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Primary and Secondary Infertility in Tanzania

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Abstract

The trend and predictors of infertility are not well known in sub-Saharan Africa. A nationally representative Demographic and Health Survey (TDHS) was conducted in Tanzania in 1991/92, 1996 and 1999, enabling a trend study of infertility. Logistic regression was used to determine the predictors of infertility. The prevalence of primary infertility was about 2.5%, and secondary infertility was about 18%. There was no change between the 1991/92, 1996 and 1999 TDHS. The risk of primary infertility was higher in the Dar es Salaam and Coast regions than in other regions and secondary infertility was higher in the Dar es Salaam region. The Dar es Salaam and Coast regions are known for also having elevated levels of HIV/AIDS. Because sexual practices and sexually transmitted diseases are strong predictors of pathological infertility and HIV infection in Africa, we recommend that concerted efforts be made to integrate the prevention of new incidences of infertility with the HIV/AIDS campaigns.

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Introduction

Although infertility in sub-Saharan Africa is a significant problem with serious social consequences, it has received relatively little attention from researchers (Caldwell & Caldwell, 2000). Infertility has been obscured by the region's high fertility rates and attributed largely to the high prevalence of sexually transmitted diseases (STDs) (Cates, Farley, & Rowe, 1985; Mayaud, 2001). Infertility was a neglected issue in population and health policy debates before the 1994 United Nations International Conference on Population and Development (ICPD). The 'Program of Action' of the ICPD calls for reproductive health for all by the year 2015 (ICPD, 1995). According to the 'Program of Action', reproductive health care includes safe delivery, prevention and appropriate treatment of infertility, and abortion in accordance with national laws. To implement the 'Program of Action' more analyses of specific aspects of reproductive health are required. For instance, knowledge about the etiology, behavioral risk factors and social consequences of infertility for women and men from community-based studies remains sparse in sub-Saharan Africa (Caldwell & Caldwell, 2000; Boerma & Mgalla, 2001).

A recent community-based study of 28 sub-Saharan African countries found that secondary infertility was prevalent, while primary infertility was relatively low (Larsen, 2000). In this study, primary infertility was approximated by childlessness, and secondary infertility by the inability to have a live birth for parous women. Primary infertility exceeded 3% in less than a third of the 28 sub-Saharan African countries analyzed. In contrast, elevated levels of secondary infertility prevailed among women age 20-44 in most countries, ranging from 5% in Togo to 23% in Central African Republic. Furthermore, the prevalence of infertility varied significantly by urban and rural residence and by region, while this study provided little information about trends (Larsen & Raggers, 2001). Thus, further country-specific analyses are required to assess local variations in infertility, and to enhance the understanding of the predictors of infertility. This knowledge could provide the empirical basis for designing and targeting future interventions aimed at reducing the burden of infertility, and facilitating the implementation of the goals of the 'Program of Action' by the year 2015.

In the present study, we examined the trend, national and regional prevalence, and social factors associated with primary and secondary infertility in the East African country of Tanzania. In Tanzania, childlessness declined from about 10 to 2.5% from 1973 to 1991/92, and it is unknown whether this trend continued throughout the 1990s. However, despite the decline in childlessness, Tanzania had higher prevalence of secondary infertility than the neighboring countries of Kenya, Uganda, Rwanda, Burundi and Zambia from survey data collected in the early 1990s. There is no explanation for the higher rates of secondary infertility in Tanzania (Larsen, 2000). The sequel from STDs is believed to be the main cause of pathological infertility in Tanzania, and knowledge about predictors of infertility might provide some insight about risk factors for STDs, including HIV. The HIV epidemic spread rapidly in Tanzania from the first case reported in 1983 to an estimated prevalence of about 10 % in 2000 (Ministry of Health, Tanzania, 2000). Thus, there is currently a sense of urgency to enhance the understanding and to implement new prevention aimed at improving reproductive health in Tanzania.

Data and Methods

The analysis was based on three nationally representative surveys: the 1991/92, 1996 and 1999 Tanzania Demographic and Health Survey (TDHS) (Ngallaba et al., 1993; Bureau of Statistics & Macro, 1996; National Bureau of Statistics & Macro, 2000). The 1991/92, 1996 and 1999 TDHS interviewed 9238, 8120 and 4029 women age 15-49 years. These surveys provided complete birth histories and comparable data about contraceptive use, sexual practices and socioeconomic characteristics. The surveys were conducted as collaborative projects between the National Bureau of Statistics in Dar es Salaam, Reproductive and Child Health Section, Ministry of Health, Tanzania and Macro International Inc. in Maryland, U.S.A. The United States Agency for International Development provided funding for the TDHS. UNICEF and UNFPA also supported the 1999 TDHS.

