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Preliminary study on employment status and fertility in South Africa

ABSTRACT

The role of occupational exposures in the declining fertility rate in South Africa is not known. Data on time-to-pregnancy (TTP) and important risk factors including employment was obtained from 166 African women of reproductive age by trained community interviewers. For analysis, unplanned pregnancies were excluded and participants who were never pregnant were censored. Kaplan-Meier survival-curves were used to describe TTP and Cox proportional-hazard models were used to estimate hazard ratios (HR). TTP information was available for 42% of study participants. The TTP distribution had a mode of 1 month, a median of 3 months, and a mean of 7.6 months. After adjusting for age, smoking, alcohol, urban status, contraception and gravidity, women who were employed took longer to fall pregnant than women who were not (adjusted HR 0.38, CI; 0.19 – 0.76). This study shows that TTP in African women in South Africa may be related to employment status.

Key words: time-to-pregnancy, fertility, women, employment, South Africa

INTRODUCTION

Studies have shown that the total fertility rate (TFR) for South Africa is on the decline. It is also reported to be the lowest in Africa.¹⁻³ This decline has been largely attributed to contraception, education and HIV/AIDS.^{2,3} However, the role of declining fecundity – the natural ability to reproduce – in the reported declining TFR has not been elucidated. Currently, little is known of the population's fecundity distribution as studies are yet to be undertaken in this area.

Time-to-pregnancy (TTP) is the number of non-contraceptive menstrual cycles (months) it takes a couple to conceive; it covers the entire distribution of waiting times from time 0 to several years.^{4,5,6} TTP is

used to measure fecundability – the per-cycle probability of falling pregnant.⁷ An increased TTP therefore reflects decreased fecundity and may be taken as an injury to the reproductive system. Infertility is defined in terms of TTP; a common definition of infertility is TTP longer than 1 year.^{5,8}

TTP is a validated measure of fertility.⁹ It is a functional outcome of reproductive mechanisms in both men and women and the measure has been applied in fertility studies in both genders.¹⁰ TTP is a sensitive, ethical and informative outcome, which can be obtained by means of a questionnaire. Therefore, TTP measurement is feasible for large-scale studies because it does not require laboratory investigations, making it useful for occupational health epidemiology and reproductive health studies in an African setting. Also, the advantage of detecting small increases in average TTP is that the reproductive hazard may be identified and controlled before irreversible damage occurs.¹¹

TTP is a useful reproductive outcome. However, there are limitations to collecting TTP information retrospectively by means of a questionnaire. These limitations could introduce different forms of bias into the study.^{6,12} Bonde et al.⁶ highlight 'selective' and 'volitional' factors which can cause such bias. Selective factors include factors that determine who is included in TTP analysis. These factors (e.g. accidental pregnancies) might bias results by excluding a section of the population. Volitional factors are related to sexual behaviour (e.g. sexual practice) and may confound inferences from



“Time to pregnancy...is the number of non-contraceptive

menstrual cycles...it takes a couple to conceive...”

TTP studies. These factors could make the groups being compared incomparable. Another problem is the difficulty of accurate memory recall, which is especially so for explanatory variables, e.g. frequency of alcohol consumption at the time of pregnancy attempt. Other issues include exposure trends, pregnancy recognition bias etc. Most of these problems can be effectively controlled if the studies are appropriately designed, conducted and analysed.^{6,13}

Ideally TTP studies should be conducted prospectively with couples recruited at the start of attempt, thereby obtaining accurate TTP and detailed time-specific exposure information. However, they are very expensive, time consuming, logistically difficult and they lack a clear sampling frame.¹⁰ There is also the drawback of low participation rate and selection bias can also occur due to differential motivation to take part in the study.^{6,13}

TTP is affected by many maternal and paternal risk factors including socio-demographic factors, reproductive history (prior contraceptive use, gravidity, etc), health and lifestyle factors, and environmental and occupational factors.¹⁴⁻⁶ Properly designed studies that adjust for important risk factors for TTP may be able to identify the effects of environmental and occupational factors.

