be more important influences than age on coital frequency with a regular partner. Being single or child-free in

this population does not equate to a higher coital frequency but to a lower one. The association with parity is not easily explained as a determinant of coital frequency. Whilst having no children may indicate more opportunity for sex, low coital frequency more surely determines low parity, especially in a population such as this where contraceptive use is low and pre-marital childbearing is accepted.

There was an association with the age gap between partners, but this was apparent only as a reduced frequency for respondents who thought their partner was about their own age, compared to respondents who knew their partner's age to be within 5 years of their own. Respondents who estimated the age of their regular partner might not know the partner as well as people who knew the age of their partners. Relative unfamiliarity could lead to both a low coital frequency and a vagueness in reporting characteristics of the relationship.

This may also explain the association observed with duration of relationship. This was not important except among men who reported durations of one year, compared to those whose relationship had been in existence for two years (the baseline). Men who reported a duration of one year reported a lower frequency of sex with their regular partner than either the baseline group or men who reported a duration between 6 and 12 months. Some men whose regular partner was not very important to them may have given a normative response to the question on duration (i.e. one year) and coital frequencies may well be lower in such couples. Alternatively, this may be an artefact of the way in which relationships are classified. If most regular partnerships last less than a year then many of those captured in the survey with a duration of 1 year may be in the final phases of the relationship, hence the lower coital frequency. 52% of those with regular partners reported that the relationship had been ongoing for less than 1 year. Those relationships that last longer than one year may evolve into a different sort of relationship, with a higher coital frequency.

Familiarity with a regular partner may well be related to proximity and the residence of the partner emerged as an important factor in the regression models for both men and women. The highest coital frequencies were reported by men and women whose regular partners lived in the same village and there was a steady decline with increasing distance. This suggests that the availability, or accessibility, of a partner plays an important role in coital frequency.

For both men and women, those who reported more than one partner in the recent past had higher coital frequencies than people who had only one partner during the same time. For men, the association was clearest for the number of partners in the month before the survey whereas for women it was most apparent for partners in the year before the survey. This may be because, for women, there was a closer correspondence between the numbers of partners in the last month and year than for men. Among men with regular partners who reported more than one partner in the year before the survey, 34% reported the same number of partners in the month before the survey. The equivalent figure for women was 37%. Those with multiple long-term partnerships may have different coital frequencies than people with shorter ones due to a decline in frequency as the relationship ages. In addition, those with the greatest interest in sex may be likely to seek more partners, maintain more partnerships and to have the more sex with their partners than people with less interest, opportunity or motivation.

Other synergies are apparent in the results. People who also had sex with a spouse as well as their regular partner reported lower coital frequencies with the regular partner than those with no spouse. This mirrors the results for spouses, and suggests that men and to some extent women, who have both spouse and regular partner, have less sex with both as a result. The IRR, for sex with a regular partner, for a man who had both a spouse and regular partner in the last year, compared to a man who had only a regular partner, was 0.45 (95% CI 0.33-0.61). For women, the IRR was 0.74 (95% CI 0.52-1.06).

The reduction in coital frequency with regular partners estimated for pregnant women compared to non-pregnant women at survey (IRR 0.7) was greater than the reduction for spousal sex (IRR 0.8).

Men who were older at first sex (19 or above, compared to 18) had a lower coital frequency with their regular partners. This may reflect something about personality, or socialisation, such that those who start sex at an older age also have less interest, or opportunity later in life.

Condom users had less sex with their regular partner than non-users. This association could represent several things: those who use condoms have less sex as a result, those who have infrequent sex find condoms the most satisfactory choice of contraception and/or disease

protection, or if condoms are used mainly with less familiar partners, this variable might also be picking out respondents who do not know their regular partners very well.

How do these results compare with the literature

The absolute coital frequencies reported by men and women in Sero 5 are higher than those reported by respondents in other Tanzanian surveys. In the 1991 DHS [82], the mean for married women aged 15-49 was 3.5 times in 4 weeks compared to a mean of 7.2 (1.8 times per week) with a spouse for women aged 15-49 in Sero 5. Women in Kisesa may have higher coital frequencies than women elsewhere, but it is at least as likely that this difference is due to the methods of data collection. The DHS respondents were not necessarily sexually active- the question was posed to all married women and that is the denominator for this estimate. In addition, the four week reference period used in the DHS would have elicited zero reports from women who had infrequent sex with their husbands (i.e. less than once every 4 weeks), whereas the approach taken in Sero 5 captured a non-zero frequency for such respondents.

The GPA survey fielded in Tanzania[34] estimated the mean four-weekly coital frequency for married men and women aged 15-49 to be 4.9 and 4.4, respectively. The mean coital frequency for married men aged 15-49 in Sero 5 was 8.4 (2.1 times per week). The estimates from Sero 5 are more similar to the results from the European surveys, and the Australian data , than the older African data (see Chapter 3).

The correlates of coital frequency observed in Sero 5 data concur with those from the literature regarding married women's sex with their spouses [4,39,40,44]. Marital coital frequency declines with age, is higher in the early stages of marriage and is reduced by pregnancy [52]. Contraceptive use is not associated with coital frequency in this population, but this may be due to a low prevalence of use and because we do not have information on the desire to avoid pregnancy.

There is little literature on men's coital frequency and none on coital frequency outside marriage. Results from Sero 5 indicate that men's marital coital frequency declines with age, but later and not as sharply as women's, and this agrees with the available literature.

What are the problems/limitations with these data and analysis

The data on coital frequency have some limitations regarding partner dynamics and these necessitated assumptions for some respondents and precluded certain analyses.

The main omission was regarding the duration of relationships. The duration was recorded in years for spouses, which meant there was no information on the length of marriages that had begun less than a year before the survey. This information was crucial for analysis of respondents who answered the coital frequency questions for the year before the survey (i.e. those who had not had sex within the month before the survey). Fortunately there were very few of these respondents (7) so the assumption of 6 months duration for those people is unlikely to have strongly influenced results.

For respondents who reported their coital frequency with their regular partner in months, and who had only acquired their regular partner one month before the survey, I assumed the partnership had been in existence for the entire month. This may be incorrect, but the frequencies reported by those respondents were in line with those who had had their regular partners for two months, for whom a full month's denominator was correct. Therefore this assumption is unlikely to have biased the analysis.

Going forwards, it would be worth the effort to collect duration of relationships more precisely, as times of first and most recent sex with each partner, to ensure that the denominator for coital frequencies (and other measures) is as accurate as possible.

The design of the questionnaire focused on coital frequency only with current spouses and current regular partners. This means that it is not possible to estimate a respondent's total coital frequency within a given period, or to compare what kind of people have the most sex. Coital frequency with casual partners may be less likely to follow a fixed pattern and is therefore harder for the respondent to summarise and report. However a question on number of acts in a shorter time frame than for the other partners would have sufficed. That would enable a summary measure of acts with any type of partners for the shorter time frame and this would permit more complete comparisons between respondents. In doing this, care must be taken to identify respondents who finished partnerships immediately before the survey. They may have had sex with the ex-partner during the reference period for which total number of acts is calculated, but they would not have had

the opportunity to report this if the partnership was not classed as current at survey. If the short reference period used for total acts per person was kept very short (e.g. two weeks) that would make this very unlikely to happen, and any respondents who fell into this category could be excluded from the analysis without having much effect on the results.

In these data there is no information about fertility intention and this information would have helped to understand both coital frequency, and contraceptive and condom use.

How does the negative binomial regression model fare?

The negative binomial models fitted the data better than Poisson models, but did not capture all of the variation observed in the data. This is probably because the covariates in the models did not adequately classify groups of respondents by coital frequency, implying that there is poor correspondence between the characteristics measured in Sero 5 and coital frequency.

Summary

The factors found to be associated with coital frequency in this population are similar to those identified in the literature, but the nature of the associations seems to be more complex than suggested by previous studies. Some relationships that have been proposed in the literature are not entirely supported by these results. In part this may be because this analysis is based on data from more than 9000 people and which were collected with this analysis in mind. This permitted more in depth analysis than was possible for most of the published studies.

Age was associated with coital frequency with spousal partners but no association was seen for regular partners. For regular partners, factors strongly linked to age such as parity (for women) and ever having married (for men) were associated with coital frequency. This suggests that the association with age may be modified by the type of relationship. It is possible that associations between coital frequency and markers of age and life stage may arise because of lifestyle changes that occur as people age, rather than resulting from a biological relationship. To some extent the associations seen with duration of relationship support this theory, although the uncertainty about some of the duration estimates makes these results less reliable.

It has been suggested in the literature that there is a reduction in per partner coital frequency by individuals who have more than one partner (coital dilution) [16 34]. In these data, individuals with more than one partner tend to have more frequent sex with each partner than individuals with just one partner. However, the mix of partners appears to modify this association. Polygynous men have more sex with each spouse than monogamously married men, an effect that is not explained by differences in age or duration of marriage.

However, men who have both a spouse and a regular partner have less frequent sex with each whereas men who have a casual partner in addition to their spouse have more frequent sex with their spouse (no data for the casual partner). Remarried women have more frequent sex with their spouse than women in their first marriage. There is no effect of polygamous marriage for women and the effect persists when duration of marriage is controlled for. The patterns of associations for both men and women suggest that coital frequency within marriage is influenced by marital history and the presence of other partners. Different partner histories, and mixes of current partners may reflect individual preferences for the amount of sex, and it may be that people who choose to have several partners, over time or simultaneously, do so because their sex drive is higher than people who stick to a single partner. Differences by partner mix may be further modified by opportunities for sex, which probably vary by type of partner and the degree of secrecy about additional partners. Therefore, in polygamous marriages, where the multiple partnership is publicly acknowledged and the opportunity for sex is presumably not limited, there is an increased per partner coital frequency. For people with a spouse and a regular partner, where perhaps the regular partner is clandestine and not as easily accessible, the per partner frequencies are depressed. People who have extra marital partners may do so because of deficiencies in their relationship with their spouse, which would explain the lower coital frequency with the spouse, but not necessarily the lower coital frequency with their regular partner.

Coital frequency with regular partners was influenced by the proximity of the regular partner's residence to the respondent's home. This seems entirely logical: it is easier to have more frequent sex with a partner who is nearby. This may also explain some of the

association outlined above, since it would be easier to keep a partner secret if they do not live near the spouse.

If this is the case then there is no evidence coital dilution within marriage, as proposed by Reniers[16], but some indication of a suppressive effect of certain mixes of partners which may be driven by differences in opportunity, rather than appetite, for sex.

Chapter 7 Do differences in coital frequency bias estimates of condom use derived from survey data?

The aim of this chapter is to explore the extent to which variation in coital frequency undermines the utility of condom use indicators. Measures of condom use are tracked for a number of reasons: to monitor trends in risk behaviour, to evaluate the impact of campaigns to promote condom use and to assess the future need for condoms. For all these reasons it is important to have a measure which accurately describes condom use and is not confounded by changes in other behaviour.

The most frequently reported condom use measure is the extent of use at last sex which is typically defined as the most recent occasion within the 12 months before the survey. Sometimes this is limited to sex with particular types of partner, such as a cohabiting/spousal partner or a commercial partner. One of the most commonly used international indicators is condom use at last sex with a non-cohabiting partner, out of all of those reporting such a partner in the last 12 months[83-84] and this is one of the indicators chosen to assess progress towards the Millennium Development Goals (Indicator 6.2[85]).

The focus on last sex is to improve the recall and reporting of this behaviour: the most recent occasion is thought to be the most memorable and, by asking about a specific act, the answer is a straightforward yes or no (leaving aside considerations about whether the condom was used correctly and throughout sex). Questions regarding the frequency or consistency of use are subjective and may demand too much of the respondent.

A downside of this measure is that respondents who have infrequent sex contribute the same as those who have more frequent sex. This means that the measure is not dominated by those who have the most sex. This is potentially misleading because those who have the most sex may have the most potential for spreading or contracting STIs, especially if they have more than one partner.

This effect can be ameliorated by using a shorter reference period for last sex and confining the measure to respondents who have had sex within that shorter time frame. This is likely to make the respondents more homogeneous with respect to coital frequency. However it

also reduces the number of people for which the measure can be calculated. This could be an issue when trying to measure, with adequate precision, condom use with uncommonly reported types of partner (CSW for example).

An alternative is to use reported coital frequency to derive condom use measures that are weighted by frequency of sex and can describe both the proportion of sex acts that are protected and the amount of unprotected sex that individuals experience.

This chapter examines the extent to which differences in coital frequency distort measures of condom use at last sex based on survey data from Australia, Burkina Faso, Ghana, Malawi, Rwanda, Uganda and Zambia.

The intention is to capture the aspects of condom use that have the most epidemiological relevance: the percentage of sex acts that are protected by condoms and the percentage of people who protect themselves by using condoms. Information on coital frequency is essential for both of these measures and these estimates can be compared to last sex based measures to see whether they present a different picture of condom use.

The proportion of acts protected and the proportion of people protected provide complementary information. A high proportion of acts protected may still leave scope for the spread of STIs if most people use condoms inconsistently and therefore occasionally expose themselves to infection. Conversely, a large proportion of people protected may be insufficient if those who have the most sex are not using condoms consistently. The working assumption is that the condom use measure based on use at last sex captures neither dimension very well.