The analysis was restricted to ever-married women to assure regular exposure to childbearing. Data about dates of union dissolution and dates of re-entry into a union were not included in the TDHS surveys. Hence, it was not possible to restrict the analysis to the time periods in union for women married more than once. Furthermore, estimates of infertility would be downward biased, if the analysis were restricted to currently married women because Tanzanian women who have been married more than once have higher infertility (Larsen, 1997). For each woman, the analysis began the month of first marriage and ended the month of interview or month of last intercourse, whichever came first.

The 1991/92, 1996 and 1999 TDHS did not include pregnancy histories or data about how long a woman had tried to conceive. This information was not collected in any of the Demographic and Health Surveys conducted in more than 80 developing countries since 1986 (Macro, undated). As a consequence, it was not possible to estimate infertility following the standard epidemiologic and clinic definitions of infertility that rely on data about a woman or couple's inability to conceive (WHO, 1975; Rowe et al., 1993). To circumvent this lack of data, Larsen and Menken (1989, 1991) developed demographic measures of infertility based on the inability to have a live birth (Pressat & Wilson, 1985). Primary infertility was measured by the proportion of childless women after seven years of marriage and secondary infertility by the proportion 'subsequently infertile' of parous women. A woman was defined as subsequently infertile from age a years onward, if her last live birth occurred at age $a-1$, and she was observed at least until she reached age $a+4$. When incomplete birth histories were used, five-years of observation after a live birth were needed to determine the woman's subsequent infertility status. Thus, if women were aged x at survey, we could determine their subsequent infertility status only to age $x-5$. Hence, estimates of secondary infertility were obtained for women age 20-44. Secondary infertility was not estimated for women younger than 20 to circumvent the difficulties of separating adolescent subfecundity and infertility.

Tanzania covers an area of 940,000 square kilometers, and Tanzania is divided into 20 regions in the Mainland and five in Zanzibar (Figure 1) (Bureau of Statistics & Macro, 1997). It was problematic to estimate regional levels of primary and secondary infertility because of relatively few cases per region. Therefore, the regions were collapsed into six ecologic or geographic zones providing relatively large numbers of cases in each zone, and thereby reducing sampling error (Bureau of Statistics & Macro, 1997). (Tentative regional estimates of primary and secondary infertility are available from the author.) Each zone covers a large geographic area and to determine more specifically the locations with elevated risks of infertility the multivariate analysis estimated relative risks of primary and secondary infertility by region, instead of by zone.

In the multivariate analysis, the models of primary infertility were estimated by logistic regression. Secondary infertility was estimated by standard five-year age intervals from age 20 to 44. Each discrete five-year age interval for each woman was treated as a separate observation. The explanatory variables for each of these new observations were assigned, all observations were merged and the simultaneous effects of covariates on the prevalence of secondary infertility were estimated by discrete logistic regression (Allison, 1995). Univariate models included one covariate, bivariate models included age and one covariate, and covariates entered the model at the 0.2 level of significance. Multivariate models included all the covariates that added significantly to the model fit at the 0.05 level of significance using stepwise selection.

Results

Prevalence and trend of primary and secondary infertility

The prevalence of primary infertility or childlessness in Tanzania was 2.3, 2.4 and 2.5% from 1991/92, 1996 and 1999 TDHS and the upward trend was not significant (Table 1). Primary infertility declined in urban areas from 4.1 to 2.3% and increased in rural areas from 1.8 to 2.6% from 1991/92 to 1999, although the urban and rural trends were not significant. There was no difference in levels of primary infertility between urban and rural areas in 1999. The zonal estimates suggest that primary infertility was at the same level in the Coastal, Northern Highlands, Lake, Central, and Southern Highland zones, while the Southern zone had higher rates, although the estimates for the Southern zone had wide 95% confidence intervals. Estimates of primary infertility were not biased by contraception because none of the childless women from the 1991/92, two from the 1996 and one from the 1999 TDHS reported that they used contraception at the time of interview.

Table 1: The prevalence of primary infertility in all of Tanzania, by place of residence and by zone from 1991/92, 1996 and 1999 TDHS data

Variable	Primary infertility								
	1999			1996			1991/92		
	%	95% CI	N[a]	%	95% CI	N[a]	%	95% CI	N[a]
All of Tanzania	2.5	1.9 – 3.3	2,066	2.4	1.9 – 2.9	4,184	2.3	1.9 – 2.8	4,622
Place of residence									
Urban	2.3	1.2 – 4.1	512	3.5	2.4 – 5.0	847	4.1	2.9 – 5.5	1,003
Rural	2.6	1.8 – 3.5	1,554	2.1	1.6 – 2.6	3,337	1.8	1.4 – 2.3	3,619
Zone[b]									
Coastal	2.5	1.2 – 4.3	452	2.7	1.7 – 3.9	930	1.9	1.2 – 3.0	995
Northern Highland	2.4	.9 – 4.6	312	1.9	.9 – 3.7	460	.6	.1 – 1.8	487
Lake	2.2	1.2 – 3.6	646	2.1	1.4 – 3.1	1351	2.6	1.8 – 3.5	1518
Central	1.6	.3 – 4.7	184	1.9	.8 – 4.0	358	4.4	2.7 – 6.5	509
Southern Highland	2.1	.8 – 4.8	267	2.5	1.4 – 4.0	618	1.0	.4 – 2.2	602
Southern	4.7	2.4 – 8.7	206	3.2	1.8 – 5.2	467	3.5	2.1 – 5.5	511