While some may welcome the reported declining fertility rate in the South African population, it is possibly related to a waning fecundity caused by occupational and environmental exposures. The continuous industrialisation and urbanisation of the country in the past few decades presents new occupational and environmental risks. Many of these risk factors (e.g. chemicals and physical factors) have never been assessed for their reproductive health hazards. In addition, women are now entering industries from which they were previously excluded such as mining and construction. The need for studies that assess the effect of occupational exposures on reproductive health in Africa has therefore been highlighted.¹⁷

This paper reports on the effect of employment status on fertility, measured in terms of TTP. TTP has never been measured in South Africa, and we have not found any TTP studies in Africa. We believe this is the first study to do so.

METHODOLOGY

Study design

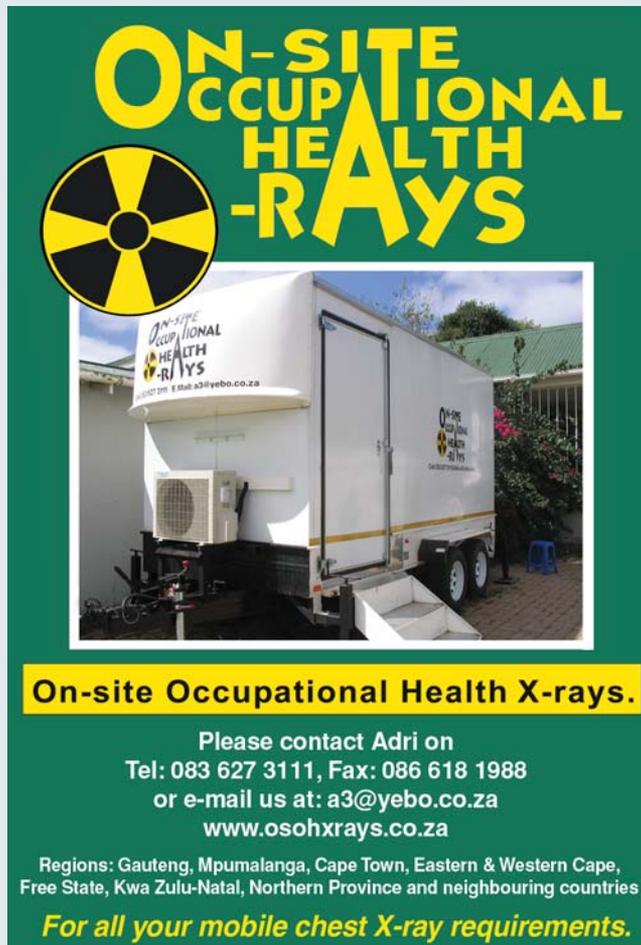
This study was a quantitative, retrospective study with the data collected cross-sectionally, using a questionnaire.

Study setting

Data collection took place in an urban (Potchefstroom) and a rural community (Ganyesa) in the Northwest province in the months of November and December 2006. These settings were selected to enable comparison of urban and rural women.

Population and sampling strategy

The study was population-based which included women who had been pregnant and those who had attempted to conceive. The sample consisted of 166 women, and the inclusion criteria were being African women of



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reproductive age (18 – 49 years), who have been pregnant or tried to be pregnant and reside in the selected communities. There was no clear sampling frame and study participants were volunteers, thus a response rate could not be ascertained.

Study questionnaire

The European Union Reproductive Health questionnaire was adapted for the setting and objectives.¹⁸ Certain words and phrases were changed and the questionnaire was translated and back-translated from English into Setswana, the main language used in the community. It sought information on TTP, time-specific information on maternal and paternal risk factors (socio-demographic,

lifestyle, health and reproductive) and occupational factors. For women who had experienced more than one pregnancy, TTP information was sought for the first pregnancy and the most recent pregnancy. First pregnancies provide an unbiased estimate of fertility (a woman's pregnancy experience can alter her reproductive behaviour). However, TTP information is likely to be more accurate for most recent pregnancy due to recall. This is especially a concern in poor settings where education and knowledge of reproductive issues might be low.