7.1 Choice of data

It was not possible to obtain data from a single source that allowed comparison of different methods for calculating measures of condom use weighted by frequency of sex. Three different sources of data have been used to contrast the results obtained using three different approaches. The first of these is the dataset from the Australian Study of Health and Relationships, used in Chapter 5. The second source is the National Surveys of Adolescents (NSA) conducted amongst 12 to 19 year olds in Burkina Faso, Ghana, Malawi, Uganda. These data have already been used in Chapter 3. The third source are two datasets from Rwanda and Zambia. These are from surveys conducted by the social

marketing organisation Population Services International (PSI www.psi.org). Both are household surveys of young people. In Zambia, 2,400 people aged 13 to 24 were followed over seven rounds of data collection that finished in 2003. In Rwanda, data on 9,278 15-24 year olds were collected in a single round during 2003.

These surveys were chosen because each contained information that could be used to construct measures of condom use that accounted for coital frequency.

7.1.1 Data requirements and availability

Condom use can be summarised in terms of the number of condoms used or the number of people who use condoms.

The level of condom use is dependent on three factors:

- The number of people who use condoms
- The consistency of condom use amongst those who use condoms
- The frequency of sex (among users and non-users)

Although this chapter is primarily concerned with understanding how coital frequency may affect measures of condom use, there are two key aspects of sexual behaviour which are used to define the scope of the data collected in surveys and which may be associated with condom use:

- Recency of sex
- Relationship to partner

Both of these factors are typically associated with coital frequency. Therefore, in order to understand how coital frequency may affect measures of condom use, it is necessary to first review how these data collection issues impact on the measurement, construction and interpretation of condom use measures.

Recency of last sex (with a particular partner) is used to determine which respondents are asked certain questions. Limits are imposed because recall of information is likely to be poor for events that happened a long time ago, and because asking all respondents about all their partners would be too time consuming in a large survey. Indicators of condom use are usually restricted to a specified time period, often 12 months[83]. It is important to limit

indicators to a specific period of time so that trends over time can be tracked using these measures. The period chosen is a compromise between capturing up to date information and getting responses from enough respondents to produce a precise estimate of the indicator.

Some aspects of behaviour are most easily measured with reference to a specific sex act and the most recent sex (with a particular partner) is often selected as the occasion to focus on.

Relationship to partners is sometimes used to identify those partners on which detailed data will be collected. The Rwandan and Zambian surveys used in this chapter focussed on spouses, regular partners, casual partner and CSW partners.

The design of the questionnaires used in surveys of sexual behaviour imposes some limits on the estimates of condom use that can be derived from the resultant data. To fully tease out the three different determinants of condom use listed above, data are needed on all partners from a specified time period (a partner history) which includes time since last sex, relationship to partner, condom use at last sex and some measure of frequency or consistency of use with that partner in addition to coital frequency. None of the more than one hundred datasets available to the author perfectly fulfilled these criteria. Table 49 shows the information available from the surveys that were the most appropriate for this analysis.

	Australia	Rwanda	Zambia	NSA†
Partner history	Yes (≤ 3 partners)	No	No	Yes (≤ 3 partners)
For each partner:				
Time since last sex	Yes	Yes*	Yes*	Yes
Condom use at last sex	Yes	Yes*	Yes*	Yes
Consistency/frequency of condom use	No	Yes*	Yes*	Yes

Table 49: Summary of information available from each survey †National Surveys of Adolescents

**Information is incomplete because the format of the questionnaire was not a partner history but a series of questions about the most recent partner of each sort. Therefore any respondent who had more than one partner of a particular type in the reference period did not have the opportunity to report any information on the second (or higher order) partner.*

When interpreting the results in this chapter it is important to bear in mind that the results for all the surveys are slightly incomplete due to the omission of some partnerships as a result of the questionnaire design.

The Australian survey collected data on the three most recent partners for each person. 2.5% of respondents reported more than three partners in the 12 months before the survey and 1% reported 6 or more partners during that time (for questionnaire see Appendix 1 page 1). Most respondents reported only one partner (75%). The total number of partners belonging to all survey respondents in the year before the survey cannot be precisely calculated because reports of more than 6 partners were categorised during data collection into 6-10 and 11-100. However, taking the lower and upper limits of these groups suggests that data were not collected on between 7% and 41% of the partners declared for that period. However, this analysis concerns only the month before the survey and only 13% of the respondents who had more than three partners in the year before the survey reported three partners in the month before. Therefore the majority of respondents with more than three partners in the year before the survey reported fully on all of their partners in the month before the survey.

Theoretically the NSA have the same problem but only 28 men out of a total of 10,052 reported more than 3 partners in the year before the survey so this design is unlikely to have affected the results (see Appendix 1 page 13 for the questionnaire).

Neither the Rwandan or Zambian surveys included a partner history. These questionnaires are given in Appendix 1 pages 41 and 23 respectively. Respondents were asked about four different types of partner: spousal/cohabiting, regular, casual and CSW partners. Consequently only the most recent partner of each sort was included in the questionnaire, and the overall mix of reported partners is not entirely representative of the mix of partners in the population. Casual and commercial partners are likely to be over-represented in the data because these partners are not as common as regular and spousal partners, but each respondent had the opportunity to report only one of each type.

To complicate matters further, in the Rwandan survey, respondents were asked for the number of sex acts and the number of times condoms were used with all of their partners of a specified type, but asked about condom use at last sex with the most recent one only.

It is impossible to establish exactly how many partners might have been omitted from the Zambian and Rwandan surveys as a result of this method of data collection because the information used in this analysis relates to the month before the survey (the only reference period common to all surveys) and the questions on the number of partners of each type were asked for a longer period.

In Rwanda, more than one partner of each type in the 12 months before the survey was reported by 2% of those with a spouse, 9% of those with a regular partner and 4% of those with a casual partner. This question wasn't asked in regard to CSW partners.

In Zambia, respondents were asked how many partners of each type they had had in the three months before the survey. More than one partner of each type was reported by less than one percent of those with a spouse, 7% of those with a regular partner, 39% of those with a casual partner and 48% of those with a CSW partner.

The first part of the results section shows how recency of last sex and relationship to partner are associated with condom use and with the distribution of sex acts.

7.2 Choice of Measures

Of the information listed in Table 49, time since last sex and condom use at last sex are fairly straightforward to define and to collect. The frequency or consistency of condom use can, however, be measured in different ways.

Survey respondents can be asked to report on the number of occasions on which they did and did not use a condom within a prescribed reference period. This has been done by PSI and in the NSA. It is not possible to assess how accurate these data are because there is no way to validate respondents' reports. It seems reasonable to assume that the recall of this information might be difficult for most respondents, especially for those with high coital frequency.

Alternatively, respondents can be asked for their assessment of how often they use condoms. This can be descriptive (e.g. never, sometimes always) or more specific, such as a question to those who used a condom at last sex about whether they had any unprotected acts with that partner.

If not reported directly, the proportion of acts in which condoms were used (by a respondent with a specific partner) can then be inferred from the information on the frequency of both sex and condom use.

The number of sex acts protected by condoms is calculated as the total number of sex acts in a specified period multiplied by the proportion of acts in which condoms were used. The proportion of all sex acts in the population that were protected by condoms is the sum, for all respondents, of the number of acts in which condoms were estimated to have been used divided by the sum of the number of sex acts reported during the reference period.

If there is information on all partners, for each respondent, during the reference period it is possible to identify survey respondents who did not experience any unprotected sex during the reference period. If the quality of the information on coital frequency and condom use is good then respondents can be further classified by the number of unprotected acts they experienced.

7.2.1 Condom use indicators

For this analysis the following indicators shown in Table 50 were chosen. This choice was dictated by the information available from each survey.

		Australia	Rwanda	Zambia	NSA
Condom use at last sex: percent of those who had a:					
Spousal/cohabiting partner	Last 12 months	•			
	Last 3 months	•			•
	Last 1 month	•	•	•	
Non-spousal/non-cohabiting partner	Last 12 months	•			
	Last 3 months	•			•
	Last 1 month	•	•	•	
Any type of partner	Last 12 months	•			
	Last 3 months	•			•
	Last 1 month	•	•	•	
Percent of sex acts in which a condom was used, among those who had a:					
Spousal/cohabiting partner	Last 12 months	•			
	Last 3 months	•			•
	Last 1 month	•	•	•	
Non-spousal/non-cohabiting partner	Last 12 months	•			
	Last 3 months	•			•
	Last 1 month	•	•	•	
Any type of partner	Last 12 months	•			
	Last 3 months	•			•
	Last 1 month	•	•	•	
Proportion who had any unprotected sex, among those who had a:					
Spousal/cohabiting partner	Last 12 months	•			
	Last 3 months	•			•
	Last 1 month	•	•	•	
Non-spousal/non-cohabiting partner	Last 12 months	•			
	Last 3 months	•			•
	Last 1 month	•	•	•	
Any type of partner	Last 12 months	•			
	Last 3 months	•			•
	Last 1 month	•	•	•	

Table 50: Condom use measures constructed for the four different sets of data.

7.3 Methods

Definition of indicators

All the following indicators can be calculated for all partners combined, or separately by type of partner. They are defined below for all partners; if calculated for one type of partner the denominator is restricted to respondents/acts with a partner of that type during the reference period. The reference period is not sex, and is referred to below as X months.

Condom use at last sex:

$$\frac{\text{Number of respondents who used a condom at last sex within X months}}{\text{Number of respondents who had sex during last X months}}$$

Percent of sex acts in which condoms were used:

$$\frac{\text{Number of sex acts in which condoms were used within X months}}{\text{Total number of sex acts reported during last X months}}$$

Proportion who had any unprotected sex

$$\frac{\text{Number of respondents who reported} \geq 1 \text{ act without a condom during last X months}}{\text{Number of respondents who had sex during last X months}}$$

Some of the information needed to calculate these indicators had to be derived from the questionnaire responses. The surveys used in this chapter collected different information, and took two different approaches. The ASHR and NSA collected a partner history whereas the PSI surveys repeated a series of questions for four different types of partner and asked for detailed information on the most recent partner of each type. No survey contained exactly the information needed to calculate these measures without some bold assumptions.

ASHR

The partner history included up to three partners from the 12 months before the survey. Respondents were asked about their coital frequency with each partner, and their condom

use at most recent sex. Unfortunately the questions on the frequency, or consistency, of condom use were asked only once rather than for each partner and could not be used to estimate unprotected acts. Therefore, for ASHR data, it was assumed that use at last sex was typical for each partnership i.e. every partnership was deemed to always or never use condoms based on their use or non-use on the most recent occasion. The proportion of acts in which condoms were used for these data is therefore the proportion who used a condom at last sex.

NSA

The partner history included up to three partners from the 12 months before the survey. Male respondents were asked about their condom use at most recent sex with each partner. They were also asked about the number of times they had sex with each partner in the three months before the survey, and the number of occasions on which they used a condom during that same period. The proportion of acts in which condoms were used was the number of acts in which condoms were used divided by the total acts reported for the three months before the survey.

It was theoretically possible to calculate the condom use measures outlined in Table 50 separately for spouses and non-spousal partners. However, in this very young survey sample, only a handful of young men reported spousal partners and therefore partner types were not considered separately.

Rwanda

In this survey, respondents were asked about sex with spouses, regular partners, casual partners and sex workers. Frequency of sex, condom use at last sex and typical frequency of condom use (never, sometimes, often, always) were collected for each type of partner. The dates of last sex with each type of partner were recorded, which made it possible to transform the data to a format similar to a partner history by making the assumption that each respondent would have had only one partner of each type. If a respondent had more than one partner of a particular type, and had had sex with both/all in the month before the survey, the questions on frequency of sex and frequency of condom use were phrased to include all the partners. These were used as reported but this question might have been confusing for any respondents with multiple partners who had different condom use habits

with each partner. Condom use at last sex was specifically asked for the most recent partner.

For these data, the respondents' reports of the frequency of condom use were cross-tabulated with use at last sex, by type of partner. The proportion of respondents in each group who used a condom at last sex was used to approximate the proportion of sex acts in which condoms were used by respondents who had that type of partner.

Zambia

In the Zambian survey, respondents were asked about sex with spouses, regular partners, casual partners and sex workers. Frequency of sex, condom use at last sex and the number of occasions on which a condom was used were collected for each type of partner. Coital frequency and number of times a condom was used were collected for the month before the survey. Recency of last sex with each type of partner was also collected, permitting condom use at last sex to be calculated for the month before the survey. As in Rwanda, the dates of most recent sex were used to transform the data into a format resembling a partner history, with the same limitations. The proportion of acts in which a condom was used, and the proportion of respondents who always used a condom every time they had sex was calculated directly from the respondents' reports. The proportion of acts in which condoms were used was the number of acts in which condoms were used divided by the total acts reported for the month before the survey.

The standard errors were corrected for the clustering that was due to repeated measures on the same respondents.

7.4 Results

Influence of questionnaire design factors

The first section of the results explores the associations between the two factors associated with data collection strategies and both the condom use variables and the distribution of the number of sex acts.

The denominator for the following analysis is partnerships rather than people.

Figure 47 shows the distribution of types of partner for all the partnerships captured in the three surveys and for the most recent partner for each respondent. In all surveys, spouses

and regular partnerships dominate and this is more pronounced when restricted to the most recent partner.