[a] *Weighted sample sizes are presented, and the zonal sample sizes do not add up to the total because of rounding error.*

[b] *Each zone includes a number of regions, as follows:*

Coastal	*Tanga, Morogoro, Coast, Dar es Salaam, and Zanzibar*
Northern Highland	*Arusha and Kilimanjaro*
Lake	*Tabora, Kigoma, Shinyanga, Kagera, Mwanza and Mara*
Central	*Dodoma and Singida*
Southern Highland	*Iringa, Mbeya and Rukwa*
Southern	*Lindi, Mtwara and Ruvuma*

From the 1999 TDHS, secondary infertility at age 20-44 reached 20.9 % for all women, 24.0 % for women not currently using contraception, and 18.1 % for all women, when current contraceptive users were considered fertile at survey date. Thus, if the analysis were restricted to current non-contraceptors upward biased estimates would be obtained, because fertile women were more likely to use contraception; if estimates of infertility were based on all women and contraception were not accounted for, then estimates of infertility would be upward biased because some effective contraceptors were falsely classified as infertile; and if current contraceptors were considered fertile at survey date downward biased estimates might result because some contraceptors were infertile. We found that the bias from contraception was less than 3% (the difference between the estimate of secondary infertility for all women age 20-44 (20.9), and the estimate considering current contraceptive users as fertile at survey date(18.1)) (Table 2). The prevalence of secondary infertility for all women increased gradually from 8.2 to 16.4, 29.5, 45.5 and 68.7 % at age 20-24, 25-29, …, 40-44, and when current contraceptors were considered fertile at interview from 7.5 to 14.3, 25.2, 38.8 and 58.3 %. Thus, the bias from contraception increased with age and the subsequent analysis employed conservative estimates of secondary infertility, where all contraceptors are considered fertile at survey. The same age pattern of secondary infertility prevailed from the 1996 and 1991/92 TDHS, but contraceptive use was lower and it had a smaller effect on estimates of secondary infertility (results not shown).

Table 2 shows that secondary infertility in all of Tanzania was 18.1 (95% CI 18.0 – 18.3), 15.6 (95% CI 15.5 – 15.8) and 17.8 (95% CI 17.7 – 17.9) from the 1999, 1996 and 1991/92 TDHS suggesting that infertility remained at about the same level during the 1990s. In contrast, from 1991/92 to 1999 secondary infertility increased in urban areas from 21.4 to 26.8 % and decreased in rural areas from 16.9

to 15.3 %, and the 1999 estimates fell outside the 95% CI for the 1991/92 estimates in both urban and rural areas. In 1999 secondary infertility was highest in the Southern zone reaching 24.9 %, followed by the Coastal and Central zones at 21.1 and 20.6 %, the Lake and Southern Highlands both at 15.9 %, and lowest in the Northern Highlands at 13.1 %.

Table 2: The prevalence of secondary infertility in all of Tanzania, by place of residence and by zone from 1999, 1996 and 1991/92 TDHS data

Variable	Secondary infertility								
	1999			1996			1991/92		
	%	95% CI (%[a])	N[b]	%	95% CI (%[a])	N[b]	%	95% CI (%[a])	N[b]
All of Tanzania	18.1	18.0-18.3 (20.9)	19,996	15.6	15.5-15.8 (17.6)	40,073	17.8	17.7-17.9 (18.3)	44,378
Place of residence									
Urban	26.8	26.5-27.2 (31.5)	4,839	20.0	19.7-20.3 (25.0)	7,760	21.4	21.2 -21.6 (22.3)	9,363
Rural	15.3	15.2-15.5 (17.6)	15,157	14.6	14.5-14.7 (15.8)	32,313	16.9	16.8-17.0 (17.2)	35,016
Zone[c]									
Coastal	21.1	20.7-21.4 (24.7)	4,409	19.2	19.0-19.4 (21.7)	8,770	19.4	19.2-19.7 (20.0)	9,628
Northern Highland	13.1	12.8-13.5 (18.3)	2,659	10.8	10.5-11.1 (16.3)	4,257	12.9	12.7-13.2 (14.0)	4,742
Lake	15.9	15.7-16.2 (16.7)	6,052	14.1	14.0-14.3 (15.0)	12,778	17.2	17.0-17.4 (17.5)	13,940
Central	20.6	20.1-21.1 (24.0)	2,067	13.1	12.8-13.4 (14.9)	3,628	16.7	16.4-17.0 (16.8)	5,021
Southern Highland	15.9	15.5-16.3 (19.2)	2,697	16.7	16.4-17.0 (17.7)	6,130	16.2	15.9-16.5 (16.8)	5,725
Southern	24.9	24.3-25.4 (27.9)	2,111	18.2	17.9-18.5 (19.9)	4,510	23.9	23.6-24.2 (24.1)	5,321

