# RECENT FERTILITY DECLINE IN ERITREA:
# IS IT A CONFLICT-LED TRANSITION?

Gebremariam Woldemicael[1]

Work in progress

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[1] Associate Professor of Demography, University of Asmara: email: gebre_wm@yahoo.com.
Currently, a guest researcher at Stockholm University, Demography Unit/Sociology Department,
SE-106 91 Stockholm, Sweden,  email:  gebremariam.woldemicael@sociology.su.se

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**Abstract**:  During a period of military conflict towards the end of the 1990s, Eritrea experienced a remarkable decline in fertility. This decline has been a concern to many Eritreans. An important issue of concern has been whether the decline is driven primarily by the recent border conflict with Ethiopia or by changes in other factors including delay in age at marriage, improvements in child survival and socio-cultural factors that pre-dated the conflict. Using retrospective event histories from the 1995 and 2002 Eritrea Demographic and Health Surveys (EDHS), this study provides an in-depth exploration of recent fertility change in Eritrea. The study indicates that marriage delay among younger cohorts does not appear to be a major contributor to the overall fertility decline. The findings rather illustrate a decline in fertility within marriage partly due to cessation of childbearing after families reach their desired family size. Although we cannot conclude that the overall fertility decline is primarily an outcome of the conflict, there is evidence that it has contributed substantially to the decline, particularly for first birth fertility. The implications of these findings for theories about fertility change in times of military conflict is that crises may not be likely to initiate a sustainable overall fertility transition, but can still prompt short-term fertility changes among certain social groups or modify an ongoing decline.

# 1 Introduction

Although Eritrea is one of the countries that have witnessed a steady decline in fertility during a military conflict, there is very little evidence that describes how fertility declined so rapidly in a country that apparently meets few of the standard preconditions for fertility transition including significant socio-economic progress, major declines in child mortality, and substantial changes in the status of women. Some progress was made in the realms of education, health care services and agriculture after independence in 1991, particularly between 1992 and 1998, but after this period, Eritrea experienced severe economic declines, internal displacement, and military mobilization as a result of the 1998-2000 border conflict with Ethiopia (GSE and UNICEF 2001). The records from the EDHS surveys show that Eritrea's infant and child mortality has rapidly and consistently declined since the mid-1990s (NSEO and ORC Macro Inc. 1997, 2003). In terms of women's status, like in most other sub-Saharan African countries, men's dominance and women's dependency on men still exists in Eritrea, particularly in the rural societies, even though some improvements have been made since the struggle for independence (this is discussed in the background section). Regarding the proximate determinants of fertility, Bongaarts and Potter (1983) argue that an increase in contraceptive use and in induced abortion, a relatively late age at marriage as well as long periods of post-partum sexual abstinence and postpartum ammenorrhoea can substantially reduce fertility from its natural maximum. However, with the exception of age at first marriage and proportion of never married women, which have both slightly increased in recent years, the other proximate determinants did not change much in Eritrea since 1995 (NSEO & ORC Macro Inc, 1997, 2003).

Today, despite the uncertainties that surround the nature and causes of changes in Eritrea's fertility, no comprehensive evidence is available, with the exception of one article on the role of conflict in the rapid fertility decline in Eritrea and its prospects for the future by Blanc (2004) and the reports of the 1995 and 2002 EDHS surveys (NSEO and ORC Macro Inc. 1997, 2003). Blanc's study reveals a TFR decline from 7.1 in 1997/98 to 4.4 in 2000/01, while the EDHS survey shows a TFR decline from 6.1 to 4.8 between 1995 and 2002. Blanc (2004) applied Bongaarts's Proximate Determinants Model (Bongaarts, 1978) to the 2002 EDHS data to examine the

relative contribution of each proximate determinant to the decline and used TFR to assess the trend in fertility. However, although TFR is an appropriate aggregate measure of fertility that controls for age composition and is useful to compare populations with different age structures, it is not robust to discern whether fertility change can be attributed to changing reproductive pattern at low or high parities (Njogu and Martin, 1991) or to trace changes in fertility behaviour by various socio-demographic characteristics (Luther and Pejaranoda, 1991). Blanc (2004) concluded that the recent fertility decline is mainly an outcome of the border conflict mediated by a reduction in the proportion of women exposed to the risk of pregnancy as a consequence of delayed age at marriage and spousal separation. Whether such impacts would be evident when other more specific factors including parity, spacing of births, and other fertility behaviours are investigated using a multivariate model that controls for various socio-demographic determinants of fertility is still unclear.

In this study, a more comprehensive analysis is made using both trend analysis of TFR and age-and parity-specific approaches and multivariate regression methods in order to improve our understanding of the nature and possible causes of the decline. It argues that failure to take into account the different socio-demographic factors that affect fertility in a multivariate analysis may misrepresent our understanding of the onset of the decline and the factors that contributed to it. The timing of the fertility decline and its underlying causes have been important unresolved issues in Eritrea with many doubts particularly about the effect of the border conflict. We focus on the analysis of fertility during the recent past and do not attempt to cover the pre-independence period. Due to the absence of survey data or any systematic records for the 1980s, we are unable to perform detailed analyses of the effects of war and other factors on fertility for the period before 1990.

## 2 Theoretical Background

Several classical demonstrations of demographic transition show the following factors as essential precursors of the trend toward low fertility: the changing structural conditions that alter the costs and benefits of children in the course of socio-economic development, the weakening of normative control as societies are more educated, empowerment of individuals to make their own choices, often for smaller families, and declines in child mortality (see for e.g., Bulatao and Casterline 2001; Cleland

2001). In recent years, these explanations are supported or substantiated by another set of explanations that centre on the spread of positive attitudes toward controlled fertility and family planning (Basu and Amin 2000). These attitudes may build up through a process of diffusion of ideas among people in which individuals' decisions are influenced by the knowledge and behaviour of others including family, relatives, peer groups, elites, etc. with whom they come in contact (Montgomery and Casterline 1998).

However, empirical evidence on the declines in fertility in the contemporary world has not always been consistent with the above explanations. Other factors, for instance, military conflict, famine, and economic downturn can lead to low aspirations and crisis-led fertility transitions (Avogo and Agadjanian 2007; Hill 2004; Lindstrom and Berhanu 1999; Lesthaeghe 1989; Busza and Lush 1999; McGinn 2000).