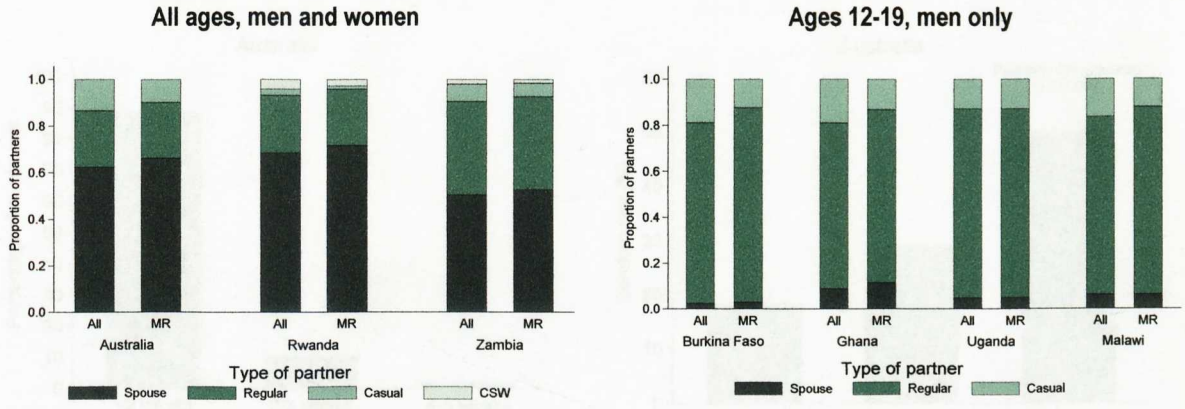

Figure 47: Relationship to each reported partner, by survey. The bars relate to all reported partners (All) and the partner with whom the respondent most recent had sex (MR).

Condom use and recency of last sex

Figure 48 shows the trend in condom use with increasing time since last sex for the three surveys of adults/ young adults. Condom use at last sex, and the proportion of partnerships in which condoms were always used, is lowest for the partnerships in which sex occurred during the two weeks before the survey and highest in the subsequent groups. Chi-squared tests for each country and each of the two condom use measures all yielded very small p-values so these associations are unlikely to be due to chance. These results are restricted to those who had sex in the month before the survey and therefore 4-5 weeks before the survey covers only the 28 to 30 days before the survey.

Figure 48 also shows that most of the reported sex acts occurred in the two weeks before the survey, the period for which the least condom use was reported.

Figure 49 shows these same results for the young men interviewed in the National Surveys of Adolescents. The trend towards increasing condom use with increasing time since last sex is not apparent for these young men, confirmed by the large p-values for the Pearson χ^2 tests. This is probably because most of the reported partners were girlfriends and time since last sex is therefore less indicative of the relationship to the partner.

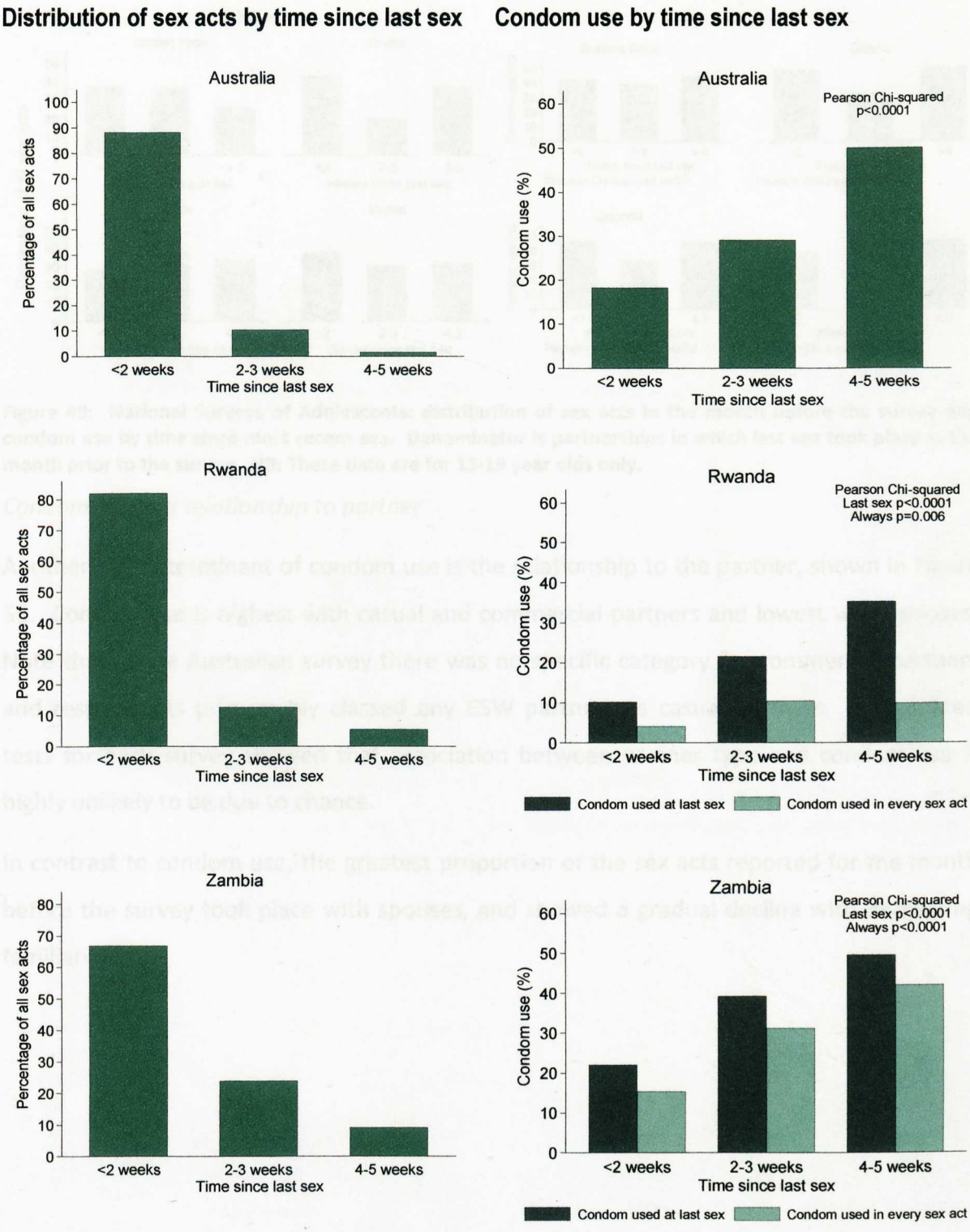

Figure 48: Distribution of sex acts in the month before the survey and condom use by time since most recent sex. Denominator is partnerships in which last sex took place in the month prior to the survey.

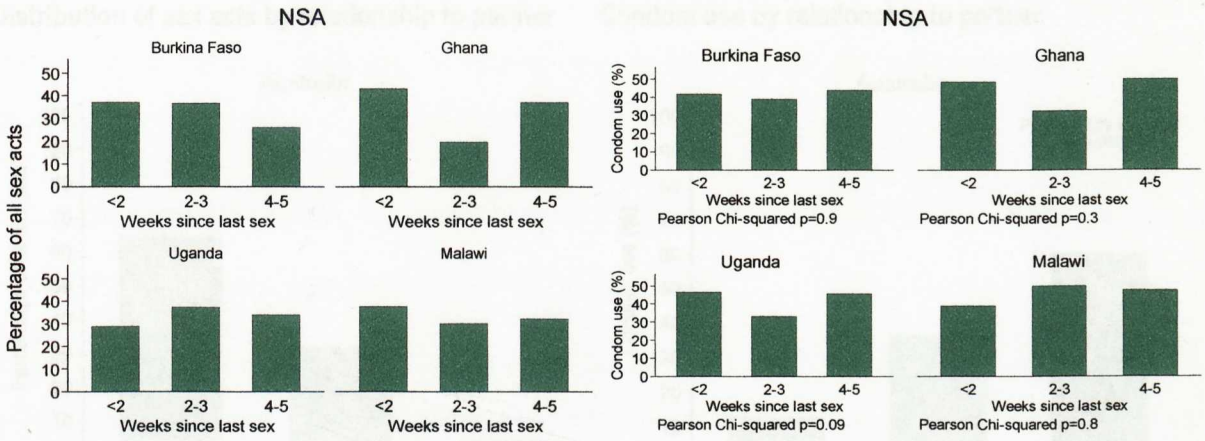

Figure 49: National Surveys of Adolescents: distribution of sex acts in the month before the survey and condom use by time since most recent sex. Denominator is partnerships in which last sex took place in the month prior to the survey. NB: These data are for 13-19 year olds only.

Condom use and relationship to partner

Another key determinant of condom use is the relationship to the partner, shown in Figure 50. Condom use is highest with casual and commercial partners and lowest with spouses. Note that in the Australian survey there was no specific category for commercial partners and respondents presumably classed any CSW partners as casual partners. Chi-squared tests for each survey showed that association between partner type and condom use is highly unlikely to be due to chance.

In contrast to condom use, the greatest proportion of the sex acts reported for the month before the survey took place with spouses, and showed a gradual decline with decreasing familiarity.

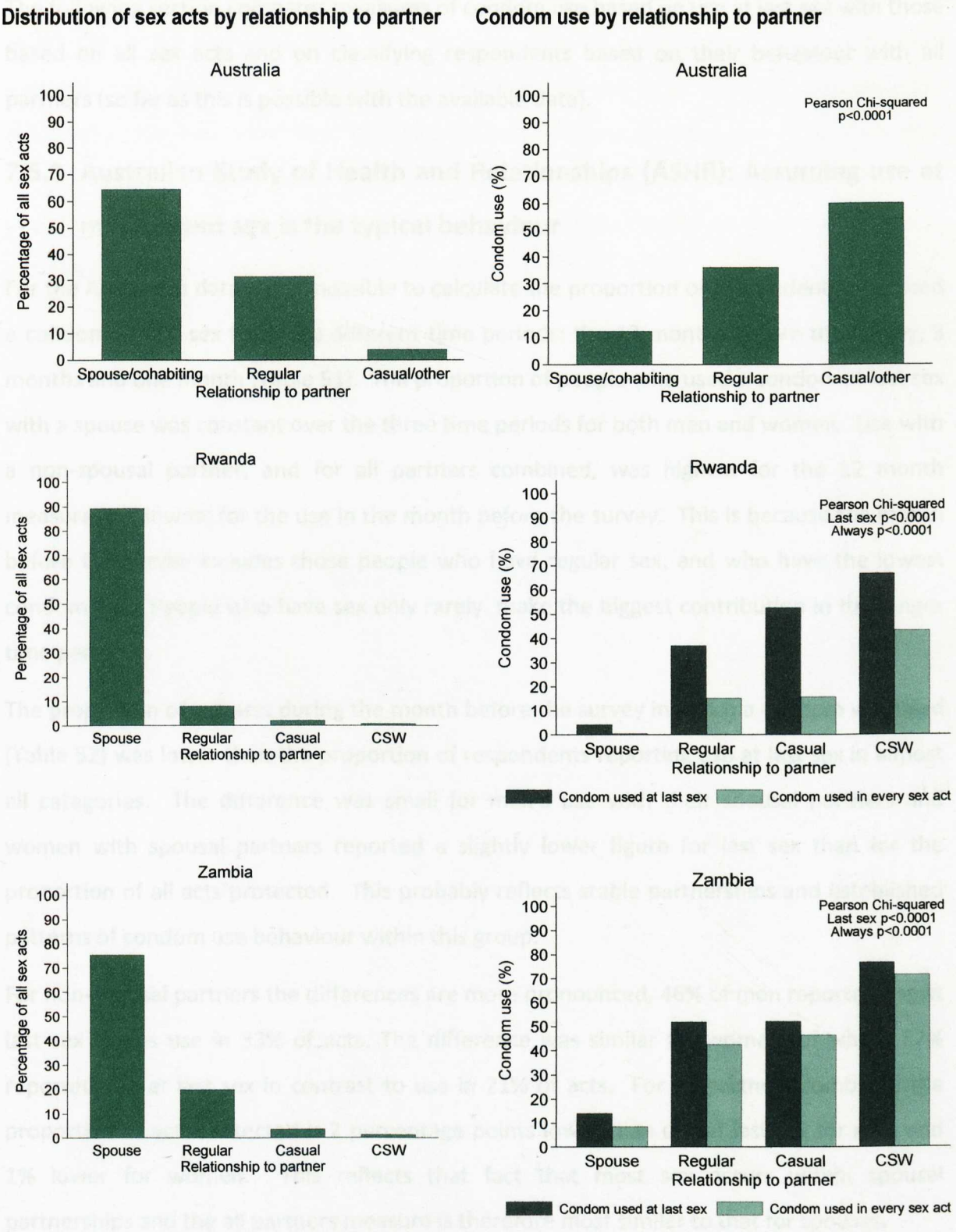

Figure 50: Distribution of sex acts in the month before the survey and condom use by relationship to the partner. Denominator is partnerships in which last sex took place in the month prior to the survey.

7.5 Comparison of the different condom use measures

The following section compares measures of condom use based on use at last sex with those based on all sex acts and on classifying respondents based on their behaviour with all partners (so far as this is possible with the available data).

7.5.1 Australian Study of Health and Relationships (ASHR): Assuming use at most recent sex is the typical behaviour

For the Australian data it was possible to calculate the proportion of respondents who used a condom at last sex for three different time periods: the 12 months before the survey, 3 months and one month (Table 51). The proportion of people who used a condom at last sex with a spouse was constant over the three time periods for both men and women. Use with a non-spousal partner, and for all partners combined, was highest for the 12 month measure and lowest for the use in the month before the survey. This is because the month before the survey includes those people who have regular sex, and who have the lowest condom use. People who have sex only rarely make the biggest contribution in the longer time period.