Data collection

Data to complete the questionnaire was collected by a supervised team of trained community fieldworkers. They

Table 1. Important characteristics of study participants by employment status at attempt of pregnancy

Characteristic	Total	Employed	Unemployed	P-value
Community at attempt				
Urban (n = 84)	51%	59%	54%	0.605
Rural (n = 82)	49%	41%	46%	
Smoked at attempt				
Yes (n = 37)	23%	27%	24%	0.653
No (n = 126)	77%	77%	76%	
Alcohol at attempt				
Sometimes/Usually (n = 36)	25%	35%	20%	0.070
Rarely/Never (n = 107)	75%	65%	80%	
Contraceptive use at attempt				
Yes (n = 74)	47%	50%	47%	0.701
No (n = 85)	53%	50%	53%	
Age at trying (mean (SD))	21.5 (5.03)	22.8 (5.5)	20.7(4.8)	0.0259
Gravidity (mean (SD))	2.00 (1.6)	2.00 (1.8)	2.00 (1.6)	0.8393
Parity (mean (SD))	1.67 (1.5)	1.66 (1.6)	1.73 (1.5)	0.7870

SD – standard deviation

Table 2. The proportion of women who planned pregnancies by important explanatory variables

Characteristic	Planned pregnancies (%)	P-value
Employment status at attempt		
Employed (n=44)	59%	0.030
Unemployed (n=101)	40%	
Community at attempt		
Urban (n=84)	50%	0.039
Rural (n=82)	34%	
Smoked at attempt		
Yes (n = 37)	51%	0.199
No (n = 129)	40%	
Alcohol at attempt		
Sometimes/Usually (n = 36)	58%	0.046
Rarely/Never (n = 107)	39%	
Contraceptive use at attempt		
Yes (n = 74)	51%	< 0.001
No (n = 85)	40%	

“The TTP distribution ...was positively skewed...

and similar to...European and Asian countries.”

visited and interviewed eligible consenting women in their homes until 166 participants were recruited.

Ethics

Questionnaires were confidential but had a personal information page and contact details for quality control purposes. Ethical permission was granted for the study by the University of the Witwatersrand Human Research Ethics Committee.

Exposure and outcome variables

In assessing the relationship between fertility and employment status, TTP values were used as the outcome variable while employment status at the time of pregnancy attempt was used as exposure variable. Employment was defined as any kind of work; formal or informal. The TTP distribution of women who were employed at the time of pregnancy attempt were compared to those who were not, adjusting for potential confounders also defined at the time of attempt.

Statistical analysis

Data was entered into EpiData 2.1b and statistical analysis was carried out in STATA version 9.0. For TTP analysis, all women with TTP values were included. TTP values were only available for participants who planned their pregnancies and could remember the number of months it took them to fall pregnant. Accidental and unplanned pregnancies were excluded and participants who were never pregnant were censored at the time of survey as our study was population-based. For this group, their TTP was defined as the ‘time of unprotected intercourse’.¹⁹ For women who reported TTP for both their first and most recent pregnancies (n = 3), only the most recent was used to minimise bias.

Chi-square and t-test were used to assess differences in categorical and continuous variables respectively. Kaplan-Meier survival curves were used for descriptive analysis of TTP and Cox proportional hazard model was used to estimate hazard ratios.

RESULTS

A total of 166 women participated in the study of which, 136 (82%) had had at least one pregnancy and 30 (18%) had never been pregnant. The total number of pregnancies was 326 while the total number of live births was 272. The mean current age of participants was approximately 35 years with 27% having less than primary education, 46% completed primary and 27% completed high school. Table 1 shows the basic description of the study participants and by employment status at the time of attempt.

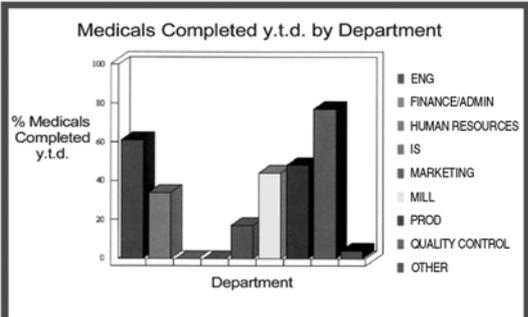
Employed and unemployed women in our study only differed significantly with respect to age.