The proponents of crisis-led fertility decline suggest different pathways through which military conflict can affect fertility. One of the mechanisms is unintentional limiting of births due to social and economic disruptions directly caused by the fighting itself and displacement of people as well as due to temporary separation of couples (Lindstrom and Berhanu 1999; Hill 2004), all of which lead to limited exposure to pregnancy and low desire for children. In addition, the number of births may be low during crisis periods as the number of still births, spontaneous and voluntary abortions increase due to deterioration of health services and the nutritional status of pregnant mothers (Palloni et al 1996; Holck and Cates 1982). During war periods, the reproductive health problems faced by women are massive and include psychological stress, frustration, despair, weakness, and impairment (Chaudhury et al. 2003). Traumatic experience and psychological stress associated with declines in the reproductive health status are likely to reduce fecundity and frequency of intercourse. Moreover, outbreak of war can lead to conscious adjustments in fertility behaviour because couples are more likely to opt for avoiding births during the time of trouble (CEPED 1998). For instance, during war periods, family income declines and the support from extended families erode, prices of food and other commodities rises because of destruction of resources or their diversion to non-productive ends, famine and epidemics become widespread (Eloundou-Enyege et al. 2000; Boserup 1985). Such economic hardship may increase couple's awareness of the costs associated with

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each additional child and the benefits of having fewer children (Rutenberg and Diamond 1993).

Despite, the above explanations for the support of crisis-driven fertility decline, the empirical record is limited and inconsistent (Agadjanian and Ndola 2002). For instance, evidence from Angola's experience of conflict for extended period of time shows a wartime drop and a post-war rebound in fertility (Hill 2004). Similarly, other studies (e.g. Lee 1997; Palloni et al 1996) found evidence of crisis induced fertility declines and post-war fertility rebounds. In a recent study on the fertility response to crises in Ethiopia during the 1970s and 1980s – periods marked by social and political upheavals, large population movements, civil war, famine and economic hardship - Lindstrom and Berhanu (1999) found mixed evidence of the effects of war and economic crisis on fertility. They noted that fertility in the 1970s remained high and relatively stable, though marked by periodic declines and rebounds in response to specific political and economic events. In 1982, however, fertility began a gradual decline, which appears to have been sustained into the 1990s, when stability returned to the country. The authors attribute this decline to the ongoing civil war and economic decline after 1982.

On the other hand, counter arguments of crisis-led fertility decline suggest that the fertility response may move in the opposite direction. That is, the number of births could increase as a result of crisis. For example, the eight-year war with Iraq (1980-88) created a pronatalist atmosphere among Iranian couples by which they were encouraged to have more children to replace those whose loss they were anticipating, and high fertility and population growth was considered as a matter of comparative advantage by the government of Iran (Abbasi-Shavazi 2001). In the Middle east, the conflict between Palestinians and Israelis have likely contributed to higher than expected fertility levels among the Palestininans (Fargues 2000). Particularly, in the refugee camps of West Bank and Gaza, political reasons were more important than economic and religious reasons for the increased desire for a large family during the intifada years, 1989-90 (Marwan, et al. 2003).

Still others argue that even if some military conflicts are reported to have resulted in short-term fertility changes, most wars are not associated with substantial fertility

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change. For example, in Lebanon, the civil war and economic crisis had little effect on fertility mainly due to the low fertility levels already reached prior to the civil war (Khlat, et al. 1997). Fertility was the same before and after the 1974-75 famine in Bangladesh (Watkins and Menken 1985). Similarly, in Rwanda, the most severe crisis of the twentieth century was not found to have any great impact on fertility of that country (Hill 2004).

Clearly, the existing literature suggests conflicting expectations. The hypothesis of crisis-led fertility decline remains an empirical question on which there is remarkably little evidence. While extreme conditions involving drought, economic decline, and military conflict have prompted short-term fertility declines, the evidence is not conclusive that such conditions can always lead to fertility decline (Lesthaeghe, 1989; Lindstrom and Berhanu, 1999; Peng, 1987; Watkins and Menken, 1985). Evidence on fertility response to crises has not been demonstrated successfully, particularly for countries in the east African region, including Eritrea. Understanding this relationship is especially critical for countries in this region, which have been affected severely by military conflict and political unrest, and where the transition to lower fertility is at its early stage. Thus, Eritrea becomes an interesting case study for exploring whether the recent border conflict is neutral in effect and the recent fertility decline stems from other factors or not.

## 3 Data and Method

The major source of data for this study is the 2002 Eritrea Demographic and Health Survey. This survey covered a nationally representative sample of 9,389 households with 8,754 women of reproductive ages at the time of the survey, of which 6,900 were currently or formerly married. In the trend analysis, data from the 1995 EDHS survey are used in order to measure fertility trend more accurately in the early 1990s. The 1995 survey covered a total of 5,054 women aged 15-49 years, of which about 3,600 were married.

In the trend analysis, annual total fertility and age-and parity-specific fertility rates are estimated and presented for the five years before each survey in order to assess the timing of the fertility change in relation to the onset of the border conflict in 1998-

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2000. Here, the main issue is that if the recent decline is conflict-led, then fertility change should follow rather than precede the outbreak of the border conflict. By plotting the annual fertility estimates, we can visually examine whether the fertility decline started before or after 1998, which marks the onset of conflict (although its impact may be visible starting in 1999). The purpose of including age-and parity-specific estimates in addition to the summary measure is mainly to explore better the structure of the decline by age and parity.

To ascertain further evidence of the fertility decline and investigate its underlining factors, a multivariate regression analysis is employed. The specific model used is the Cox regression method. This method is preferred because it accurately handles the timing of birth events. The time dimension used in the Cox model analysis differs for first and higher order birth models: in the models for first births, it is time since first marriage in models where only data from married women are used (Table 3) and time since women's twelve's birthday in models where data for all women are used (Table 2). The rationale for estimating separate first birth models for married women is to explore whether delay in age at marriage has an effect on first birth fertility, as this variable is applicable for married women only. In the models for second and higher order births, the time variable is time since previous birth.

## 4 Description of Variables

The dependent variable is whether or not a woman experienced a live birth during the interval that is studied and the timing of that event. The independent variables include calendar period, birth order, age of mother at the birth of the previous child, spacing of births, survival of preceding child, age at first marriage and/or marital status, women's education, region of residence, and childhood rural-urban residence.