The proportion of sex acts during the month before the survey in which a condom was used (Table 52) was lower than the proportion of respondents reporting use at last sex in almost all categories. The difference was small for men's use with their spousal partners and women with spousal partners reported a slightly lower figure for last sex than for the proportion of all acts protected. This probably reflects stable partnerships and established patterns of condom use behaviour within this group.

For non-spousal partners the differences are more pronounced, 46% of men reported use at last sex versus use in 33% of acts. The difference was similar for women, of whom 32% reported use at last sex in contrast to use in 21% of acts. For all partners combined the proportion of acts protected is 2 percentage points lower than use at last sex for men and 1% lower for women. This reflects that fact that most sex occurs within spousal partnerships and the all partners measure is therefore most similar to that for spouses.

The proportion of respondents who used condoms every time they had sex (Table 53) is essentially the same as the proportion who used them on the most recent occasion. This is

an artefact of the way in which this measure was calculated. Since there wasn't sufficient information on the frequency of condom use with each partner the use at last sex was taken as typical use within each partnership. The only way the proportion of people who used every time can therefore differ from the proportion who used a condom at most recent sex is if those who had more than one partner had different condom use behaviours with different partners. There are small differences in the last sex measures and the proportion of respondents who used a condom every time, showing that there were some respondents whose condom use did vary with different partners.

Condom use at last sex

AUSTRALIA		MEN		WOMEN	
Condom use at last sex		**Number**	**Percent (95% CI)**	**Number**	**Percent (95% CI)**
Spouse	Last 12 months	1510	13.9 (11.6 - 16.1)	1439	10.7 (8.4 - 12.9)
	Last 3 months	1479	14.0 (11.7 - 16.3)	1357	10.6 (8.3 - 12.9)
	Last 1 months	1411	13.3 (11.0 - 15.6)	1297	10.4 (8.1 - 12.7)
NSP	Last 12 months	1376	51.0 (46.2 - 55.8)	807	38.8 (32.9 - 44.7)
	Last 3 months	1020	47.4 (41.7 - 53.2)	628	35.6 (28.9 - 42.2)
	Last 1 months	869	45.6 (39.3 - 51.8)	545	31.9 (25.3 - 38.6)
Any partner	Last 12 months	2712	24.8 (22.3 - 27.3)	2153	17.6 (15.2 - 19.9)
	Last 3 months	2435	22.0 (19.5 - 24.5)	1960	16.2 (13.8 - 18.6)
	Last 1 months	2234	20.5 (17.9 - 23.0)	1826	14.9 (12.6 - 17.3)

Table 51: Proportion of Australian respondents who used a condom at the most recent sex with spousal and non-spousal partners. Denominator is all respondents who reported a partner of that sort within the specified period.

Proportion of sex acts in which a condom was used

AUSTRALIA	Men	Women
Percent of acts in last month in which a condom was used	**Percent (95% CI)**	**Percent (95% CI)**
Spouse	12.5 (9.5-15.5)	11.3 (7.9-14.8)
Non-spouse	33.2 (23.2-43.2)	21.4 (14.5-28.4)
All partners	17.9 (14.2-21.5)	13.7 (10.7-16.7)

Table 52: Australia: proportion of sex acts in the month before the survey in which a condom was used

Proportion of people who always used condoms in the month before the survey

AUSTRALIA		MEN		WOMEN	
Used condoms every time with		**Number**	**Percent (95% CI)**	**Number**	**Percent (95% CI)**
Spouse	Last 12 months	1510	13.8 (11.6 - 16.1)	1439	10.6 (8.4 - 12.9)
	Last 3 months	1479	14.0 (11.7 - 16.3)	1357	10.6 (8.3 - 12.9)
	Last 1 months	1411	13.3 (11.0 - 15.6)	1297	10.4 (8.1 - 12.7)
NSP	Last 12 months	1376	46.6 (41.7 - 51.5)	807	36.1 (30.3 - 41.9)
	Last 3 months	1020	45.4 (39.6 - 51.2)	628	34.8 (28.2 - 41.4)
	Last 1 months	869	44.2 (37.9 - 50.4)	545	31.4 (24.8 - 38.0)
Anyone	Last 12 months	2713	23.4 (20.9 - 25.9)	2153	16.6 (14.3 - 18.9)
	Last 3 months	2435	21.5 (19.0 - 24.0)	1960	15.9 (13.5 - 18.3)
	Last 1 months	2234	20.1 (17.6 - 22.6)	1826	14.7 (12.4 - 17.0)

Table 53: Proportion of Australian respondents who always used condoms during the month before the survey

7.5.2 Rwanda: Using respondents' categorical answers to question about frequency of condom use with each partner

In this survey of young people, although there were 9,278 respondents only 1,999 had ever had sex (26% of men and 17% of women).

In the Rwandan data, responses to the question on frequency of condom use with each type of partner were used to assign, by partnership, a proportion of acts in which condoms were used.

Table 54 describes this information. It shows the percentage of respondents who used a condom at last sex, by partnership and reported frequency of condom use. For all types of partnership the proportion who used a condom at last sex is very high in the always and often group. It is more than 50% in the group who said "sometimes" with the exception of those who reported using a condom sometimes with their spouse.

The proportion of respondents who used a condom at last sex with their spouse is low (5.5% for men and 3.5% for women Table 55). Condom use is more common with non–spousal partners. The proportion of respondents who used a condom at last sex, regardless of partner type, is higher for men than for women and this is largely due to differences in the types of partner reported by women and men in this survey. Women were more likely to report spousal partners: 318 women reported spousal partners whereas only 51 reported non-spousal partners. Men were equally likely to report either type of partner.

There is considerable difference between the reported use at last sex and the proportion of acts protected (Table 55). Compared to the 23% and 7% of men and women who reported use at last sex, only 13% of men's sex acts and 4% of women's were always protected by condoms. The difference is largely due to the large number of sex acts and low condom use with spouses. In 92% of spousal partnerships condoms were never used, compared to 58% of regular partnerships and around 40% of casual and CSW partnerships. A quarter of those reporting CSW partners said they always used condoms compared to 12% of those with casual and regular partners and a mere 0.5% of those with spousal partners. This trend is in the opposite direction to the frequency of sex. The mean number of acts for the month

before the survey was 12 with spousal partners, 3 with regular partners, 8 with casual partners and just 2 with CSW (Table 56).

The proportion of respondents who used a condom every time they had sex is lower than use at last sex (Table 55). For women, the proportion who used a condom every time (3%) is similar to the proportion of sex acts protected. For men it is intermediate (17% used a condom every time, compared to 23% at last sex and 13% of acts). More men than women reported always using a condom. Women reported a higher number of sex acts with their spousal partners than men, although their reports were similar for other types of partner.

The proportion of people who used a condom at last sex is higher than the proportion who used a condom every time because of inconsistent users. These are people who use condoms some of the time with their partners, and people who have multiple partners and use condoms consistently with some and not others. 12% of respondents who had sex in the month before the survey reported using condoms "sometimes" or "often" with at least one partner. Table 54 gives, for each type of partner, the proportion of respondents who used a condom at last sex by answers to how often they used a condom with that partner. This shows that in this sample "often" means at least 4 out of 5 occasions on average. Very few respondents (41) reported more than one partner in the month before the survey and among those 17% reported condom use with some but not all of their partners.

The difference between use at last sex and the proportion of sex acts protected by condoms is due to the differences in coital frequency (as shown in Figure 48).

Stated frequency of condom use with this partner:	**Percentage who used a condom on the most recent occasion**			
	Spouse	*Regular*	*Casual*	*CSW*
Never	0.5	1.6	3.6	4.2
Sometimes	23.1	55.6	54.5	78.6
Often	87.5	79.5	100	85.7
Always	100	98.1	87.5	92.9
Number of partnerships	445	436	63	59

Table 54: Proportion of Rwandan respondents who used a condom at most recent sex with different types of partner, by reported frequency of condom use with that person.

RWANDA	Number	Condom use at last sex	Percent of acts in last month in which a condom was used	Used condoms every time with:	Used condoms ≥1 time with:
MEN					
Spouse	127	5.5 (2.7-11.1)	3.7 (1.5-5.9)	3.2 (1.2-8.1)	10.2 (6-16.8)
NSP	111	43.2 (34.4-52.6)	38.4 (28.1-48.6)	34.2 (26.0-43.5)	51.4 (42.1-60.5)
Anyone	231	23.4 (18.4-29.3)	12.5 (8.6-16.4)	17.3 (13.0-22.8)	29.9 (24.3-36.1)
WOMEN					
Spouse	318	3.5 (1.9-6.1)	2.9 (1.4-4.4)	0.9 (0.3-2.9)	6.6 (4.3-9.9)
NSP	51	29.4 (18.6-43.2)	13.3 (3.5-23.1)	17.7 (22.6-36.5)	33.3 (21.8-47.2)
Anyone	365	6.8 (4.7-9.9)	3.5 (2.0-5.1)	3.0 (1.7-5.4)	10.7 (7.9-14.3)

Table 55: Condom use indicators for Rwanda

		Number of sex acts in 1 month with:			
		Spouse	**Regular**	**Casual**	**CSW**
Men	Mean	8.8	3.0	2.3	1.9
	Total	1122	325	25	34
	N	128	108	11	18
Women	Mean	13.1	2.9	25.3	1.7
	Total	4195	147	101	12
	N	320	51	4	7

Table 56: Mean and total number of sex acts reported for the month before the survey by Rwandan respondents.

7.5.3 Zambia: Using respondents' estimates of the number of sex acts with and without a condom in the month before the survey

The Zambian data also concerns young people but, unlike in Rwanda, most of the 2400 respondents had had sex, at least by the final round (70% of men and 63% of women).

Young Zambians reported higher levels of condom use than respondents in either Australia or Rwanda. Use at last sex was reported by 44% of men and 24% of women. Around half of those with non-spousal partners reported use at last sex with that partner and 19% of men and 13% of women with spousal partners reported use at last sex with a spouse (Table 57).

The proportion of sex acts in which a condom was used (Table 57) is lower than use at last sex in all categories but very similar to the proportion of respondents who always used a condom (Table 57).

For women, the proportion who reported using a condom every time they had sex was higher than the proportion of acts protected, showing that more acts were occurring amongst those who did not use condoms.

The difference between use at last sex and the proportion of people protected is explained by inconsistent use. For all categories, the proportion of respondents who reported using a condom at least once with that type of partner during the month before the survey was higher than the proportion reporting use at last sex, and considerably higher than the proportion who reported always using condoms. Of respondents who reported having used a condom at least once (condom users) the percentage who reported always using condoms with that partner ranged from 41% (women with their spouses) to 75% (women with their casual partners). Overall, a higher proportion of male condom users were consistent users: 62% versus 56% of female condom users. This is because, compared to women, more of men's partnerships were with non-spousal partners with whom condom use is more common.

ZAMBIA	Number	Condom use at last sex	Percent of acts in last month in which a condom was used	Used condoms every time with:	Used condoms ≥1 time with:
MEN					
Spouse	271	18.5 (14.3-23.5)	13.9 (9.9-17.9)	13.3 (9.7-17.9)	29.5 (24.4-35.3)
NSP	1151	49.8 (46.9-57.4)	46.3 (42.9-49.7)	39.7 (36.9-42.5)	56.4 (53.5-59.2)
Anyone	1389	43.8 (41.3-46.4)	33.5 (30.5-36.5)	34.6 (32.2-37.1)	55.4 (52.9-58)
WOMEN					
Spouse	1905	13.3 (11.9-14.9)	8.9 (7.7-10.0)	8.2 (7.0-9.5)	19.7 (18-21.5)
NSP	769	53.8 (50.3-57.4)	43.7 (39.1-48.1)	44.9 (41.3-48.5)	59.7 (56.2-63.1)
Anyone	2688	24.2 (22.6-25.9)	13.4 (12.2-14.6)	18.1 (16.6-19.6)	32.0 (30.3-33.9)

Table 57: Condom use indicators for Zambia

7.5.4 NSA: Using respondents' estimates of the number of sex acts with and without a condom in the month before the survey

The condom estimates from the NSA (Table 58) are higher than the estimates of use with any type of partner for Australia, Rwanda and Zambia. This is most probably because the respondents in the NSA are younger and very few are married. Therefore more of their sex acts took place with non-spousal partners than in the other surveys. The NSA estimates are based on the three months before the survey whereas the Rwandan and Zambian estimates are for the month before the survey.

In these data there is less difference between the estimates of use at last sex and the percent of acts protected than seen in the other countries. This could be because use is more consistent among NSA respondents, or that there is less variation in coital frequency among this group compared to the respondents in the other surveys. The proportion who used condoms every time during the month before the survey is not that different to the other countries: 34% of men in Rwanda, 40% of Zambian men and 44% in Australia. In Australia the proportion using a condom every time during the 3 months before the survey is similar to the estimate for the month before (45%). Lack of variation in coital frequency appears the most likely explanation for the similarity between use at last sex and the proportion of acts protected and this is confirmed by Figure 51. Coital frequencies in these surveys are lower than in the surveys with older respondents. Figure 51 shows that, in the NSA countries, most of the report a small number of acts without a condom. Those who report any condom use in Burkina Faso and Malawi typically report low numbers of acts both with and without condoms.