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Planned pregnancy

The proportion of women who planned their pregnancies was 42%. The mean ages of these women compared with those who did not were significantly different; 22.6 and 20.5 years respectively. The women who planned their pregnancies had a significantly lower gravidity (1.4) than those who did not plan (2.4). As expected, planning was also found to be related to other variables including contraceptive use.

Time to pregnancy distribution

Forty-two percent (n = 70) of all the participants had a TTP value. This includes all women who had tried to fall pregnant without success.

TTP is summarised in Table 3 for women who had been pregnant and women who had never been pregnant. The median TTP for the former group was 3 months, with a mode of 1 month and a mean of 7.6 months, whilst 65% of them fell pregnant within 6 months of trying and 80% with 1 year of trying. These figures were higher when women who were never pregnant at

the time of survey were included, due to the higher TTP values for these women.

Relationship between employment status and TTP

We hypothesized that employment (at pregnancy attempt) has a negative effect on fecundity. A Kaplan-Meier curve of TTP by employment (Figure 1) shows that women who were employed prior to pregnancy had a significantly longer TTP than those who were not (HR = 0.55 ; 95% CI, 0.31 – 0.96).

This relationship remained significant (Adjusted HR = 0.38 (0.19 – 0.76)) after adjusting for six important risk factors reported in the literature; urban status, age, contraceptive use, gravidity, smoking and alcohol. Gravidity was also significantly related to TTP (Table 4). Due to the small numbers in this study and the range of occupations, we could not complete occupation-specific analysis. Of the 23 women who worked, 39% were domestic workers, 14% administrative workers, 13% were cooks, and another 13% were employed in agriculture.

DISCUSSION

Reproductive health is a human right. A decline in fecundity may limit the right of couples to have as many children as they desire. Thus the reported decline in fertility in South Africa should be investigated. Reproductive health is biologically complex and can be affected by many factors in both men and women. For some couples, their occupation is a source of harmful exposures which may affect fertility.

Time-to-pregnancy

TTP has been widely used to determine the effect of occupational and environmental factors on fertility. The TTP distribution of a community represents its degree of biologic fertility.¹⁰ The proportion of planned pregnancies in our study is considerably lower than what is commonly reported for Western settings, 91 – 99%,²⁰ probably due to differences in cultural beliefs around reproductive health issues, education, and access to contraception. However, some Western studies have reported similarly low values for planned pregnancies; in a multi-centre European study,¹⁸ the proportion of planned pregnancies for East Germany, West Germany and Sweden were 41%, 58% and 63% respectively. The proportion reported for the United States was about 50%.²¹ It is necessary to take this low proportion into account when planning TTP studies in the African setting.