In this study, we adopted the simplest way to measure the occurrence of conflict in relation to historical calendar period. This means that we are not able to identify the specific factors responsive for the conflict that may link the border conflict directly or indirectly with fertility (e.g., changes in GNP, living conditions, etc.). The focus is on how fertility changed during the conflict period in comparison to pre-conflict periods. The analysis recognizes 1999 as the starting year of the social and economic effects of

the conflict. Calendar period is a time-varying covariate measured by a set of dummy variables.

Previous studies have shown that the likelihood of bearing another child is associated with the length of the preceding birth interval (Nair 1996; Rodriguez et al. 1984). According to these authors a longer previous birth interval (24 months or more) is associated with a lower probability of a further conception or birth. Data from the EDHS surveys show that the median length of birth interval in 2002 is 2 months longer than that in 1995 (33.4  versus 31.3 months, respectively). This increase in birth interval may be partly attributed to the improvement in child survival in the country. Although there is no general level of child mortality which leads to a fertility decline when it is reached, there is a general consensus that the death of a previous sibling is associated with a shorter than expected birth interval, and similarly with a higher probability of conception or birth (Park et al 1998; Santow and Bracher 1984; Lindstrom and Kiros 2007). In Eritrea, infant mortality declined from 72 to 48 per 1000 live births between 1995 and 2002 (NSEO and ORC Macro Inc. 2003).

Age at first marriage has been recognized as an important determinant of fertility because it marks the beginning of exposure to the risk of childbearing in societies where pre-marital sex is uncommon and where there is little deliberate effort to control fertility (Blanc and Rutenberg 1990; Hinde and Mturi 2000). However, some studies suggest that the effect of changes in nuptiality on overall fertility is not clear because of substantial fertility among never-married women (Hinde and Mturi 2000; Innocent 2001). In Eritrea, where pre-marital childbearing is uncommon or very low (NSEO and ORC Macro Inc. 1997), delays in marriage can reduce the number of women under risk of childbearing and hence fertility. Thus, in order to check whether delay in age at marriage has a significant effect or not on the recent fertility decline, we have included this variable in the analysis of first births.

The variable region of residence serves as a test criterion for the impact of the border conflict: the assumption is that if the conflict is responsible for initiating the fertility decline, then this decline should be most marked among populations with the more severe experience of conflict. Since two regions, South and Gash Barka, were the hardest hit, one could expect a stronger response in these two regions. Women's

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education is included to assess if improvement in women's education has an effect on the decline of fertility. Women's education is a significant predictor of fertility in most contexts (Cleland and Wilson 1987; Martin 1995; Sathar et al. 1988). Rural-urban residence is included to explore whether there are rural-urban differentials in the recent decline of fertility. It is likely that urban dwellers usually benefit from more and better family planning and health facilities, and better living conditions than rural dwellers. Consequently, urban residence has generally been associated with lower fertility and mortality in most developing countries.

The analysis and interpretation of the association between explanatory variables and fertility is facilitated by estimation of separate models for first and higher order births. This analytical strategy emanates from the fact that some variables have different impacts on fertility at first and higher birth orders. For example, age at first marriage and marital status is more important for first births (onset of reproduction) than for fertility at higher birth orders. Variables like age of woman at birth of previous child, birth order, spacing of previous births, and survival status of the previous sibling are only applicable for higher parities, etc.

## 5 Background to Eritrea

Eritrea lies in the northeastern region of Africa, which also includes Sudan, Djibouti, Ethiopia, Somalia, and Kenya, where fertility is still high - except in Kenya for which fertility decline has been convincingly documented. Eritrea is a small country with a land area of about 125,000 square kilometers and a population size of approximately 3.2 million. Administratively, it is divided into six regions: Southern Red Sea, Anseba, Northern Red Sea, Gash Barka, Central and Southern. Three out of every four Eritreans live in rural areas, where people are engaged primarily in subsistence agriculture.

As in other traditional societies, women's worth is measured in terms of their role as mothers and wives, particularly in the rural areas of Eritrea. During the pre-independence period, no much effort was made by the Ethiopian regime to change women's subordinate status, which is based on deep-rooted traditional values and beliefs. Women traditionally have suffered socio-cultural and economic

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discrimination and have had fewer opportunities than men for education, employment, and participation in decision-making activities. In the urban areas, where education, health care and employment outside the home were relatively better, few women with higher education found professional employment: most held low-paying jobs. On the other hand, women who participated in the struggle for independence made a unique contribution, both as fighters and as civilian supporters to challenge and ousting the Ethiopian government. Women were active participants in the social, political, and cultural activities of the communities under the jurisdiction of the Eritrean Peoples Liberation Front, EPLF (now the government of Eritrea). Particularly, women fighters (although a small segment of the population as compared with men) were allowed to participate equally and fully in all sectors of activities performed in the areas administered by the EPLF. Thus, although we do not have any statistical evidence to support our argument, such involvements of women in social, administration and leadership may have facilitated the emergence of new perceptions of their roles and rights that may enable them to make their own decisions. It is also likely that old economic relations, customs, and value systems have been somewhat weakened by the gains in women's status during the struggle and afterwards. But, since women who participated in the struggle were a small segment of the population (the majority, especially in the capital city and other urban areas were under the administration of the Ethiopian government), it is hard to judge their influence on the overall status of women in Eritrea.

Although the intensity of hostilities varied over time, Eritrea suffered through one of the longest and most bitter war for independence in modern Africa (1961-91). After independence, hostilities flared up again with Ethiopia in mid-1998, which continued until 2000. Only between 1992 and mid-1998 has Eritrea lived through a period of relative peace. No official data on the size and distribution of recent and post war-related population displacement, migration and mortality are available. There is also hardly any available literature on Eritrea's demographic situation in general and fertility in particular until 1995. The only available sources of demographic and reproductive situation are the two EDHS surveys conducted in 1995 and 2002. Although there is no detailed or systematic record on the amount of destruction inflicted by the war for liberation, there is no doubt that it resulted in profound damage to the economy and human life. In general, prolonged war and military

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tensions with Ethiopia in combination with cycles of drought and lingering poverty made life very tough in Eritrea prior to independence.