NSA	Number	Condom use at last sex	Percent of acts in last 3 months in which a condom was used	Used condoms every time
MEN				
Burkina Faso	335	46.6 (37.9-55.6)	45.2 (36.4-53.9)	40.2 (31.0-50.1)
Ghana	78	47.2 (33.5-61.4)	46.1 (24.2-68)	40.1 (28.4-53.0)
Uganda	258	43.0 (35.5 -50.9)	35.5 (27.8-43.1)	30.5 (24.1-37.7)
Malawi	286	30.7 (24.0-38.3)	27 (20.3-33.7)	22.0 (16.7-28.4)

Table 58: Condom use indicators for NSA

7.5.5 Influence of coital frequency

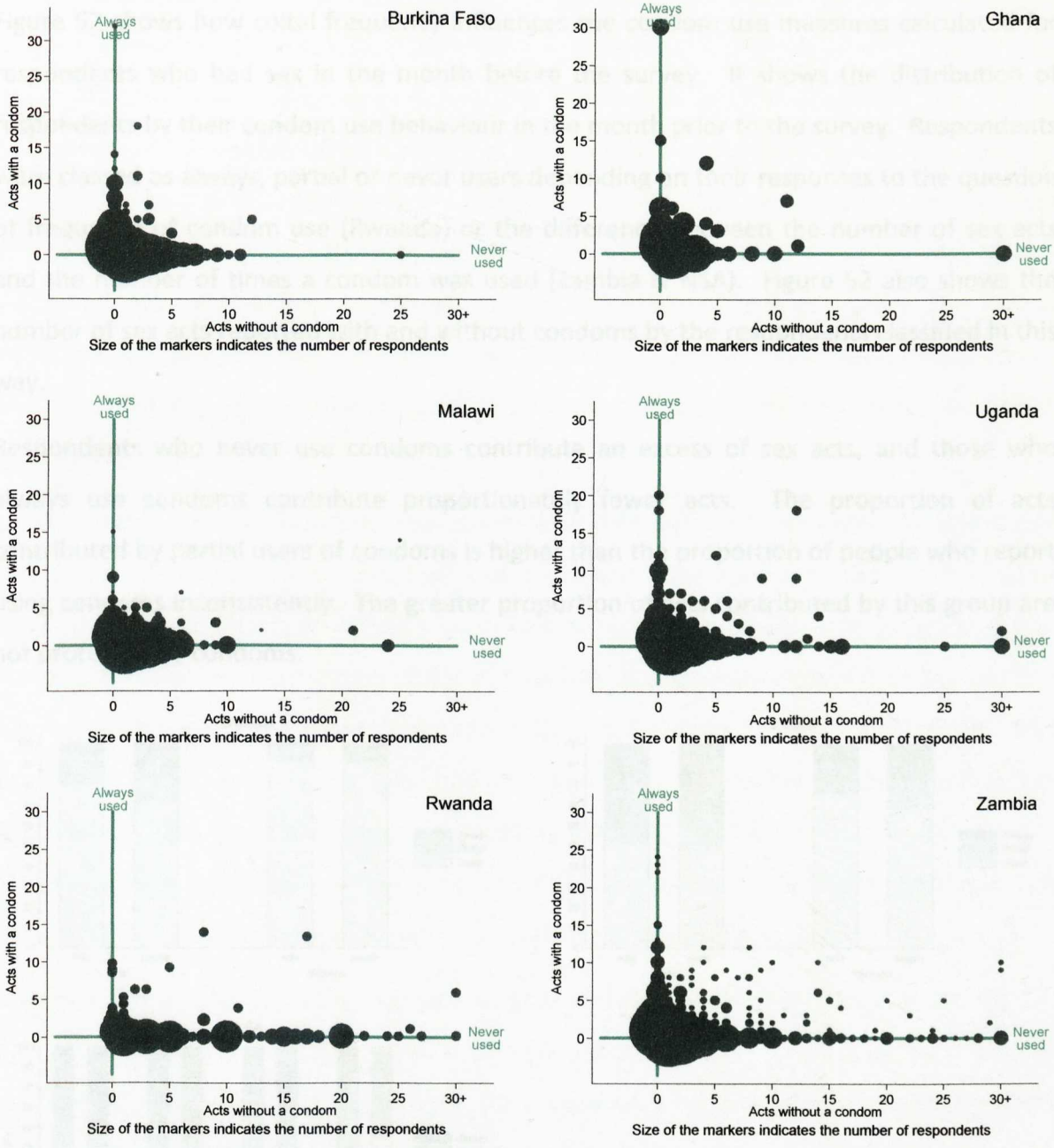

Figure 51: Distribution of sexually active respondents by number of sex acts with and without a condom.

Figure 51 shows that the majority of respondents reported that all or most of their sex acts were without a condom. Most inconsistent users reported less than half their acts were protected by condoms. The number of sex acts by never users exceeds that of always users. No correlation is evident between the number of acts with and without condoms. In the

four NSA surveys of young men, fewer respondents report large numbers of sex acts compared to the other two surveys. There is more variation in Uganda, and this is the survey with the largest difference between the estimates of use at last sex and the proportion of acts protected.

Figure 52 shows how coital frequency influences the condom use measures calculated for respondents who had sex in the month before the survey. It shows the distribution of respondents by their condom use behaviour in the month prior to the survey. Respondents were classed as always, partial or never users depending on their responses to the question of frequency of condom use (Rwanda) or the difference between the number of sex acts and the number of times a condom was used (Zambia & NSA). Figure 52 also shows the number of sex acts reported with and without condoms by the respondents classified in this way.

Respondents who never use condoms contribute an excess of sex acts, and those who always use condoms contribute proportionately fewer acts. The proportion of acts contributed by partial users of condoms is higher than the proportion of people who report using condoms inconsistently. The greater proportion of acts contributed by this group are not protected by condoms.

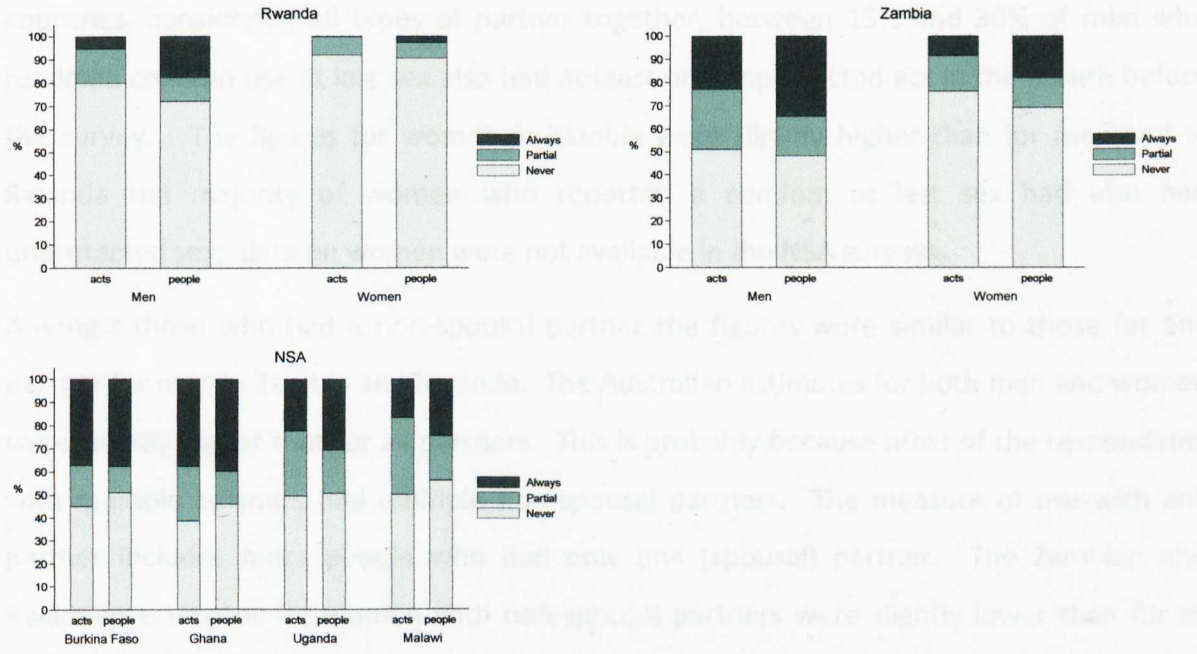

Figure 52: Distribution of sex acts in the last month, and sexually active respondents, by condom use patterns.

7.5.6 Misclassification by last sex based measure

From an STI prevention perspective, the goal of condom use promotion is to achieve consistent use. Therefore the gold standard measure of condom use is the proportion of people who always use a condom. The proportion who used one at last sex is informative and easier to measure, but how well does it capture the always users? This can be examined in a way analogous to calculating the specificity of a diagnostic test. What percentage of those who used a condom at last sex are false positives. i.e. what proportion of condom users at *last* sex did not use one in *all* sex acts. This proportion is given in Table 59. The calculation was done for all types of partner combined and also for non-spousal partners because condom use at last sex with non-spousal partners during the last 12 months is one of the MDGs. In this analysis the same indicator is calculated for the month before the survey because the consistency of condom use is available only for the month prior to the survey.

In the Australian data this discrepancy can only be detected for people who had more than one partner in the reference period because there was no directly reported information on frequency or consistency of condom use. This is most probably why the proportion who have been misclassified is much smaller in Australia than the other countries. In the other countries, considering all types of partner together, between 15% and 30% of men who reported condom use at last sex also had at least one unprotected act in the month before the survey. The figures for women in Zambia were slightly higher than for men and in Rwanda the majority of women who reported a condom at last sex had also had unprotected sex; data on women were not available in the NSA surveys.

Amongst those who had a non-spousal partner the figures were similar to those for any partner for men in Zambia and Rwanda. The Australian estimates for both men and women were slightly higher that for all partners. This is probably because most of the respondents with multiple partners had multiple non-spousal partners. The measure of use with any partner includes more people who had only one (spousal) partner. The Zambian and Rwandan estimates for women with non-spousal partners were slightly lower than for all partners. This suggests that Zambian and Rwanda women use condoms more consistently

with non-spousal partners than with spousal partners. However a substantial proportion of those who used a condom at last sex did not use one all the time.

Percent of condom users at last sex that did not always use a condom		Men	Women
NSP			
Australia	1 month	3.1	2.4
	12 months	8.6	7.3
Zambia		23.0	18.1
Rwanda		25.0	40.0
Any partner			
Australia	1 month	1.8	1.2
	12 months	5.7	5.0
Zambia		25.0	28.1
Rwanda		25.6	55.6
Burkina Faso		16.8	-
Ghana		15.2	-
Uganda		30.1	-
Malawi		30.3	-

Table 59: Percentage of respondents who used a condom at last sex who did not always use a condom in all sex acts.

7.6 Discussion

The aim of this chapter was to understand whether simple measures of condom use are biased by differences in coital frequency since:

a) Coital frequency is *a priori* a determinant of the number of condoms used.

b) Coital frequency is associated with relationship to partner and time since last sex.

c) Condom use is also associated with relationship to partner and time since last sex.

It takes more effort to generate a measure of condom use that is weighted by coital frequency, both in terms of data collection and analysis. However, there are potential benefits to constructing and using such measures. They may be more useful for understanding the epidemiology of STIs and they can provide more accurate estimates of the numbers of condoms used and needed. An important practical question is the extent to which levels of condom use are linked to supply of condoms: demand may drive supply, but does a lack of supply diminish use? Questions of this sort cannot be tackled using sales data because these are commercially sensitive and therefore not widely available, because condoms may be wasted rather than used and because many condoms are not sold but distributed free of charge. Programmes do not keep sufficiently detailed statistics on the destinations and numbers of condoms distributed to permit this sort of analysis. Were these data available it would be complicated to put together all the data from different agencies distributing condoms in the same locality, at different points in time, in order to build up a clear picture of supply patterns and continuity of supply in particular locations.

This chapter shows that:

- The proportion of people who use a condom every time they have sex can be calculated by combining information on use at last sex and another reported measure of consistency of use. It shows how this information can be combined for all partners, to describe the proportion of respondents who are "safe" because they use condoms in all their sex acts.
- The proportion of sex acts in which condoms are used can be calculated using information on condom use and coital frequency. This can be done for a variety of different questionnaire designs.

- Some questionnaire designs introduce systematic differences to measures of condom use. These arise when data collection is restricted to certain types of partner or to those with whom last sex occurred within a certain time frame.
- Improvements to questionnaire design could produce better data with which to estimate measures of condom use. The current defects exist largely because of a focus on collecting simple indicators and not because it is too difficult to collect the necessary data- the components of a comprehensive questionnaire have been used by the different surveys in this thesis, what remains is to bring together all of these components in one survey.
- Measures of condom use based on use at most recent sex may be inflated by contributions from those who have sex rarely, which is apparent in the Australian, Rwandan, Ugandan and Zambian surveys in which use at last sex with any partner exceeds the proportion of acts in which a condom was used by 1.1% to 10.9%.
- In these surveys, measures of condom use that describe the proportion of people who use a condom every time they have sex are higher than the proportion of all sex acts in which condoms are used because those who used condoms all the time tended to have less sex than those who did not.