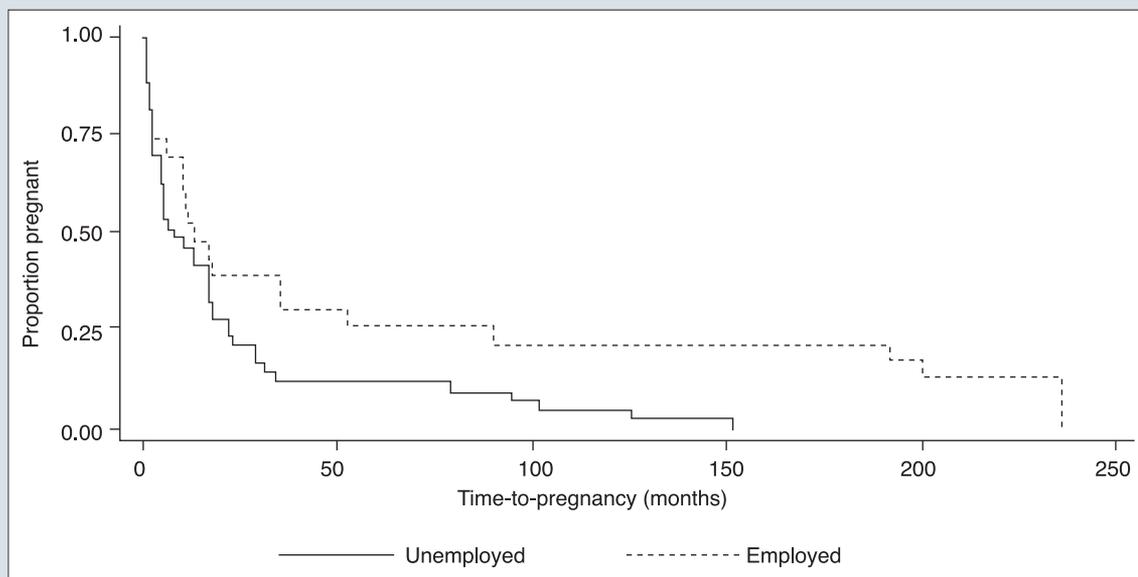


Figure 1. Kaplan-Meier curve of TTP for all participants with TTP values by employment status prior to trying to fall pregnant

*“...time-to-pregnancy is affected negatively
by employment status....”*

Table 3. TTP distribution for participants with TTP value by pregnancy status

	Ever-pregnant n = 40	Never-pregnant n = 30	Total n = 70
TTP estimates (in months)			
Mean (SD)	7.6 (9.5)	70 (78)	34.5 (60)
Median (IQR)	3 (8.5)	26 (85)	11.5 (26)
Mode	1	17	1
Range	1 – 36	5 – 236	1 - 236
TTP categories			
Less than 6 months	26 (65.0%)	2 (6.7%)	28 (40.0%)
6 – 12 months	6 (15.0%)	2 (6.7%)	8 (11.4%)
Greater than 12 months	8 (20.0%)	26 (86.7%)	34 (48.6%)

Table 4. Unadjusted and adjusted hazard ratios showing the relationship between TTP and employment status

Variable	Unadjusted HR (95% CI)	Adjusted HR (95% CI)
Employment status		
Not employed	1	
Employed	0.55 (0.31 - 0.96)	0.38 (0.19 - 0.76)*
Community		
Rural	1	
Urban	0.84 (0.52 - 1.36)	1.06 (0.57 - 1.98)
Smoked while trying		
No	1	
Yes	0.86 (0.50 - 1.48)	0.64 (0.32 - 1.26)
Used alcohol while trying		
Never/Rarely	1	
Sometimes/Usually	0.79 (0.46 - 1.36)	1.75 (0.79 - 3.87)
Contraceptive use		
No	1	
Yes	1.94 (1.12 - 3.38)	1.49 (0.72 - 3.08)
Age	1.00 (0.95 - 1.05)	0.94 (0.88 - 1.01)
Gravidity	1.45 (1.22 - 1.71)	1.73 (1.33 - 2.23)*

* Significant at 0.05 α -level. HR = Hazard ratio

The TTP distribution reported in this study gives an insight into the biologic fertility of an African population. It was positively skewed, as expected, and similar to those reported for other settings, including European and Asian countries. A pregnancy-based Italian TTP study reported a mean TTP of 6.8 months and a median of 2 months with 11.3% becoming pregnant after more than 1 year of trying.²² These values are similar to our study findings (7.6 months and 3 months respectively)

for women who conceived. In the Jensen pregnancy-based study carried out in four European cities,²⁰ the proportion that waited for more than 1 year to conceive ranged from 7.5 – 10.1%. In a United States of America study, the proportion was about 20%.²³

Employment and TTP

The results of this study support the hypothesis that TTP is affected negatively by employment status. Women who were employed prior to pregnancy had a lower per-cycle probability of becoming pregnant than women who were not. Employment can be viewed as a proxy for a number of workplace factors – like chemicals, heat, stress – that might reduce fertility. A sizeable proportion of employed women in this study worked as domestic workers and they may be exposed to high levels of organic solvents and physical demands that may impair fertility.^{24,25} Similarly, studies have suggested a relationship between agricultural workers and reduced fecundity.^{25,26,27}

Infertility is reportedly an increasing public health issue in industrialised countries.²⁸ This result suggests that participating in the South African workplace may have an effect on the reported declining fertility rate in the country, and highlights the need for assessment and monitoring of TTP in specific occupational subgroups.