The attainment of Eritrea's independence in mid-1991 fostered high expectations that it would create new opportunity for socio-economic development. As anticipated, progress was made between 1992 and mid-1998. Some available reports show that Eritrea's GDP grew at an average rate of 7% per annum between 1992 and 1997 (UN 2002). Total government expenditure grew by 79% during this period. There were major investments in extending health care and education services. As a result, immunization coverage was expanded and polio was close to being eliminated and infant and child mortality rates declined sharply (NSEO and ORC Macro, 2003). The primary school gross enrolment ratio increased from 36% in 1992 to 52% in 1997 (Ministry of Education 2002). Primary analysis from the two EDHS surveys also shows that the proportion of women in the reproductive ages with primary or higher education has increased from about 34% in 1995 to 50% in 2002.

Unfortunately, Eritrea's initial promising socio-economic growth was disrupted by the unexpected border conflict with Ethiopia that started in May 1998 and resulted in a war that continued until 2000. This conflict has reversed much of the progress that Eritrea made during 1992-1997. The war has not only caused loss of human life, displacement of nearly one-third of the total population (about one million people), but has also reversed much of the progress in socio-economic trends made during the post-independence - pre-conflict period (UN 2002). For instance, the growth of GDP declined from about 7% annually during 1992-1997 to 4% in 1998, 1% in 1999, and a negative growth of 8% in 2000; inflation rose from an average of 6% during 1994-1997 to 27% in 2000; and the fiscal deficit increased from 6% of GDP in 1997 to 48% of GDP in 2000 (UN 2002). Prices of food and other commodities rose rapidly starting in late 1998 and continued to rise in subsequent years.

The border conflict also resulted in the military mobilization of all Eritreans, but mostly of males aged 18-40 years. It is certain that such mobilization has decreased the proportion of married couples living together. A comparison of the proportions of married women residing with their husbands at the time of the 1995 and 2002 EDHS surveys shows a significant decline in all age groups (see Table 1) and particularly at

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younger ages. For example, only three in ten married women aged 15-19 were living with their husband in 2002, while the corresponding figure was six in ten in 1995. One would expect that separation of couples have reduced married women's exposure to the risk of pregnancy. A review of evidence on the fertility response to war and population displacement of women in Sarajevo before and during the Bosnian war in 1992-94 showed that in the short-term fertility fell mainly as a result of temporary separation (Hill 2004).

Table 1: Percent ever married and percent of married women residing with husband, by age

| Current age | Ever married | | Residing with husbands | |
|---|---|---|---|---|
| | 1995 | 2002 | 1995 | 2002 |
| 15-19 | 37.6 | 31.0 | 60.4 | 30.5 |
| 20-24 | 78.1 | 72.7 | 74.4 | 42.1 |
| 25-29 | 92.1 | 88.5 | 79.1 | 48.9 |
| 30-34 | 95.8 | 95.4 | 84.0 | 60.6 |
| 35-39 | 98.2 | 97.8 | 88.4 | 72.4 |
| 40-44 | 97.3 | 99.0 | 89.0 | 78.9 |
| 45-49 | 98.1 | 99.2 | 90.6 | 88.0 |
| Total | 80.0 | 76.7 | 80.9 | 58.5 |

The figures are calculated from the 1995 and 2002 EDHS data files

## 6 Fertility Development

### 6.1 Timing of the fertility decline: Trend analysis for 1990-2001

Using the event-history data from the 1995 and 2002 EDHS surveys, we begin our investigation of trends in fertility in Eritrea by estimating annual total fertility rates (TFR), and age- and parity-specific fertility rates (ASFR and PSFR). These are plotted in Figures 1, 2 and 3, respectively, by single calendar year for five years prior to the 1995 survey and seven years before the 2002 survey. In later sections, further analysis is made using multivariate regression techniques to explore the nature of the trend and its possible underlying factors.

It is clear from Figure 1 that fertility was relatively high (between 7.0 and 6.0) with some fluctuations before 1998, and subsequently declined to a level of 4.5 in 1999-2000 with a slight increase in 2001. From this trend, the decline is more noticeable after 1998 and based on data from both surveys there is no clear indication that a

consistent decline started before 1998. This is consistent with Blanc's (2004) findings. Although there is no logical reason that can explain the sudden fertility increase in 1998, the clear and rapid decline in fertility during the period 1999-2001 is likely to be due to the interference of the border conflict. The slight increase in fertility in the year just prior to the 2002 survey may be genuine due to the relative peace after 2000 or due to more accurate reporting of births during the year immediately preceding the survey (Institute for Resource Development 1990).

In addition to the TFRs, age-and parity-specific fertility rates (ASFRS and PSFRS) are calculated and plotted by calendar year in order to find out whether the change in fertility is particularly pronounced at younger or older ages of women and at lower or higher order births. These are summarized in Figures 2 and 3, respectively. The ASFRS and PSFRS in Figures 2 and 3 support the above observation that fertility was high in the early and mid-1990s, followed by a downward trend after 1998, and the decline seems to have occurred at all reproductive ages and birth orders. It is worth noting here that the irregularities (peaks and troughs) shown at certain calendar years and at certain ages or parities can be either due to genuine fluctuations in fertility because of the changing circumstances in Eritrea from year to year, or these fluctuations can be due to misreporting errors such as shifting of births or ages of women. It should also be remembered that the figures are for single calendar years and are thus affected by random fluctuations.