[a] *Estimates of secondary infertility, when contraceptive use is not considered*
[b] *Weighted women years of exposure. The zonal figures do not add up to the total because of rounding error.*
[c] *Each zone includes a number of regions, as follows:*

Coastal	*Tanga, Morogoro, Coast, Dar es Salaam, and Zanzibar*
Northern Highland	*Arusha and Kilimanjaro*
Lake	*Tabora, Kigoma, Shinyanga, Kagera, Mwanza and Mara*
Central	*Dodoma and Singida*
Southern Highland	*Iringa, Mbeya and Rukwa*
Southern	*Lindi, Mtwara and Ruvuma*

Multivariate analysis of primary and secondary infertility

The multivariate analysis was done on only the 1999 TDHS data, because there was no trend in primary or secondary infertility between the 1991/92 and 1999 TDHS. The univariate and multivariate models of primary infertility had very similar effect estimates of each variable with the exception that the variables about education and religion were significant only in the univariate models (Table 3). In the multivariate model residents in the Coast and Dar es Salaam regions had 4.03 (95% CI 1.13 – 14.39) and 2.71 (95% CI 1.23 – 5.98) times higher odds of primary infertility relative to residents in all other regions of Tanzania. Furthermore, women who had had two or more partners had more than four times higher odds of experiencing primary infertility (OR=4.38, 95% CI 1.73 – 11.09). In contrast, primary infertility was not associated with place of residence, age at first sex, marital status or times in union.

Table 3. Odds ratios of primary infertility for ever-married women in Tanzania

Variable/Category	Univariate			Multivariate		
	OR	95% CI	p-value	OR	95% CI	p-value
Region						
Coast	3.97	1.17 – 13.47	.03	4.03	1.13 – 14.39	.03
Dar es Salaam	2.46	1.14 - 5.32	.02	2.71	1.23 – 5.98	.01
Rest of Tanzania	1.00			1.00		
Education				NS		
None	1.00					
Primary	2.12	1.10 – 4.08	.02			
Secondary and above	1.99	.77 – 5.12	.15			
Religion				NS		
Muslim	1.00					
Christian	.58	.32 – 1.03	.06			
Other	1.00					
Sexual partners other than husband						
None or one	1.00			1.00		
Two or more	4.13	1.70 – 10.03	.002	4.38	1.73 – 11.09	.002
Currently contracepting						
Yes	.10	.03 - .43	.002	.09	.02 - .37	.001
No	1.00			1.00		
Sample size	2,083			2,083		

NS Non-significant variable at the five percent level.
Variable did not enter the model.
Variables not entering the univariate model at the .2 level of significance: place of residence, age at first sex, marital status and times in union.

In the univariate and multivariate models of secondary infertility the effects estimates were similar, although the effects were stronger in the univariate models (Table 4). In the multivariate model the odds of secondary infertility were significantly higher in the three regions of Dar es Salaam, Ruvuma and Mwanza compared to all other regions in Tanzania, and urban residents had 1.16 (95 % CI 1.00 – 1.35) higher odds of secondary infertility than rural residents. Women with primary education had higher odds of secondary infertility compared to women with none or secondary and above education, and Christians had lower odds than Muslims and women with other religions. Furthermore, several variables measuring sexual practices were significant. That is, the relative odds of secondary infertility declined the higher the age at onset of sexual relations, women married more than once had higher odds of secondary infertility and so did women who were formerly married, while the number of sexual partners was not significant in the multivariate model.