When comparing across populations, or examining changes within a population over time, it is important to note that estimates of condom use at last sex may be influenced by changes in partner mix, coital frequency, uptake of condoms and consistency of condom use within and between partnerships. It may be difficult to interpret trends in an indicator based on last sex in the absence of information on these other aspects of behaviour. Declines in condom use at last sex may actually represent a shift towards safer behaviour if people shun casual partnerships and stick instead to a mutually monogamous spouse and discard condoms in the process.

The proportion of people who always use condoms has the same difficulties of interpretation as condom use at last sex but one important advantage: condom use at last sex does not mean that individuals are adequately protecting themselves from STIs whereas condom use in every sex act does show this. It is therefore easier to draw epidemiological conclusions from this measure than one based on use at last sex. Trends in this indicator

could still be obscured by changes in partner mix, as outlined above, and so it is important to consider this indicator separately by types of partner or with supporting data on partner mix.

The proportion of sex acts in which condoms are used is also important for epidemiological purposes since it shows that a high proportion of people who always use condoms does not necessarily mean there is less scope for the spread of infections. Declines over time in the level of this indicator might also be indicative of a shift towards "safer" partners: the types of spousal partnership in which coital frequency is high and condom use is, typically, low.

Taking both the proportion of acts protected and the proportion of people protected provides information on both aspects of condom use. The proportion of people who used condoms at last sex is a hybrid of these two measures and, although easier to collect and analyse, it is less informative.

In this chapter it has been assumed that systematic differences in condom use and in coital frequency may be determined by a similar mix of causes. These differences may arise independently or there may be causal associations between use of condoms and frequency of sex. The frequency of sex may influence choice of contraceptive method – people who have frequent sex may prefer a coitus independent method. People who have more frequent sex must also make more effort to use condoms correctly for every sex act. It may be that a greater number of sex acts increases the chance of inconsistent use. This does not alter the conclusions outlined above, but emphasises the importance of capturing the different aspects of behaviour since they may interact to increase, or decrease, risk of STIs.

Decisions about the time period for which data are collected are likely to influence the results obtained for condom use measures. Shorter time frames are likely to include respondents in active relationships, who may be more similar with respect to coital frequency than respondents whose sexual activities are only captured by a longer reference period. Shorter reference periods may minimise differences between measures that are due to differences in coital frequency, but may bring other problems regarding sample size and precision of the estimates. They may also miss certain types of infrequent sexual activity which may be of particular interest for the study of STI epidemiology.

7.6.1 Limitations

It is unfortunate that it was not possible to directly compare the different methods used to construct these indicators within the same dataset, or even the same country. The ASHR data lacked a partner specific estimate of frequency of condom use and did not collect the number of sex acts with a condom; the Zambian data did not contain an estimate of the frequency of condom use whereas the Rwandan data omitted the number of sex acts with a condom which was collected in Zambia. The NSA respondents were not asked how often they used a condom but were asked the number of acts in which they used condoms. Since the indicator comparisons from each country agree, the substantive conclusions about the relationships between the different indicators seem reliable. However, it is hard to compare the relative merits of the three different methods of data collection i.e. obtaining a subjective frequency estimate from the respondent, obtaining the number of sex acts with and without a condom and using the proportion of respondents who reported use at last sex as a proxy for the proportion of acts in which condoms were used within a partnership.

The partner mix in the survey samples may not be representative of the true mix in the population because of the questionnaire designs. The Australian and NSA data are likely to be the most accurate because they are based on a partner history, whereas the Rwandan and Zambian data invited responses for a single partner in each of the four categories. This potentially inflated the number of reports about certain types of partner relative to others.

Condom use measures based on the proportion of people protected and the proportion of acts protected can only be useful if based on good data that do not require untestable assumptions for analysis. These results show that the proportion of acts are protected with condoms is smaller than the proportion of people who use condoms. This is plausibly explained by differences in coital frequency between condom users and non-users. However, it was not possible to calculate these measures without assumptions about the representativeness of the partners included in the surveys, and in Rwanda and Australia, assumptions about the consistency of condom use. These assumptions may not have been correct, and therefore the measures of the proportion of people protected and the proportion of acts protected may not reflect the true values in these populations.

7.6.2 Summary

In Zambia and Rwanda the differences between the estimates are larger than in the other countries. That the differences are most apparent in Zambia and Rwanda is probably entirely due to the differences in instrument design and study population: these two surveys had a wider age range than the NSA. The Australian survey did not collect a measure of frequency of condom use so all respondents had to be assumed to be either 'always' or 'never' users.

Coital frequency does influence measures of condom use. Partner mix is also an important component. Condom use measures based on proportion of acts protected, or on use at every coitus rather than on a single occasion, are not vulnerable to bias or confounding arising from systematic differences in coital frequency. They are still vulnerable to differences in the mix of different types of partner between populations or in the same population over time. Partner mix should therefore be measured alongside condom use.

The proportion of acts in which condoms are used, and the proportion of people who use condoms in all of their acts are complementary pieces of information and should probably be considered together. Condom use at last sex is a hybrid of the two, and consequently harder to interpret. From the perspective of HIV epidemiology it is not clear which is the more important aspect – the proportion of people or acts protected? This probably depends on the rate of partner acquisition and the age/stage of the epidemic (i.e. proportion of people newly infected and therefore highly infectious). This would suggest both measures are useful.

Chapter 8 Discussion

8.1 Summary of the results

This thesis began with an interest in condom use measurement and speculation as to why, at the population level, changes in condom use were not reflected in STI prevalences over time. It seemed that deficiencies in the way condom use was measured were at least as likely an explanation as an inadequate level of condom use, or because of incorrect use of condoms. The original intention was therefore to demonstrate these inadequacies in measurement, to show their potential impact on our understanding of condom use trends and to suggest better ways to measure condom use. It immediately became apparent that the problem of accurately measuring condom use stemmed partly from a lack of data on coital frequency. Coital frequency is *a priori* a crucial underlying determinant of exposure to STIs. Since condom use could not be accurately measured or summarised without information on coital frequency, it was important to first establish the nature and utility of available information on coital frequency.

The review of the literature on coital frequency (Chapter 2) highlighted the paucity of information. The published studies related mainly to marital sex and focussed almost entirely on women. Little was known about men. Most of the data were several decades old and many were not representative of the general population. Much of the literature concerned Europe and the USA, there was little from the developing world. Most authors found declines in coital frequency with increasing age and/or marital duration. However, the small size of most datasets and limited supporting information precluded sophisticated analysis in most studies.

There was more data on coital frequency than had been analysed and reported on in published literature. Several sources of data that had not previously been analysed, or which had not been systematically analysed, were used in Chapter 3 to estimate coital frequency, classified by various background characteristics.

The review and analysis of the data confirmed that the association between increasing age and coital frequency, which had been observed in the literature for other countries (e.g. [43]), was evident in both Australia and Britain.

This chapter examined the role of marriage and showed that most sex occurs within marriage. Within a population, the group who are currently married are more homogeneous with respect to coital frequency than never married or formerly married people. However, the largest observed cross-national variation is amongst married people. Cross-national variation is substantial and in some case dwarfs the differences by marital status within surveys.

The data review contributed scarce information on male coital frequency and revealed some asymmetry in reporting between men and women. This may be partly due to differences in the age ranges covered by the surveys and to differences between the ages of male and female partners. It is common for male partners to be older than female partners [48] and, on this basis, some of the partners of survey respondents would not have been eligible for survey (female partners aged less than 15 and male partners aged 45/50+) which could have introduced some imbalance in the total numbers of acts reported by men and women.

Differences in reporting are another reason for a difference between male and female estimates [28 32]. Women may have described boyfriends as spouses and men may have described girlfriends as casual partners. This might stem from gendered differences between men and women in how partners are classified which may reflect a desire to present socially acceptable sexual partners. The socially acceptable partners could be different for women ('spouse' instead of 'boyfriend') and men ('casual' rather than 'girlfriend').

Some difference in classification may arise when there is disassortative mixing with regard to marital status. There is some evidence for this in the data: never married women had a higher coital frequency than never married men. Formerly married men had a higher coital frequency than formerly married women. This is most easily explained by formerly married men having sex with never married women but rarely vice versa. These differences by marital status are clear in Britain and Australia, countries where the age structure is such that the numbers of (older) formerly married men could be sufficient to pair up with never married women and therefore to explain this pattern. In these populations, where marriage occurs at older ages and marital break ups are common, the age gaps between formerly married men and never married women can be quite small making such partnerships more

likely. If the age gaps are larger than between partners of the same marital status then the age restriction of the surveys makes the omission of one partner from a couple with different marital status more likely than from a couple with the same status.

The estimates from individual surveys should be treated with caution because the type of survey, the instrument used and the timing of the survey might have influenced the estimates obtained. In eight countries it was possible to calculate estimates for more than one time point and in all countries there were differences between the estimates from the different time points. None of the surveys carried out at different times were directly comparable; even in the four countries in which there were two DHS the survey format changed slightly between the two rounds.

The same is broadly true of the differences between countries, which may also have been partially due to differences in survey methods. On the other hand, many of these estimates come from DHS which, at least within survey rounds, should have used similar methods and survey instruments and which still revealed cross-national differences.

There were no regional patterns to the differences in coital frequency. West Africa may have lower coital frequencies than elsewhere, as previously suggested[5]. However, this is far from clear cut in this analysis based on DHS data from 16 African countries unlike the previous analysis by Brown which used a subset of DHS data from 9 African countries.

Cross-national differences did not arise because of differences in age structure between countries. Countries with a large proportion of the adult population in their twenties, when coital frequency is highest, might be expected to have a higher average coital frequency than countries with very young, or very old, populations. Controlling for age structure produced estimates net of this effect but the cross-national differences remained.

Differences between countries could be due to differences in the sexual culture, in physiology or environment. If the differences between the countries are real, it would be reasonable to expect some geographic pattern to the differences, such that countries which are near neighbours, and which therefore share similar cultures, physiologies and environments, might be more similar. This is not evident in the available data but that may be due to shortcomings in these data.

Summary of the existing knowledge/data on coital frequency

The data and literature review chapters confirm that it is important to consider coital frequency when measuring and comparing summary measures of sexual behaviour. There are differences in coital frequency between sub-groups of survey respondents. These differences may potentially confound measures of sexual behaviour compared between groups or over time. These differences are not sufficiently systematic in nature to allow one to avoid possible confounding by stratification of indicators on a few key variables. Coital frequency must therefore be accounted for directly.

Differences in coital frequency might be determined by the same factors that determine exposure to STIs. Or the factors that determine coital frequency and exposure to STIs might share the same root cause. Given the strong possibility that coital frequency and STI exposure share the same determinants, and may influence each other directly, this makes it even more important to include coital frequency in any comparative analysis of sexual behaviour.

Given that coital frequency should be measured, the immediate problem is a lack of data. More surveys now make some attempt to measure coital frequency, and there has been recent interest in these data following a UNAIDS reference group meeting on concurrency[86]. Even if, going forwards, coital frequency is more widely measured in surveys there is still a need for retrospective data with which to understand trends over time. If the widely available data on time elapsed since most recent sex (TSLS) could be used to generate a proxy measure of coital frequency this would facilitate trend analysis. Chapter 4 described the theoretical conditions under which the relationships between TSLS and mean coital frequency were close enough to allow regression methods to be used. In Chapter 5, this approach was tested on real data from Australia. The success of using TSLS to estimate coital frequency rested on being able to divide survey respondents into groups that shared the same underlying coital frequency distribution based on other characteristics which had been measured in the survey.

The ASHR was the only dataset suitable for this analysis: it had a large sample, had comprehensive information on sexual behaviour in the recent past and had obtained both TSLS and the respondents' estimates of the number of sex acts in the four weeks prior to the

survey. However, the numbers of sex acts predicted by the gamma regression model fitted to TSLS showed little correlation with the numbers reported by respondents and the variance of the predicted values was much smaller than that of the reported values. It emerged that the covariates included in the regression model had not identified respondents that shared the same underlying coital frequency distribution. The ASHR data had information on most of the factors shown in the literature to be correlates of coital frequency but it is unlikely that these factors are the only influences on coital frequency. The factors measured in surveys may have only a minor influence on coital frequency. The results from the analysis of ASHR data concurred with the results using simulated data and therefore, in summary, TSLS from real survey data cannot be used to provide an estimate of coital frequency because it is not possible to allocate respondents into groups which share the same underlying rate of coital frequency.

This means that survey-based estimates of coital frequency must be derived from more direct questions about the number of sex acts in a given period. This raises the question of how best this can be achieved. Short reference periods tend to improve the accuracy with which behaviours can be recalled and therefore reported and coital frequency is probably no exception. However, a short recall period will typically yield a large number of zero reports from respondents who have sex infrequently (with that partner). A longer period would capture more information but may compromise the accuracy of the respondents' reports.

The ASHR data were also used to investigate the correlates of the number of sex acts reported within partnerships for the 14 days before the survey and in total for each respondent for the month before the survey. The associations observed in these data concur with those reported in the literature: declines in the reported number of acts were seen with increasing age; respondents with a partner 5 or more years older reported fewer sex acts; respondents with newer partners (< 6 months duration) reported higher number of acts and condom users reported fewer acts than non-users(see for example [4 43-44]). These models also revealed a new association, people with more partners reported more sex acts, not only overall but also with individual partners. This association was mediated by the types of partners: certain combinations resulted in markedly higher numbers of sex acts compared to people with only one spouse.