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Figure 1: Estimates of total fertility rate for single calendar years prior to the 1995 and 2002 EDHS
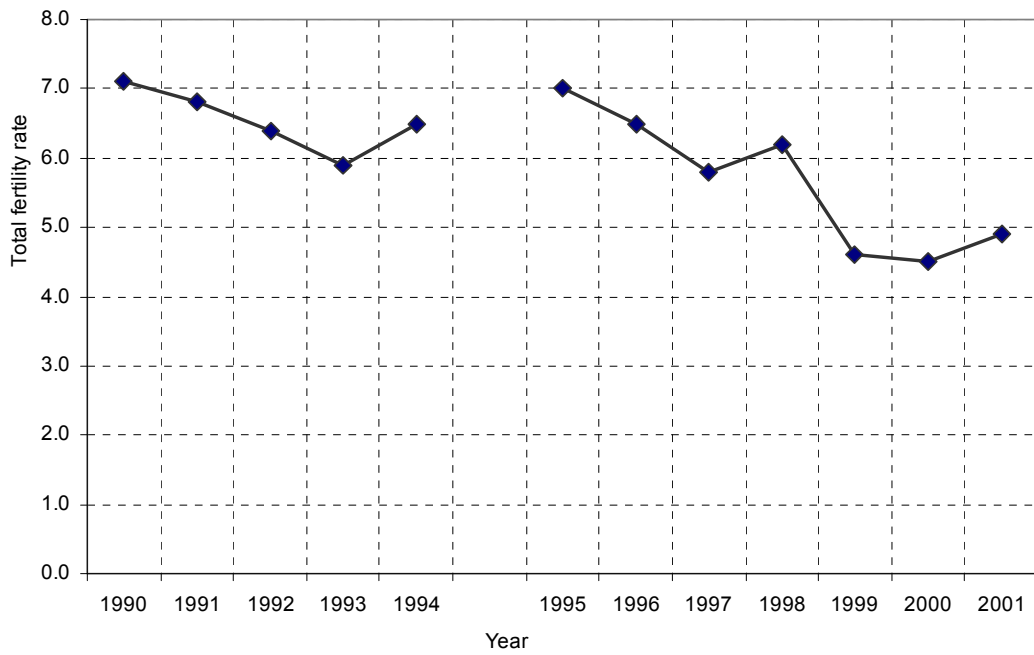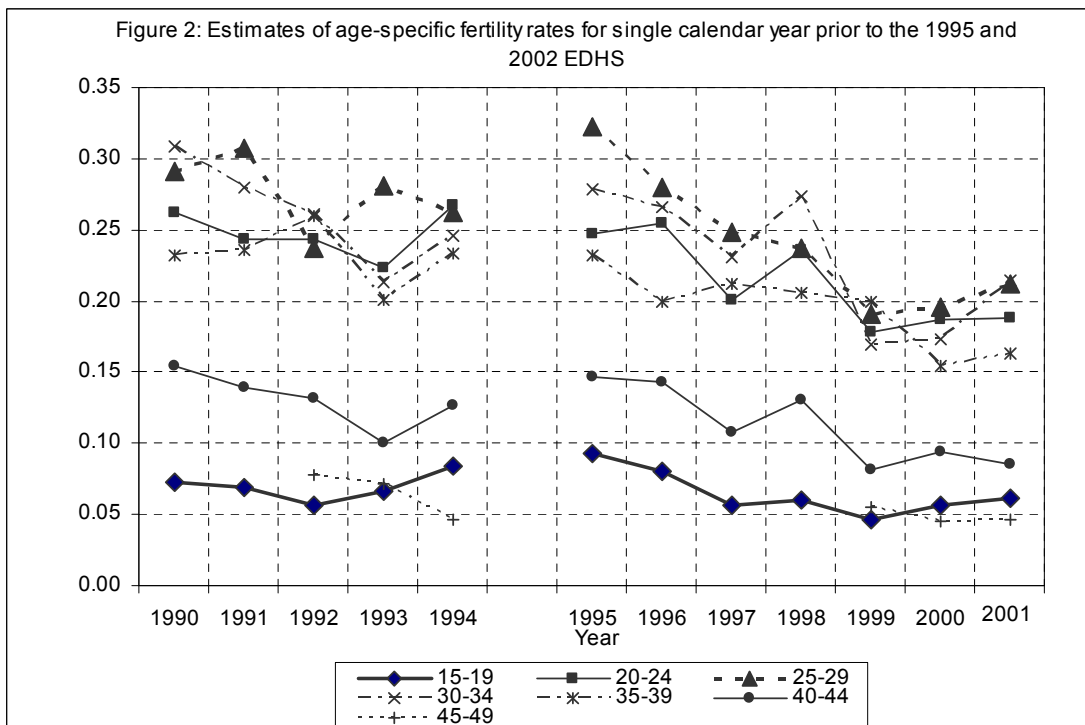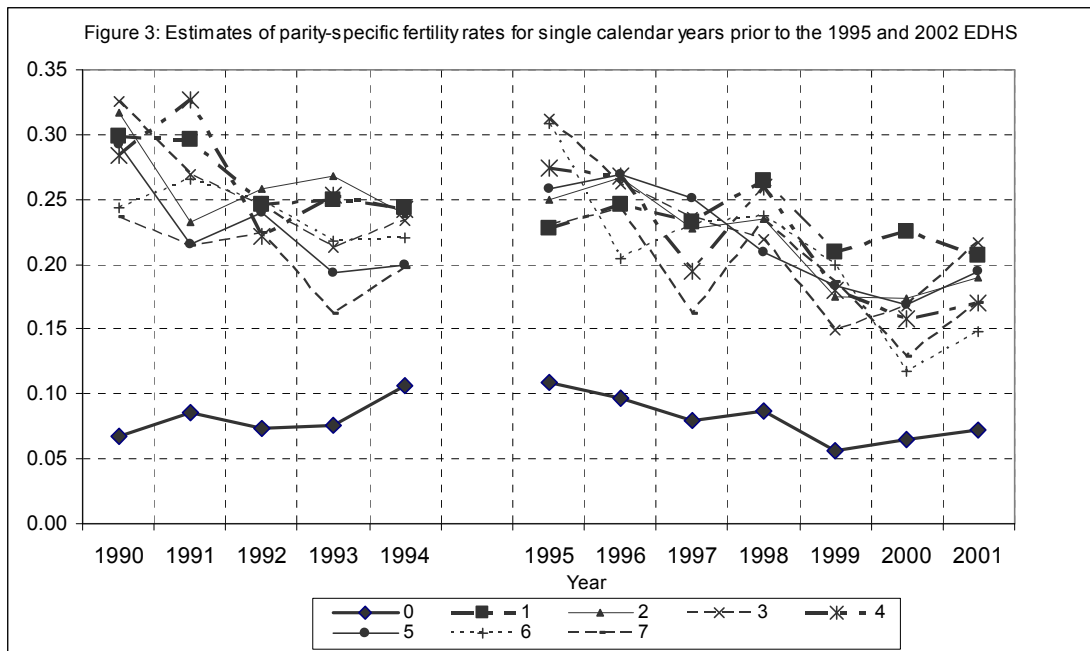


Figure 2: Estimates of age-specific fertility rates for single calendar year prior to the 1995 and 2002 EDHS

Figure 3: Estimates of parity-specific fertility rates for single calendar years prior to the 1995 and 2002 EDHS

## 6.2 Multivariate Analysis

The above trend analyses of aggregate fertility measures indicate that the decline in fertility is certainly noticeable after 1998 and that it occurred at all ages and birth orders. But, such aggregate measures may not be robust enough to discern the underlying trend of the decline and do not capture the impact of compositional changes among women and of change in reproductive behavioral factors related to family size limitation, including changes in birth spacing, parity, child survival status, marital status, and other socio-demographic factors. In order to further investigate in-depth whether a clear change in fertility is visible before or after 1998, multivariate regression methods are used to estimate separate models for first and higher order births.