Table 4. Odds ratios of secondary infertility for ever-married women in Tanzania

Variable/Category	Bivariate			Multivariate		
	OR	95% CI	p-value	OR	95% CI	p-value
Age group[a]						
20-24	1.00			1.00		
25-29	1.56	1.32 – 1.84	<.0001	1.60	1.35 – 1.89	<.0001
30-34	3.10	2.62 – 3.68	<.0001	3.21	2.69 – 3.82	<.0001
35-39	6.79	5.52 – 8.35	<.0001	7.09	5.73 – 8.77	<.0001
40-44	22.98	16.30 – 32.39	<.0001	25.09	17.68 – 35.60	<.0001
Region						
Morogoro	1.36	1.00 – 1.85	.049			
Dar es Salaam	1.92	1.48 – 2.48	<.0001	1.35	1.03 – 1.77	.031
Mtwara	1.43	1.01 – 2.01	.044			
Ruvuma	3.02	2.06 – 4.43	<.0001	2.50	1.71 - 3.67	<.0001
Singida	1.56	1.06 – 2.29	.023			
Tabora	1.65	1.14 – 2.40	.008			
Mwanza	1.45	1.14 – 1.86	.003	1.29	1.02 – 1.63	.036
Pemba	1.37	1.10 – 1.70	.005			
Zanzibar	1.53	1.27 – 1.85	<.0001			
Rest of Tanzania	1.00			1.00		
Residence						
Urban	1.35	1.18 – 1.54	<.0001	1.16	1.00 – 1.35	<.0001
Rural	1.00			1.00		
Education						
None	1.00			1.00		
Primary	1.14	1.01 – 1.30	.039	1.16	1.01 – 1.32	.048
Secondary and above	1.00			1.00		
Religion						
Muslim	1.00			1.00		
Christian	.71	.62 - .81	<.0001	.78	.68 - .89	.0003
Other	.78	.63 - .97	.024	1.00		
Age at 1st sex						
<15	1.25	1.08 – 1.44	.003	1.17	1.01 – 1.36	.037
15-19	1.00			1.00		
20 and above	.55	.42 - .71	<.0001	.58	.45 - .76	<.0001
Missing or inconsistent	1.35	.98 – 1.88	.071			
Times in union						
1	.74	.65 - .84	<.0001	.81	.71 - .92	.001
2+	1.00			1.00		
Marital status						
Currently married	1.00			1.00		
Formerly married	1.72	1.48 – 2.01	<.0001	1.64	1.40 – 1.93	<.0001
Sexual partners besides husband				NS		
None	1.00					
One	1.32	1.10 – 1.59	.003			
Two or more	1.47	.99 – 2.17	.055			
Number of observations			5,199			5,199

NS Non-significant variable at the five percent level.
Variable did not enter the model.
[a] *Age group is the only variable in the model.*

Discussion and Conclusion

The prevalence of primary infertility in Tanzania was relatively modest at 2.5 %, while secondary infertility for women age 20 – 44 was 18.1% from the 1999 TDHS, and there was no trend in either primary or secondary infertility during the 1990s. The finding that primary and secondary infertility remained at the same level was unanticipated in light of the decline in primary infertility or childlessness from 10 to 2.5 % during the 1970s and 1980s (Larsen, 1996). It is difficult to explain a rapid decline in primary infertility during the 1970s and 1980s and no decline in the 1990s, and it is possible that estimates of childlessness were exaggerated for the 1970s. Furthermore, there was a substantial increase in secondary infertility in urban areas during the 1990s, and in the multivariate analysis urban residents had significantly higher odds of secondary infertility than rural residents, suggesting that efforts aimed at preventing new cases of infertility should focus on urban residents. In this context, it should be noted that infertility is generally more prevalent in urban compared to rural areas in sub-Saharan Africa (Larsen & Raggers, 2001). There is anecdotal evidence suggesting that infertile women tend to migrate from rural to urban areas, and there is probably more sexual networking in towns and urban settings, increasing the risk of STDs and subsequent infertility. Hence, the higher prevalence of infertility in urban compared to rural areas.

The multivariate analysis showed that the risk of primary infertility was significantly higher in the Coast and Dar es Salaam regions compared to the rest of Tanzania, while secondary infertility was significantly higher in the regions of Dar es Salaam, Ruvuma and Mwanza relative to the rest of Tanzania. Regional estimates may not be stable because each region included relatively few women. However, from the 1996 TDHS (results not shown) primary infertility was also significantly higher in the Coast and Dar es Salaam regions and secondary infertility was higher in Dar es Salaam region in multivariate models, supporting the position that the Coast region suffers from primary and the Dar es Salaam region from both primary and secondary infertility. (Recall, contraceptive users are considered fertile, so that secondary infertility estimates are not biased by contraceptive use). The elevated levels of primary infertility in the Coast and Dar es Salaam regions were masked when the prevalence of primary infertility was estimated by zone, and the Southern zone has the highest prevalence of primary infertility. Dar es Salaam region has many squatters and a high level of morbidity, e.g. it had a recent outbreak of cholera. The Coast region surrounds and is an extension of Dar es Salaam region. The big highways from Dar es Salaam City to Dodoma and Arusha go through the Dar es Salaam and Coast regions and sexual networking is common along the big highways, probably contributing to high incidences of STDs and subsequently infertility. However, our findings about regional variations in infertility are tentative and further studies of more women in each region are needed to draw inferences about the regional distribution of infertility in Tanzania.