In Tanzania, the Kisesa cohort study (part of the Tazama project) included questions on coital frequency with spouses and regular partners in the fifth sero-survey. All adults resident in the study area (Kisesa ward) were eligible for this survey which included detailed questions on sexual behaviour. The questions on coital frequency were designed to eliminate the problem of zero reports by asking a series of questions. Respondents were asked how many times they had sex, with each of their partners. Initially they were asked for the number of times in one week. If a non-zero answer was obtained the interviewer skipped the remaining coital frequency questions. It the answer was zero the question about coital frequency was repeated for one month and if the answer was still zero the respondent was asked how many times in the last year. Respondents who gave a non-zero answer to acts in the last month were not asked about coital frequency in the last year.

These data were used to explore the factors associated with coital frequency in this large dataset.

Collecting the data in this way did alleviate the problem of zero reports and results were obtained for almost all respondents which indicates that the method was acceptable to both interviewers and respondents. However, the interviewers and respondents in Kisesa are experienced in these surveys and may be better at asking and answering questions on sexual behaviour. Most respondents reported frequencies for the week before the survey but a substantial number gave a zero report for both the week and month before the survey. Monthly and yearly frequencies were reported more often for regular partners than for spouses and more often by women compared to men.

It would have been possible to ask all respondents about the number of sex acts in the three periods (week, month, year) but this would have increased the number of questions in a long questionnaire and it might have been difficult for respondents having regular sex to report the number of acts in a year with any accuracy.

Most surveys that collect coital frequency do so for the month (or 4 weeks) before the survey. At the population level, the zero reports do not matter too much as some respondents with low coital frequency will have contributed a non-zero number of acts and therefore the average across all respondents will reflect the true underlying frequency. The problem with zero reports arises when using the number of sex acts to describe exposure to

risk of infection or pregnancy at the individual level, or as a correlate of other behaviour. The respondents with zero acts in the last 4 weeks include both those with a low coital frequency and those whose coital frequency is usually higher but for whom the last month was atypical. The approach used in Kisesa makes it possible to distinguish these two groups and therefore provides a more accurate estimate for each respondent. By setting the longest reference period to one year, the only respondents with a frequency of less than once a year will be grouped with those respondents whose frequency is truly zero and for practical purposes this distinction is unimportant.

The negative binomial regression models applied to these data confirmed some of the associations seen in the literature (pregnancy, age, duration, early first sex[4 36 43 81]) and revealed some new ones. There are few large datasets from Africa with such detailed information on coital frequency, so this analysis allowed the discovery of more complex associations than had previously been observed. The most interesting finding, in relation to STI prevention, is that people with more partners tend to have more sex with each of their partners compared to people who have just one partner. Among those respondents who reported multiple partners, this effect is modified by the mix of different types of partner.

Married men with a regular partner in addition to their spouse had less frequent sex with each partner. However, married men who also had a casual partner had more frequent sex with their spouse compared to men who had no extra marital partner. No data were collected on the frequency of sex with casual partners. Polygynous men had more sex with each spouse than monogamously married men, an effect that is not explained by differences in age or duration of marriage. There was no effect of polygamous marriage for women even when duration of marriage was controlled for. Remarried women had more frequent sex with their spouse than women in their first marriage.

Coital frequency questions were restricted to those with current partners and so it was not possible to build up a picture of a single respondent's behaviour with all partners over a particular period since coital frequency with ex-partners was not known. It was therefore not possible to replicate the analysis done on the Australian data that investigated the factors associated with the overall number of sex acts for the month before the survey with the respondent as the unit of analysis. Nonetheless, the two datasets from very different

societies, give a similar picture: more partners is associated with higher numbers of sex acts and the size of the increase depends on the relationships with the different partners.

Different partner histories, and mixes of current partners may reflect individual preferences for the amount of sex. In other words, it may be that people who choose to have several partners, over time or concurrently, do so because their sex drive is higher than people who stick to a single partner. Coital frequency is associated with duration of partnerships. For spousal partners in Kisesa higher coital frequencies were seen at the start of the partnership. For men with regular partners the higher coital frequencies were observed later in the partnership. A relatively high coital frequency may indicate that the partnerships are "happy" ones[3] which are therefore maintained and a high coital frequency may make a partnership successful and therefore worth maintaining.

Opportunities for sex may further modify this dynamic – in Kisesa there was evidence of a higher frequency with regular partners who lived close to the respondent. Opportunities also varied by the type of partner and social acceptance of such partnerships. Men in polygamous marriages, where the multiple partnership is overt and socially sanctioned, showed higher coital frequency per partner than men in monogamous marriages. Amongst married men with a regular partner, which may not be socially acceptable, the per partner frequencies were depressed. If those who sought extra-marital partners did so because of deficiencies in their relationship with their spouse this could explain the lower coital frequency with the spouse compared to those without extra-marital partners.

It seems likely that there is not one causal association between partner status (married, regular, none), number of partners, duration of partnership(s) and coital frequency (with each partner). These factors probably influence each other. It is important to remember that cross-sectional survey data capture a snapshot of partnerships: some regular partners will evolve into spousal relationships and may already resemble those types of partnership at survey. Others will be more akin to a casual partnership. Longitudinal data would therefore be most helpful in elucidating these associations.

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[3] This assumes that people have the autonomy to refuse or instigate sex, or to discontinue a relationship, and this assumption is unlikely to be true in all circumstances.

If coital frequency is inextricably linked with numbers and types of partnerships it will affect the interpretation of condom use estimates, but only if it is measured directly will we be able to allow for its effects.

Chapter 7 showed how simple measures of condom are influenced by coital frequency, and to demonstrate how measures that accounted for coital frequency could be generated, and how our interpretation of levels and trends of condom use could be affected by choice of measure.

There was not one single source of data that provided all the information that was needed to construct and compare the full range of condom use measures. Consequently, different data sources were used to compare different pairs of measures of condom use. These comparisons had the additional benefit of revealing strengths and weaknesses in the different approaches to survey and questionnaire design.

There is no doubt that condom use measures based on last sex are easier to capture in surveys, and to analyse, than measures based on frequency or consistency of use. The latter require more questions to be asked and more complicated analysis. Some simplifying assumptions allowed available data to be used to calculate the proportion of people who used a condom every time they had sex and to calculate the proportion of sex acts in which condoms were used. The biggest obstacle to doing this more widely is the availability of full information on all partnerships within a fixed time duration. Within surveys some questionnaire designs limited what could be calculated because data were collected only for certain types of partner, or for a restricted time. This required assumptions about what might have happened with other types of partner, or outside the reference period. The ASHR, which has the richest data about coital frequency did not include direct questions about either the consistency of frequency of condom use. Many surveys confine their condom use enquiries to what happened at the time of the last sexual intercourse, and this limits what can be learnt about condom use. Recommendations for improvements to questionnaire design are presented in the last part of this chapter but it is worth noting that most of the deficiencies appear to exist because the data need was not anticipated rather than because of any inherent difficulties in collecting the information.

Three measures of condom use were compared: condom use at last sex, the proportion of sex acts in which a condom was used and the proportion of people who used a condom in all their sex acts. The latter two measures take coital frequency into account and provide complementary information. A high proportion of individuals who ever use condoms may not equate to a high proportion of sex acts protected, if the condom users contribute fewer acts than the non users, or if the people who used condoms are not consistent users. Use at last sex reflects both the proportion of users and the consistency of use, and changes in this measure over time may reflect changes in either or both aspects of use.

This analysis suggests that the measure based on use at most recent sex produces a higher estimate of condom use than that based on the proportion of acts protected. This is because the estimate of use at most recent sex is inflated by contributions from those who have sex rarely. In this analysis, consistent condom users reported fewer sex acts than non-users and inconsistent users. This was evident both in the data analysed in Chapter 7 and also in the analysis of data from Kisesa. Therefore measures of condom use that describe the proportion of people who use a condom every time they have sex are higher than the proportion of all sex acts in which condoms are used.

These findings suggest that the measure based on use at last sex does not give a comprehensive or unbiased picture of condom use. Within a partnership consistency of use may change over time- for example, in response to increasing trust or the introduction or discontinuation of other contraceptive methods. At the population level, changes in behaviour that promote the stabilisation of partnerships, or change the partner mix by, for example, reducing the proportion of casual partnerships could alter the proportion of partnerships in which condoms are used, the proportion of partnerships in which condoms are used consistently and the coital frequency since this is also linked to the partner mix.

A substantial proportion of people could be misclassified if use at last sex is used as a proxy measure for the proportion of people who are protecting themselves against STIs by using condoms. Between 15% to 30% of men and up to 55% of women who reported condom use at last sex were inconsistent users and had not used condoms in all their acts. Condom use at last sex may present an overly optimistic picture of condom use in populations where many people are inconsistent users.

Implications for condom use measurement

To take coital frequency into account when measuring condom use means collecting more information than is normally included in surveys on sexual behaviour. As shown in Chapter 4, the number of sex acts cannot be deduced from TSLS, which is the most commonly collected piece of information related to coital frequency. Few surveys collect the reported number of sex acts and those that do may ask this question for only a subset of reported partnerships. Better data on coital frequency need to be collected in order to produce better estimates of condom use. It is not possible to produce proxy measures of coital frequency from most existing survey data.

More detail is also needed on condom use: it is not sufficient to include questions only on use at last sex. Additional questions are needed, for each reported partnership, about consistency or frequency of use. Internal consistency checks on the datasets used in Chapter 7 showed that information about frequency of use (never, sometimes, always) or the consistency of use (number of acts in which a condom was used) did not have a perfect correspondence with use at last sex. This is probably because both these questions are difficult for respondents to answer accurately and this increases the chance that they provide contradictory information. Reporting bias, and the desire to present themselves in a socially desirable way, may play a part but since the inconsistencies were apparent both for users and non-users this may not be an important reason for the discrepancy. Reporting bias may also affect responses to questions about use at last sex.

In order to describe condom use comprehensively, it is essential for surveys to collect some measures of how often, and how consistently they are used. A compromise between data needs and reporting constraints might be to ask respondents who used a condom at last sex whether, during a set period of time, they had sex with that partner and did not use a condom. Respondents who did not use a condom at last sex can be asked whether, during the reference period, they used a condom with that partner. This approach does not produce an exact, individual level count of the number of protected and unprotected sex acts. However, if respondents cannot accurately report these counts, there is little merit in trying to construct them, and it is better to construct upper and lower bounds for number (and proportion of) protected acts at the population level. It would also be possible to derive a measure of acts protected in the population by tabulating use at last sex for

partnerships where inconsistent use was reported. The resulting proportion would indicate the proportion of acts among inconsistent users in which a condom was used. This could be combined with information on the number of acts contributed by inconsistent users to generate a proportion of acts protected at the population level.

Generating measures of condom use that account for coital frequency implies new data collection because the requisite information is not available from current large scale surveys that are representative of the general population.

8.2 Recommendations

8.2.1 What new information would be essential

The additional information needed to measure condom use accounting for coital frequency implies new questions but also increasing the scope of questionnaires to ensure that **all** partners in the chosen reference time period can be described. The information required is:

- **A partner history that includes for each partner:**
  - A direct measure of coital frequency, which could be one of the following:
    1. Number of times in the last 4 weeks
    2. Kisesa approach (# in last week, if 0 # in last month etc)
    3. Time since last sex, time since penultimate sex
  - Condom use at most recent sex
  - A measure of the consistency/frequency of condom use, one of:
    1. Subjective assessment of frequency of use (e.g. always, often, seldom, never)
    2. Number of acts during the reference period in which condoms were used
    3. Whether never/ever used a condom with the partner for whom use/non-use at last sex was reported

Partner history

It is essential to include a partner history and to ask questions about each sexual partner encountered during the reference time period. At present, few surveys do this. Some surveys ask questions about particular types of partner, with the risk that some types of partner are missed altogether if the respondent doesn't think they fit any of the predefined categories. Most surveys that include partner histories limit them to a set number of partners within a fixed period.

There are three practical formats for the partner history:

Format A) ask about the last three partners in the 12 months prior to the survey

Format B) ask about the last X partners regardless of the time (X can be any number)

Format C) ask about all the partners in the Y months prior to the survey (Y can be any number)

	A) Last 3, last year	B) Last 3*, any time	C) All in last year†
Completeness	Incomplete	Complete	Complete
Fieldwork time	Least	Most	Middle
Ease of recall	High	Low	Middle
Calculation of standard indicators	Possible	Some problems	Possible
Calculation of concurrency measures	Some problems	Some problems	Possible

Table 60: Summary of the strengths and weaknesses of the three different questionnaire formats. *Could choose a different number of partners; †Could choose a different time frame

Table 60 sets out the advantages and disadvantages to each approach.

Completeness

Completeness is whether or not it is possible to generate a denominator from the partner history. To calculate the denominator for a particular measure it is necessary to identify respondents who should be included and those who should be excluded. Most indicators are time limited so that they can be used to track trends.

In Format A two limits are imposed on the history: time and number of partners. This means that some respondents will not provide information for a complete time period, usually one year. Anyone who had more than three partners in the year before the survey is not given the opportunity to report all of their partners. There is no numerator or denominator information for the time between the third partner and the start of the year before the survey.

Limiting the partner history to a set number of partners means that respondents who had more than the maximum during the reference period are not given the opportunity to describe the excess partners. The limit is usually imposed because respondents who have had many partners may not want, or be able, to accurately recall and report details of all their partnerships. However, if they are not given the opportunity to report any information

on those partners there is a gap in the information about the people most relevant for STI epidemiology.