Many studies have reported negative effects of specific workplace exposures on fertility. A study which evaluated TTP and occupation in a group of Italian women, demonstrated a dose response relationship between mean TTP and number of hours worked; mean TTP increased from 5.1 in housewives to 7.6 in women who worked 35 – 40 hours per week (adjusted HR 0.79).²² Other studies have shown that specific workplace exposures may cause reproductive damage and increase the time to pregnancy.^{12,24–30} Our study is the first to show such a relationship in an African population.

Potential confounders

This study measured and adjusted for important variables that could potentially confound TTP associations. In the bi-variate analysis (Table 1), employed and unemployed women only differed significantly by age. However, this age difference did not play a role in the observed difference in the TTP distribution of employed



and unemployed women, as it was not statistically significant in the multivariate model. This is because although the mean difference of 2.1 years was statistically significant, it is unlikely to be biologically relevant. Although gravidity remained in our final model, it also did not confound the reported relationship.

Although socioeconomic, religious and cultural factors were not examined in this study, it is unlikely that these factors would have affected the findings of this study as the participants were from a narrow cultural, religious and socioeconomic band. The relationship

Although planning was related to a number of variables as we expected, employed and unemployed women only differed by age in our study. Employed women were significantly older than unemployed women. Thus employed women would be more likely to plan their pregnancy as shown in Table 2. Therefore any selection bias resulting from this difference would mean excluding the more fertile unemployed people from our TTP analysis, since they would be more likely to have accidental pregnancies. Such bias would have led to underestimating the effect of employment we have reported.

**Employment can be ... a proxy for ... workplace factors...
that might reduce fertility"**

found in this study was not affected by potential confounders identified in our data and those reported in the literature. This however does not exclude the possibility of residual confounding due to the effects of unmeasured variables.

Limitations

This is a cross-sectional study with retrospective ascertainment of TTP, and as a result, there is a possibility for measurement errors due to recall of information. However, we do not expect this to differ by employment status. The other limitation of this study is the small numbers of participants analysed. Although the total number of participants recruited was considered sufficient for the project, the low proportion of planned pregnancies in this population reduced the final number for TTP analysis.

Selection bias: It is possible that TTP may have been overestimated in our study as it was a volunteer study, and sub-fertile people may have been more likely to participate in the study. However, this is only likely to bias the TTP distribution of all women who reported TTP values towards higher values, and not the pregnancy-based group. This is because the TTP of women who had not conceived at the time of the survey were higher as expected. In our study the TTP distribution of women who conceived was similar to pregnancy-based values reported for some Western settings.

Time trend bias: As women wait to become pregnant, their behaviour may change with respect to their fertility status. Sub-fertile women might take up jobs, stop smoking or seek medical intervention. To assess such time-trends bias in our data, we censored TTP at 14 months. This did not change the observed effect ($HR_{adjusted} 0.39$, 95%CI 0.13 – 1.18), neither did excluding first pregnancies from the analysis ($HR_{adjusted} 0.41$, 95%CI 0.20 – 0.85). The first result was however not statistically significant due to the small numbers used in the analysis ($n = 26$).

Reproductively unhealthy worker bias: We also assessed for the role of the reproductively unhealthy worker effect (reverse causality in reproductive studies) which describes sub-fertile women as being more likely to take up employment or remain in the workforce than fertile women. We found no significant difference in number of live births between employed women and unemployed women (Table 1). We did a similar analysis using current work status and we found the same result ($n = 161$, P -value = 0.1441). In a further analysis, when the TTP analysis was restricted to primigravidae women ($n = 10$), the relationship remained (adjusted HR 0.27 95%CI; 0.03 – 2.27). This effect was not demonstrated in our data, as expected, possibly, due to the high unemployment rate in this setting; women are likely to work irrespective of fertility and probably rely on caregivers or family members for their children.

Summary box

1. TTP can be reported for an African population.
2. The TTP distribution for Africans is similar to that reported for Western and Asian countries.
3. Employment status was related to fertility.
4. A portion of the declining fertility rate in South Africa might be due to waning fecundity due to occupational and environmental exposures, and not just planning factors like education and contraception as previously thought.
5. As women in South Africa take up jobs in employment settings from previously exclusive work sectors, further studies are needed to assess the effects of specific occupational and environmental factors on fertility.

CONCLUSION

Prolonged time to pregnancy was associated with employment status.

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