The National AIDS Control Program (NACP) for Tanzania for the year 2000 reported that the region with the highest cumulative case rate was Mbeya followed by the Dar es Salaam and Coast regions (Ministry of Health, Tanzania, 2000). The NACP estimates that only 1 out of 5 AIDS cases are reported due to underutilization of health services, under-diagnosis, under-reporting and delays in reporting. Despite these limitations the data are believed to reflect the regional distribution of AIDS. For instance, the highest seroprevalence rates among blood donors for the years 1997-2000 were in Dar es Salaam (35.7), Mbeya (17.4) and Kagera (16.0) for women and in Dar es Salaam (16.1), Kagera (15.1) and Iringa (14.4) for men, while the rates for the Coast were lower at 15.5 for women and 8.4 for men (Ministry of Health, Tanzania, 2000). The finding suggesting that the Dar es Salaam and Coast regions rank relatively high in terms of both the prevalence of infertility and HIV/AIDS may reflect that sexual practices and STDs (not including HIV) are important risk factors for both infertility and HIV (Cates, Farley, & Rowe, 1985; Mayaud, 2001; Fleming & Wasserheit, 1999). Furthermore, women with HIV infection have more fetal loss and longer waiting time to conception, and this pattern is more pronounced for women with advanced disease stage, e.g., CD4 counts below 250 mm^3 (Gregson, Zaba, & Garnett, 1999; Sedgh et al., 2000). However, the majority of HIV infected people at the advanced disease stage does not live much longer in populations with no treatment, such as in Tanzania, and therefore the impact of HIV infection

on estimates of infertility is probably negligible. (Recall, that we measured infertility by the inability to have a live birth after at least five years of exposure).

The Ministry of Health recognizes that sexually transmitted infections (STIs) are a major public health problem in Tanzania, and the control of STIs is one of the strategies employed in the prevention of new HIV infections. Comprehensive STIs care is now provided in 12 regions, including Dar es Salaam, but not the Coast region. However, of the diagnosed individuals in year 2000, only 15% returned for follow-up and these figures are too low for STIs controls to be effective. If STIs care were strengthened and extended to more regions, then the rate of new incidences of infertility may decline. It is not possible to draw inferences about the regional distribution of STDs based on reported STIs episodes because many infected individuals do not seek care. In addition, STIs are usually diagnosed using the syndromic approach, and it is neither sensitive nor specific, but many clinical settings in Tanzania do not have the capacity to provide laboratory testing for specific STDs. However, it is known from clinical records that Mbeya, Mtwara, Kagera and Dar es Salaam region had high incidences of STDs in the past, but it is not known whether recent efforts to reduce high risk sexual behavior has resulted in reduced incidences of STDs. For instance, the prevalence of HIV infection in the town of Bukoba in Kagera region decreased in the period 1991-99, and then it went up in the year 2000 (Ministry of Health, Tanzania, 2000).

There is no valid data about the incidence of STDs by region. In addition, the present study suggested that only tentative estimates of the regional distribution of infertility could be made from national surveys of more than 9,000 women. Thus, in order to link infertility and STDs/HIV in Tanzania, infertility research needs to move away from national-based to locally defined community-based or clinic-based case-control studies. Beyond determining the etiology of infertility, however, further knowledge about health care seeking and treatment is required to develop and implement effective interventions aimed at reducing the prevalence of infertility of pathological origin.

The risk of secondary infertility was significantly higher for women married more than once, and for formerly married women. It was not possible to determine from the TDHS data, whether infertility preceded or resulted from marital dissolution and remarriage. Similarly, women who had had extra-marital partners had significantly higher risk of primary infertility, but we could not determine, whether women sought extra-marital partners before onset of primary infertility or after they experienced difficulties having a child. In general, the multivariate analysis showed that infertility was associated with sexual behavior, although it was not possible to determine causal relations or pathways. However, if marital dissolution, remarriage and extra marital relations were the consequences of pathological infertility, then the social implications of infertility might have fatal consequences in a country with an estimated prevalence of HIV of about 10% (Ministry of Health, Tanzania, 2000). This scenario was documented in Favot and colleagues (1997) study of a clinic-based sample of infertile women and women who had delivered at Bugando Medical Centre in Mwanza. More specifically, infertile women had higher rates of HIV (18.2 versus 6.6%) and an OR = 2.7 (95% CI 1.4-5.3) adjusting for age, residence and occupation, and infertile women had more marital dissolution, more lifetime sexual partners and more exposure to STDs. Finally, secondary infertility was higher the younger the age at first intercourse, which might reflect that adolescent women suffer more trauma at delivery, and in some cases these complications lead to subsequent infertility (this pattern also explains that primary infertility was not associated with age at first sex).