Format C does not suffer from these problems because respondents are given the opportunity to report all of their partners. The information for the reference period, 1 year in this example, is complete.

In practice, three partners is adequate for almost everyone. In most African DHS less than 1% of the sample report four or more partners in the year before the survey. However, that 1% is probably the most interesting section of the population when researching STI transmission.

Format B is complete in terms of partners: everyone has the opportunity to report the same number of partners. However most measures refer to specific periods of time and this approach would make it difficult to calculate time bounded indicators.

Fieldwork time

The fieldwork time will be affected by the criteria used when collecting a partner history. Format A requires the least fieldwork as data are collected for a maximum of 3 partners, and fewer than 3 partners for most respondents. Format B entails the most fieldwork as a greater proportion of respondents will report three partners. Format C entails a bit more work than Format A but not much: the only respondents reporting extra partners are those who had 4 or more in the last year. Format C probably raises the most problems for paper based questionnaires where one must balance wasted paper against the potential for losing additional sheets. For electronic data capture, format C does not pose any greater design problems than format A.

Recall

Format A is probably the easiest to recall since the history covers at most three partnerships all of which occurred in the recent past. Format B is probably the hardest for some respondents since the second and third partners, if they had that many, could have been encountered several years ago for respondents who have been monogamously married for some time. Format C has the advantage of confining recall to the recent past but may be difficult for respondents who have had many partners in that time.

Data processing and analysis

Partner histories also have distinct advantages over asking about types of partner when it comes to data processing and analysis. The partner history has a repetitive structure which facilitates programming to repeat sections of recoding and analysis. This makes mistakes less likely and speeds up analysis. Using a partner history, with no limits on the numbers of partners reported, means that for each respondent there is a complete record of their partnerships during the recent past. This facilitates calculation of other measures of sexual behaviour. This is not possible if respondents are instead asked about experience of different types of partner.

Standard indicators

The standard sexual behaviour indicators used for national and international monitoring and evaluation activities[83-84] have a 12 month reference period. This is fine for Formats C (so long as first and last sex can be dated) but might be problematic if Formats A or B have been used. The problem would arise for respondents whose last three partners occurred in less than a year before the survey. For indicators with a 12 month denominator, there may be some uncertainty as to how to treat respondents for whom there is no data for a portion of the 12 month reference period.

Concurrency measures

Formats A and B pose potential problems for the calculation of concurrency measures[87]. Concurrency measures are, by their nature, defined by time. Formats A and B are both limited by number of partners and do not therefore give a complete enumeration of partnerships for any set period of time. This means that some respondents will have grey areas in the reference period for concurrency measures during which we do not know whether or not they had concurrent partners. Respondents who exceeded the number of partners specified for the history, in less time than the reference period for the concurrency measures, will have this problem.

Ease of reporting

The partner history format, which is usually in reverse chronological order, may not be a natural way for respondents to list their partners. Increasing use of computer assisted interviewing could overcome many of the problems with this format. Partners could be

listed in any order, and reorganised later, providing dates are reported. Wording of questions could be tailored to the type of partner being discussed, even if the substance of the question was unaltered. If the first question for each partner asks about the relationship then the subsequent questions in that block can be worded appropriately. Instead of asking "When did you last have sex with this partner" to a respondent who has just described the partner as a spouse the question can be phrased "When did you last have sex with your wife". Computer based surveys do not suffer the same constraints regarding wasted paper or insufficient sheets for some respondents.

Coital frequency measures

Of the three approaches outlined above for collecting data on coital frequency, the third listed is the untried approach of collecting the dates of the last and penultimate sex acts. The reciprocal of the number of days elapsed between the two acts would give, for each partnership, a daily coital rate. This interval is a closed interval (between two events) in contrast to the time between last sex and interview which is an open interval. The closed interval could be more useful because it can be directly related to frequency. With an open interval one must make an assumption about the shape of the hazard function in order to estimate, from the open interval, the length of the closed interval. For this to be successful, as well as choosing an appropriate hazard function, respondents must be grouped according to their underlying coital frequency, as described in Chapter 4. Using the closed interval avoids these difficulties.

Asking for the two dates may produce fewer normative responses than asking for the number of acts in a given period because it would be harder for the respondent to guess the reason behind asking the question. It would probably be more difficult for a respondent to concoct a socially desirable answer to this question than to a direct question about the number of acts. If recall was difficult, because sex was some time ago or infrequent, then the respondent may need to give estimated times.

This approach would avoid the problem with zero reports and would be suitable for all respondents, regardless of the length or type of partnership and would therefore be the simplest form. However, it would be vulnerable, at the individual level to irregularities in the pattern of sex. If people do not have a regular pattern over a period of time, perhaps

due to menstruation, fertile periods, working patterns (e.g. shift work) or temporary separations, then the length of the closed interval could be quite misleading. For example, if sex was interrupted by menstruation for perhaps one week in four then the closed interval that spanned two acts during the three weeks that sex took place would give an overestimate and if the closed interval spanned the fourth week of menstruation then it would give an underestimate. This would not matter at the population level because the timing of the survey would almost certainly be random with regard to these types of pattern, but could be problematic at the individual level. Asking for number of acts in different reference periods (the Kisesa method) is likely to be preferable except where respondents are not expected to be able to recall or report this accurately, or where reporting bias is thought to be a problem.

Measures of the frequency/consistency of condom use

Of the three ways to measure condom use, the question on the ever/never use of a condom with the partner would be the easiest to use but provides only upper and lower bounds on use rather than an actual estimate of the proportion of the time condoms were used with each partner. This approach has been partially adopted in the most recent DHS questionnaire by asking people who used a condom if they have ever not used one with their partner. However, to be useful, the complementary question must be asked to those who did not use a condom at last sex. Asking for the number of sex acts in which a condom was used provides the most information but may not be very accurate and has not been widely used. The reported frequency of use has been commonly used and, although it is hard to validate, may be an acceptable alternative.

8.2.2 Further research

Aside from the additions to questionnaires that are mentioned above, the understanding of coital frequency could be enhanced with information that is not usually collected in surveys. It may not be possible to accurately gather data on personal preference for sex, or on opportunities. It would certainly be difficult to evaluate the attractiveness of survey respondents, even though this may be a profound determinant of coital frequency. But respondents could be asked how often they would like to have sex with each partner and the relative values reported might point to underlying differences between individuals.

Answers to this question would not need to be numeric- categories such as more than, less than or about the same as now would be sufficient.

One night stands & number of sex acts per occasion

One off partnerships, where sex occurs only on one occasion, are important to measure but rather than ask about number of acts with each person it is probably more practical to ask simply about acquisition of these partners. This can be deduced from the partner history if this contains the start and end dates for each partnership. The acquisition of these partners can then be separately modelled. It is then necessary to assume how many sex acts a one night stand might include. In this thesis it has been implied that each sex act is a single act of vaginal intercourse. This is rarely defined for the respondents who are being asked to report the number of acts (except in the ASHR) and so it is impossible to know how respondents demarcate an act. If sex occurs more than once on the same night, or again within a few hours are those acts reported separately or together? It is an important distinction as it affects the number of condoms needed. Little is known about this and qualitative research would be useful for understanding this.

Partner mix

To try to understand changes in partner mix over time, one could attempt to understand the extent to which respondents had opportunities to enter into new sexual relationships during the recent past, including those that did not actually culminate in sex. Partnership formation relies on at least one party actively seeking a new partnership and the other, if not also actively looking for a new partner, at least accepting the proposition. This does exclude coerced sex, but in reality few of these encounters may be reported in surveys of the general population. Changes in partnership formation and partner mix can arise from changes in the extent to which people actively seek new partners and also if people become more or less reluctant to accept offers for new partnerships. The extent to which partnerships are sought out might influence condom use. Qualitative research could help understand this.

The characteristics analysed in this thesis (condom use, coital frequency, partner numbers and mix) are not stable over a lifetime. The way in which people start their sex lives could profoundly influence behaviour in later life[81 88]. This may lead to differences between birth

cohorts that are not directly related to the prevailing social norms or behaviour change campaigns. Longitudinal data can help unravel these dynamic processes and reveal how behaviour evolves over lifetimes, and over time.

The Sero 5 data from Kisesa are the first on coital frequency from this population. A second round has already been collected, but is not yet available for analysis. As further rounds of data are collected it will be possible to build up pictures of individuals' coital frequencies as they age, and as their circumstances change. This will make it possible to assess the extent to which coital frequency is an individual attribute that remains fairly constant over a lifetime or more a product of circumstances. Do people enter into sexual relationships to satisfy some pre-determined appetite for sex, or does coital frequency change with one relationship to the next, and as relationships evolve over time?

Another way to investigate this question is by linking data from partners. Using Sero 5 and DSS data from Kisesa it is possible to identify cohabiting couples and therefore it would be possible to compare their reported frequencies to see the extent to which couples give similar estimates. However, as more longitudinal data are collected, it will become possible to compare coital frequencies in people who have changed cohabiting partners, and to look at what happens when a monogamous marriage becomes polygamous. These comparisons could shed light on the extent to which coital frequencies are determined at the partnership rather than individual level.

Some methodological work would help establish the best ways to measure both coital frequency and consistency of condom use. The best ways would be those which are least taxing for both the interviewer and respondent and which yield the most accurate and reliable responses. Responses in cross-sectional surveys could be compared to diary data, but there is a danger that people willing and able to complete daily diaries will be systematically different to others in the population[17]. If different methods are used in the same survey a high degree of internal consistency between the different measures could demonstrate reliability.

It would therefore be necessary to try out all the different questions on the same respondents. If that was not feasible an alternative would be to randomly allocate respondents in the same survey into subgroups and ask each subgroup a different question.

The results for each subgroup could then be compared, the randomisation should remove any confounding by differences in sexual behaviour and so any differences could be due to the method of questioning.

This type of analysis would be vastly improved if combined with some qualitative research that could shed light on how well respondents understand the questions posed, and how they go about answering the questions.

8.2.3 What are the insights from an STI prevention perspective

This thesis has highlighted the danger of measuring, in isolation, single aspects of sexual behaviour. It may be difficult to disentangle different aspects of behaviour, but it is important to realise that positive change in one aspect of behaviour may be reflected, counter-intuitively, as negative change in some other aspect.

The analyses have demonstrated that coital frequency is intertwined with other aspects of individuals' sex lives. It has not been possible to show whether coital frequency is determined by the nature and number of partnerships, or if there is some feedback between coital frequency (in total or with a specific partner) and the propensity to acquire and/or maintain alternative or additional sexual partners. These relationships may well operate in both directions, and causality could operate in different directions for different people or even at different points in time for the same person.

Some of the synergies identified in this analysis have implications for understanding STI transmission.

The positive association identified in the Kisesa data between numbers of partners and frequency of sex could operate to create a core group, defined by the density of sexual exposure rather than the conventional measures of types and numbers of partners. This makes it important to measure coital frequency when trying to understand the epidemiology of STIs. The risks associated with a single 'high risk' partner, or several `low risk' partners, may be mediated by the frequency of sex with those partners.

In Kisesa it appears that a younger age at first sex is linked to a higher number of partners later in life and that in turn may lead to more sex with each partner (dependent on the mix of partners). The higher coital frequency with spouses seen among polygamous men and

remarried women might suggest that people who want more sex may acquire partners to achieve that. Alternatively, it may be that 'attractive' people end up with more partners, and more sex, without actively seeking this.

The interaction of coital frequency with partnership factors may introduce non-linearities into the exposure of some individuals to the risk of STI transmission and acquisition. If this is the case it would also explain why simple behaviour factors alone do not clearly and consistently emerge as strongly associated with the acquisition of STIs.

An unanswered question with regard to STI transmission is who warrants the most concern: those who have infrequent sex with high risk partners or those who have sex more frequently with a lower risk partner. For the index person, each new partner may potentially bring a new infection. However, the longer a concordant negative partnership exists the greater the chance of a previously uninfected, non-monogamous partner acquiring and then transmitting an STI to the index person. Lower condom use in longer term relationships compared to casual partnerships may raise transmission risks with increasing duration of partnership and increasing numbers of (unprotected) sex acts compared to one off encounters in which condoms are used. The magnitude of these different risks are affected by the STI prevalence in the population. Mathematical models could be used to gauge the magnitude of this effect.

The suggested synergies between different behaviours may simply indicate that some people are more interested in sex than others. This may be due to sexual socialisation early in life, innate differences in sexual appetites, or a combination of both factors. The impact of innate preference is likely to be modified by opportunity: people who make more attractive partners probably have more opportunity to acquire partners, and perhaps to have more sex. Personal circumstances (such as place of residence, personal mobility, social controls) will affect the ease with which people can meet potential partners and pursue sexual relationships, regardless of their desire and motivation to do so. On the other hand, if behaviour patterns are determined more by socialisation than innate preference then individual differences may not modify the effect of socialisation when, by and large, people act out their sexual lives in the same social context as they started them. It would be important to distinguish the relative importance of these two influences because they require different approaches in order to change behaviour. They would also

imply different time lines: if it is early socialisation that has the most influence on later behaviour then successful prevention efforts could take decades to impact on STI transmission. If innate preference, coupled with opportunity, is the dominant factor, successful prevention efforts could show impact much sooner.

Further investigation of the processes that determine coital frequency, and of the variations in coital frequency within and between populations is likely to provide valuable information for interventions designed to improve sexual health.

Chapter 9 References

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