The results of the multivariate analyses are given as relative risks of giving birth to a (another) child, where the risk of giving birth is expressed relative to a reference (or baseline) category of each covariate. A relative risk of 1 indicates that the estimated risk is equal to that of the reference category; a relative risk greater than 1 indicates that fertility is higher than that of the reference category and a relative risk less than 1 indicates lower fertility than for the reference category.

Tables 2 and 3 present the results from the multivariate analyses of first births of all women and of married women, respectively. Relative risks associated with calendar

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years indicate how much fertility has changed relative to the reference level, 1996-98. It is evident from these tables that there has been a gradual increase in first birth fertility until 1996-98, and a subsequent decline after this period. This clearly suggests that first birth fertility increased during the post-independence period when Eritrea enjoyed peace and economic improvements during 1992-98 and started to decline after 1998 during the border conflict. The later development may be due to the impact of mobilization of young married Eritreans to the military service during the border conflict. The effect of calendar period remains largely consistent and statistically significant even with the addition of marital status and other variables to the model.

Rural-urban differentials indicate that first birth fertility is lower in urban than in rural areas (Model 1, Table 2). Fertility is considerably higher among ever-married than among never-married women. Adding marital status in the model reversed the rural-urban differential in first birth fertility. This suggests that rural-urban differential in first birth fertility is not due to rural-urban residence per se, but to differences in marital status between rural and urban areas with many rural women getting married at younger ages which do not give birth immediately after marriage, probably because they are either physiologically immature or are still staying with their parents, which is often the case in rural Eritrea. Model 3 shows of Table 2 no significant difference in first birth fertility among the different regions, except for the South region where the risk of having a first birth is higher than in the other regions. This region is one of the two regions where the population is most affected by the border conflict. In order to assess fertility differentials by region of residence, an interaction model between calendar period and region was run (not presented here). But, no important regional differences in fertility trends in first births were found.

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Table 2: Relative risks of first birth associated with selected variables

| Variables | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| **Period[t]** | | | |
| <1990 | 0.71*** | 0.63*** | 0.61*** |
| 1990-92 | 0.82*** | 0.79*** | 0.80*** |
| 1993-95 | 0.93* | 0.88*** | 0.80*** |
| 1996-98 | 1 | 1 | 1 |
| 1999-01 | 0.72*** | 0.75*** | 0.76*** |
| **Childhood residence** | | | |
| Rural | 1 | 1 | 1 |
| Urban | 0.62*** | 1.14*** | 1.13*** |
| **Marital status[t]** | | | |
| Ever-married | - | 1 | 1 |
| Never married | - | 0.05*** | 0.05*** |
| **Region** | | | |
| Southern Red Sea | - | - | 1 |
| Central | - | - | 1.09* |
| Northern Red Sea | - | - | 0.95 |
| Anseba | - | - | 1.04 |
| Gash Barka | - | - | 0.95 |
| South | - | - | 1.17*** |
| Change in degrees of freedom ($\Delta$df) | | 1 | 5 |
| Change in model statistic ($\Delta\chi^2$ statistic) | | 7144.80 | 265.13 |

*Factor level significant at <10%        **significant at <5%        ***significant at <1%
[t] Time varying covariates

Table 3 considers only married women. The data from Table 3 suggest the same fertility trend by period as in Table 2. In addition, first birth fertility is higher among women who married at older ages than those married at young ages. Evidently, those who marry late give their first birth very fast after marriage while those who marry very early delay their first birth. In Eritrea, where most marriages start very early (particularly in rural areas), women often stay at their parents' home for several years after getting married. This is likely to prolong the interval between marriage and first birth and hence reduce first birth fertility. Our finding is consistent with results from a study in rural Anhui, China (Yang 1990) who found women who married at an older age had a higher fertility rate for the first five years of marriage, while younger married women had a lower initial fertility rate. A higher level of woman's education is believed to be associated with lower level of fertility (e.g., UN 1987; Freedman et al. 1988). The negative effect of education on fertility may work through several mechanisms (Knodel and Pitaktepsombati 1973; Martin and Juarez 1995): first, education may raise age at marriage by postponing marriage in order to complete higher education, second, education can lead to enhancement of women's ability to

make reproductive choices, such as greater use of contraception and postponement of childbearing, and to achieve desired low family size. However, unlike in other countries, neither higher education of women nor higher age at first marriage led to lower first birth fertility in Eritrea. This may suggest that educated women marry at higher ages (NSEO and ORC Macro Inc. 2003) and once they are married, they rapidly enter into motherhood.

Table 4 displays the results from the multivariate analyses of second and higher order births. Unlike with first birth fertility, this table shows that all relative risks before the reference period are significantly above unity, and the decline has started sometime between 1996 and 1998, that is, before the conflict. This may suggest that women started to postpone or limit childbearing after they reach the desired number of children. Like with first births, the addition of other variables makes no significant difference on the period-fertility relationship. The results show that fertility is lower among women older than 35 years, but otherwise not much affected by age. The pattern by birth order also show that, net of all the socio-demographic influences (Models 4 and 5), fertility is lower at the very high birth orders, but mostly not very strongly affected by birth order. The effects of rural-urban childhood residence and education of women is in the expected direction and statistically significant, where fertility is lower among women with some education and who lived in urban areas during childhood.