The present findings were consistent with earlier work. For instance, in the early 1980s Mtimavalye and colleagues (1984, 1985) conducted a community-based study in randomly selected villages in Tanzania. Mtimavalye and colleagues reported the following findings: 1) Average primary infertility was 4.3% and secondary infertility was 18.3%; 2) Primary and secondary infertility were higher in south-east compared to north-west Tanzania; 3) Fertile women had fewer spontaneous abortions and still births than infertile women; 4) 19.1% were childless, suggesting that pregnancy wastage was prevalent because only 4.3% was unable to conceive (i.e., had primary infertility); 5) The risk of spontaneous abortion in the last pregnancy ranged between 5.7 and 34.6%, and women with a prior history of spontaneous abortions had higher risks of a subsequent abortion. Mtimavalye and colleagues provided the first nationally representative community-based estimates of both primary and secondary

infertility in Tanzania, although these national estimates were based on only seven districts. The findings presented here are not directly comparable with Mtimavalye and colleague's results because they employed the WHO (Rowe et al., 1993) definition of infertility of two years of exposure to the risk of pregnancy without conceiving, and we used a period of at least five years and a live birth as the end-point. Complete pregnancy histories were not collected in the 1991/92, 1996 or 1999 TDHS, and nationally representative data about the waiting time to conception are not available for Tanzania. Hence, our results provide the closest approximation to current estimates of primary and secondary infertility in Tanzania. It is not possible to make inferences about changes in the regional distribution of infertility between Mtimavalve and colleague's study and this analysis because Mtimavalve and colleague's data collection was restricted to seven districts. Finally, the TDHS data do not provide information about induced abortion and stillbirth.

In an unrelated community-based study, Henin (1981) found that the percentage of childless women reached 20.5 in the north-west Highlands and 18.0 in the Coastal Zone, which included south-east Tanzania, based on the 1973 National Demographic Survey (NDS). Thus, the estimates of childlessness from the 1973 NDS are in line with the estimates of childlessness from Mtimavalye and colleague's (1984, 19850) study, although it is not known whether the prevalence of childlessness changed from the early 1970s to the early 1980s. Henin showed that childlessness was associated with three factors: 1) marital patterns, i.e., women in polygamous unions and women married more than once had higher childlessness; 2) women in less developed areas of Tanzania had higher childlessness; and 3) childlessness was more prevalent in areas with greater incidence of malaria. The present analysis of secondary infertility replicated the finding that women married more than once had higher secondary infertility.

Recent studies have documented that sub-fertile and infertile women have higher rates of HIV infection compared to fertile controls (Favot et al., 1997). This finding reflects that sexual practices and STDs infections are important predictors of both pathological infertility and HIV infection in Africa. Hence, concerted efforts should be made to integrate the prevention of new incidences of infertility with the HIV/AIDS campaign. For instance, interventions aimed at reducing the incidence of STDs and preventing the sequel of STDs would have an impact on both reduction of pathological infertility and HIV transmission. We recommend that women and their partners attending infertility clinics should be offered HIV testing and counseling. This service could help HIV negative individuals to modify their behavior. In fact, as suggested by Favot and her colleagues (1997), the threat of infertility may be a more powerful argument to induce individual behavioral changes than the threat of AIDS.

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Appendix 1: The prevalence of primary infertility in all of Tanzania, by place of residence and by region from 1991/92, 1996 and 1999 TDHS data

Variable	Primary infertility						
	1999	Sample	1996	Sample	1991/92		Sample
	%	size[a]	%	size[a]	%	95% CI	size[a]
All of Tanzania	2.5	2,066	2.4	4,184	2.3	1.9 – 2.8	4,622
Place of residence							
Urban	2.3	512	3.5	847	4.1	2.9 – 5.5	1,003
Rural	2.6	1,554	2.1	3,337	1.8	1.4 – 2.3	3,619
Region							
Dodoma	2.6	117	2.2	204	5.1	3.1 – 8.1	346
Arusha	2.1	223	2.7	277	.8	.1 – 2.6	275
Kilimanjaro	3.2	89	.5	183	.4	.0 – 2.6	212
Tanga	2.9	95	2.4	247	.5	.0 – 2.3	243
Morogoro	0	85	1.1	206	2.1	.8 – 4.6	278
Coast	4.0	74	8.6	87	2.4	.3 – 8.0	88
Dar es Salaam	3.2	141	2.9	262	2.8	1.2 – 5.8	243
Lindi	3.7	49	3.0	99	2.3	.5 – 6.3	136
Mtwara	5.0	107	3.5	208	5.4	2.6 – 9.1	212
Ruvuma	5.1	50	2.9	161	2.0	.4 – 5.3	163
Iringa	.7	81	1.5	244	0.0	.0 – 1.4	263
Mbeya	2.4	142	3.9	235	2.2	.7 – 4.9	235
Singida	0	67	1.4	155	2.9	1.0 – 7.0	163
Tabora	4.6	55	4.3	130	5.9	1.1 – 7.7	148
Rukwa	3.7	44	2.0	138	1.0	.0 – 5.2	105
Kigoma	0	44	1.1	173	1.3	.1 – 3.7	194
Shinyanga	2.1	169	2.6	347	2.1	.9 – 4.0	390
Kagera	1.3	101	0.0	239	1.9	.6 – 4.2	277
Mwanza	1.8	175	2.9	320	1.4	.4 – 3.4	302
Mara	3.7	102	2.0	142	5.0	2.4 – 8.7	206
Zanzibar & Pemba	2.2	57	1.8	128	1.7	.2 – 5.0	142

[a] Weighted sample sizes are presented, and the regional sample sizes do not add up to the total because of rounding error.

Appendix 2: The prevalence of secondary infertility in all of Tanzania, by place of residence and by region from 1999, 1996 and 1991/92 TDHS data

Variable	Secondary infertility									
	1999		Sample	1996		Sample	1991/92			Sample
	%	%[b]	size[a]	%	%[b]	size[a]	%	95% CI	%[b]	size[a]
All of Tanzania	20.9	(18.1)	19,996	17.6	(15.6)	40,073	18.3	17.9 – 18.7	(17.8)	44,378
Place of residence										
Urban	31.5	(26.8)	4,839	25.0	(20.0)	7,760	22.3	21.5 – 23.2	(21.4)	9,363
Rural	17.6	(15.3)	15,157	15.8	(14.6)	32,313	17.2	16.8 – 17.6	(16.9)	35,016
Region										
Dodoma	25.1	(20.0)	1,290	17.1	(14.5)	2,087	17.4	16.1 – 18.8	(17.3)	3,206
Arusha	16.2	(15.7)	1,817	13.3	(10.3)	2,204	12.8	11.5 – 14.2	(12.5)	2,346
Kilimanjaro	22.7	(7.5)	842	19.5	(11.3)	2,053	15.1	13.7 – 16.6	(13.3)	2,397
Tanga	20.7	(18.8)	924	19.8	(18.4)	2,548	17.0	15.6 – 18.6	(16.8)	2,462
Morogoro	22.2	(19.7)	955	21.6	(20.1)	1,960	19.0	17.6 – 20.5	(18.4)	2,885
Coast	16.7	(14.1)	761	16.2	(13.2)	741	21.8	19.2 – 24.5	(21.3)	956
Dar es Salaam	33.9	(29.2)	1,261	27.9	(23.4)	2,354	22.3	20.6 – 24.1	(21.2)	2,165
Lindi	22.7	(19.0)	518	17.1	(14.5)	903	17.8	15.9 – 19.8	(17.8)	1,539
Mtwara	28.2	(24.7)	1,168	20.9	(19.3)	2,029	29.3	27.4 – 31.3	(29.1)	2,207
Ruvuma	33.3	(32.4)	425	18.1	(16.5)	1,579	23.0	20.9 – 25.1	(22.6)	1,575
Iringa	12.0	(11.2)	980	12.7	(12.3)	2,685	13.3	12.0 – 14.7	(12.0)	2,607
Mbeya	25.4	(19.8)	1,323	24.1	(22.5)	2,347	23.5	22.9 – 24.1	(23.5)	2,157
Singida	22.1	(21.7)	777	11.8	(11.3)	1,541	15.7	14.1 – 17.5	(15.7)	1,815
Tabora	24.2	(23.6)	511	26.5	(25.0)	1,255	22.7	20.6 – 24.8	(22.7)	1,561
Rukwa	16.4	(14.7)	394	16.5	(15.1)	1,099	11.1	9.2 – 13.3	(11.1)	961
Kigoma	7.7	(6.7)	460	13.5	(12.1)	1,613	18.5	16.8 – 20.4	(18.5)	1,803
Shinyanga	14.6	(14.2)	1,542	12.8	(12.5)	3,568	13.2	12.0 – 14.4	(13.2)	3,168
Kagera	15.8	(13.1)	1,030	10.6	(10.4)	2,153	14.1	12.8 – 15.4	(12.8)	2,734
Mwanza	17.5	(17.0)	1,530	17.6	(15.6)	2,830	21.4	19.8 – 23.0	(21.4)	2,612
Mara	20.2	(20.2)	980	13.7	(13.7)	1,360	18.7	17.1 – 20.5	(18.5)	2,062
Zanzibar & Pemba	19.3	(18.0)	506	17.3	(14.9)	1,168	23.0	20.6 – 25.6	(22.7)	1,159

[a] *Weighted women years of exposure. The regional figures do not add up to the total because of rounding error.*

[b] *Estimates of secondary infertility, when all current users of contraception (modern and traditional) are considered fertile at interview, are presented in parentheses.*