The effect of previous birth interval is clear and significant, where longer birth intervals are associated with lower fertility. The death of a previous child also increases the probability of having the next birth. The risk of conception is about 30% higher if the previous sibling has died than if it is alive, thus confirming the common finding that death of a previous child is correlated with the next conception (Lindstrom and Kiros 2007). There is no systematic differential in fertility by region, although fertility is relatively lower in three regions, Central, Northern Red Sea, and Gash Barka.

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Table 3: Relative risks of first birth of married women associated with selected variables

| Variable | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| **Period[t]** | | | | |
| <1990 | 0.57*** | 0.61*** | 0.62*** | 0.62*** |
| 1990-92 | 0.75*** | 0.77*** | 0.78*** | 0.78*** |
| 1993-95 | 0.85*** | 0.86*** | 0.87*** | 0.87*** |
| 1996-98 | 1 | 1 | 1 | 1 |
| 1999-01 | 0.77*** | 0.75*** | 0.75*** | 0.75*** |
| **Childhood residence** | | | | |
| Rural | 1 | 1 | 1 | 1 |
| Urban | 1.25*** | 1.18*** | 1.08 | 1.09 |
| **Age at 1st marriage** | | | | |
| <16 | - | 1 | 1 | 1 |
| 16-19 | - | 1.39*** | 1.38*** | 1.38*** |
| 20+ | - | 1.58*** | 1.58*** | 1.58*** |
| **Education of mother** | | | | |
| No education | - | - | 1 | 1 |
| Primary | - | - | 1.16*** | 1.14*** |
| Secondary or higher | - | - | 1.20*** | 1.19*** |
| **Region** | | | | |
| Southern Red Sea | - | - | - | 1 |
| Central | - | - | - | 1.00 |
| Northern Red Sea | - | - | - | 1.01 |
| Anseba | - | - | - | 1.07 |
| Gash Barka | - | - | - | 0.93 |
| South | - | - | - | 1.06 |
| Change in degrees of freedom ($\Delta$df) | | 2 | 2 | 5 |
| Change in model statistic ($\Delta\chi^2$ statistic) | | 187.10 | 20.56 | 11.95 |

*Factor level significant at <10%          *** significant at <1%
[t]Time varying covariate

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Table 4: Relative risks of higher order births associated with selected socio-demographic variables

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| **Period[t]** | | | | | |
| <1990 | 1.09*** | 1.08*** | 1.06** | 1.03 | 1.03 |
| 1990-92 | 1.25*** | 1.24*** | 1.22*** | 1.19*** | 1.19*** |
| 1993-95 | 1.26*** | 1.26*** | 1.25** | 1.23*** | 1.23** |
| 1996-98 | 1 | 1 | 1 | 1 | 1 |
| 1999-01 | 0.75*** | 0.75*** | 0.76*** | 0.77*** | 0.77*** |
| **Age of mother at previous birth** | | | | | |
| <20 | 1 | 1 | 1 | 1 | 1 |
| 20-24 | 1.05** | 1.05* | 1.05** | 1.10*** | 1.10*** |
| 25-29 | 1.04 | 1.04* | 1.04* | 1.14*** | 1.13*** |
| 30-34 | 0.96** | 0.96 | 0.96 | 1.09*** | 1.08** |
| 35-39 | 0.78*** | 0.78*** | 0.77*** | 0.91** | 0.90** |
| 40-49 | 0.55*** | 0.55*** | 0.54*** | 0.65*** | 0.64*** |
| **Birth order** | | | | | |
| 2-3 | 1 | 1 | 1 | 1 | 1 |
| 4-5 | 1.01 | 1.00 | 0.99 | 0.94*** | 0.94** |
| 6-7 | 1.00 | 0.98 | 0.96 | 0.88*** | 0.88*** |
| 8+ | 0.88*** | 0.87*** | 0.84*** | 0.76*** | 0.77*** |
| **Childhood residence** | | | | | |
| Rural | - | 1 | 1 | 1 | 1 |
| Urban | - | 0.78*** | 0.92*** | 0.92*** | 0.92*** |
| **Education of mother** | | | | | |
| No education | - | - | 1 | 1 | 1 |
| Primary | - | - | 0.85*** | 0.85*** | 0.85*** |
| Secondary or higher | - | - | 0.66*** | 0.65*** | 0.66*** |
| **Previous birth interval[$]** | | | | | |
| <18 | - | - | - | 1 | 1 |
| 18-23 | - | - | - | 0.94*** | 0.94*** |
| 24-35 | - | - | - | 0.90*** | 0.90*** |
| 36-47 | - | - | - | 0.79*** | 0.79*** |
| 48+ | - | - | - | 0.72*** | 0.72*** |
| Survival of preceding birth[t] | | | | | |
| Living | | | | 1 | 1 |
| Dead | | | | 1.32*** | 1.33*** |
| **Region** | | | | | |
| Southern Red Sea | - | - | - | - | 1 |
| Central | - | - | - | - | 0.93** |
| Northern Red Sea | - | - | - | - | 0.94** |
| Anseba | - | - | - | - | 1.02 |
| Gash Barka | - | - | - | - | 0.94** |
| South | - | - | - | - | 0.99 |
| Change in degrees of freedom (Δdf) | | 1 | 2 | 5 | 5 |
| Change in model statistic(Δχ² statistic) | | 96.12 | 131.58 | 214.85 | 21.41 |

*Factor level significant at <10%     **significant at <5%     *** significant at <1%
[t] Time varying covariate
[$]For second births the interval is from first marriage to first birth

Overall, it is evident from the multivariate models that fertility in Eritrea has declined in recent years and the onset of the decline seems to vary by birth order. While it is clear from Tables 2 and 3 that the decline in first birth fertility occurred after 1998, for second and higher order births, the decline did not follow 1998. It rather started prior to 1998, well before the conflict.

In the final model of Table 4, all possible interactions were also explored, and interactions of calendar period with birth order, age of mother at the birth of the previous child, and with region were found to be significant. Summaries of these interactions are presented in Tables 5, 6, and 7, respectively. Interactions that are not statistically significant are not shown. For instance, we run interactions of period with education and rural-urban residence to assess if the later factors have interacting effects on fertility in addition to their independent effects, but found no such effects.

The results in Tables 5, 6 and 7 indicate a consistent and significant lower fertility after 1995 for all birth orders, age groups, and regions, although the fertility response is strongest during the most recent period (1999-01). The fertility decline is relatively stronger among higher order births (4 or higher) and older women (35 or older). Although one may expect that the two regions, South and Gash Barka, which were relatively more affected in terms of population displacement, direct fighting, etc during the border conflict to have experienced lower fertility, no differential fertility response is observed in these regions. However, it is to be noted that region of residence is a potentially very problematic variable, since it is measured only at the time of the interview. The absence of information on migration histories during a period of much forced migration and displacement makes results of this variable to appear very tentative.

Table 5: Interaction effect of calendar period and birth order on fertility of 2$^{nd}$ and higher births: risks for period before 1996 & 1999-01 relative to the period 1996-98

| Birth order | | | | |
|---|---|---|---|---|
| **Period** | 2-3 | 4-5 | 6-7 | 8+ |
| Before 1996 | 1.14 | 1.17 | 1.10 | 1.13 |
| 1996-98 | 1 | 1 | 1 | 1 |
| 1999-01 | 0.83 | 0.75 | 0.70 | 0.75 |
| Change in degrees of freedom (Δdf) | 6 | | | |
| Change in model statistic (Δχ$^2$ statistic) | 14.50 | | | |
| p=0.000 | | | | |

Table 6: Interaction effect of calendar period and age of mother on fertility of 2$^{nd}$ and higher births: risks for the periods before 1996 & 1999-01 relative to the period 1996-98

| Age of mother at birth of previous child | | | | | | |
|---|---|---|---|---|---|---|
| **Period** | ≤19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-49 |
| Before 1996 | 1.17 | 1.12 | 1.09 | 1.16 | 1.31 | 1.80 |
| 1996-98 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1999-01 | 0.92 | 0.78 | 0.72 | 0.78 | 0.69 | 0.59 |
| Change in degrees of freedom (Δdf) | 10 | | | | | |
| Change in model statistic (Δχ$^2$ statistic) | 45.17 | | | | | |
| p=0.000 | | | | | | |

Table 7: Interaction effects of calendar period and region on fertility of 2$^{nd}$ and higher births: risks for period 1999-2002 relative to those of period before 1999

| Region | | | | | |
|---|---|---|---|---|---|
| **Period** | Southern Red Sea | Central | Northern Red Sea | Anseba | Gash Barka | South |
| Before 1996 | 1.14 | 1.20 | 1.28 | 1.16 | 1.16 | 0.99 |
| 1996-98 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1999-01 | 0.66 | 0.78 | 0.89 | 0.80 | 0.77 | 0.72 |
| Change in degrees of freedom (Δdf) | 10 | | | | | |
| Change in model statistic (Δχ$^2$ statistic) | 33.43 | | | | | |
| p=0.000 | | | | | | |

Note: In the interaction terms, period is collapsed into three categories

## 7 Discussion and Conclusion

In this study, an attempt is made to examine the recent fertility decline in Eritrea, a setting that experienced a violent conflict and economic crisis in recent years in order to improve our understanding of the timing of the decline and the underlying factors that contributed to it. It argues that looking solely at the changes in TFR may distort our understanding of the nature and causes of the decline as well as may lead to inappropriate policy options by failing to take into account the relative importance of the different socio-demographic factors that affect fertility.

The findings from our trend analysis of TFR and age-and parity-specific fertility show that the magnitude and trend of the fertility decline is fairly consistent with those reported by Blanc (2004). However, the multivariate analysis showed a different pattern of fertility decline for first and higher order births. For first births, the decline is only noticeable after 1998 (the onset of the conflict), while for higher order births the decline started before 1998. Thus, Blanc's generalization that the border war of 1998 to 2000 was the driving force behind the onset of the decline cannot be entirely confirmed from our study for the following reasons: First, the fact that the fertility decline of higher order births started before the conflict rather supports our argument that part of the decline may be due to a more long-term fertility transition than a short-term development initiated by the conflict. This does not rule out the effects of the conflict on first birth fertility presumably through spousal separation of young Eritreans. Second, our results from the interactions of calendar period with age of mother and with birth order clearly showed that although the decline occurs at all ages and at all birth orders, it is relatively stronger among older mothers (35 years or older) and higher order parities (4 or more). This may suggest that many couples have purposely delayed or stopped childbearing after they achieved the desired number of children. Third, improvement in child survival is likely to make a significant impact in fertility aspirations and consequently in the decline of fertility. In this study, we find a significant lower probability of having birth if the preceding child is alive than if it died. It is possible that Eritrean women are more likely to want fewer children if they have not experienced child loss than they had such an experience. Fourth, if the conflict had been the sole factor responsible for the decline, a stronger decline could have been observed in the two regions which were most affected by the fighting. But,

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we did not find any significant regional differences in fertility, rather the decline occurred in all regions. This study also found no decisive impact of delayed age at marriage on fertility. This study instead indicates that the decline in marital fertility is the main contributor to the overall decline. Part of the decline thus, appears to indicate the onset of a long-term fertility transition, which is likely to be related to factors such as improvements in access to public health care services, education, urbanization and other social services which pre-dated the conflict. Such improvements can reduce fertility by enhancing child survival.

However, although we cannot say that the decline of the recent fertility in Eritrea is the outcome of the border conflict only, this does not mean that the conflict is neutral in effect. Particularly, the decline of first birth fertility after 1998 is a clear indication of the war effect. In addition, the rapid decline of higher order births after 1998 seems unlikely to be entirely explained by factors such as improvements in child survival or the social and economic transformations that pre-dated the border war or to just reflect conscious changes in the timing and spacing of births. The border war is likely to have accelerated this part of the decline too. Overall, it is plausible to suggest that the fertility decline reflects the beginning of a long-term fertility transition which is further fuelled by a temporary impact of the border conflict and economic crisis associated with it.

The findings of this study have methodological and theoretical implications. Methodologically, they highlight the importance of examining all parities and ages in a dynamic setup to the extent that data of that kind are available. Studies which do not explicitly focus on first and higher order births, on younger and older ages of women and survival status of preceding child and/or birth spacing are likely to miss important parts of the fertility dynamics and behaviours. Our findings have also implications for theories about fertility change in times of crises in that military conflict may affect a certain social groups of the population and cause a short-term decline. The fact that the fertility response to the conflict seems to be important among first births implies that not all groups of the population may be uniformly affected by war crisis or exhibit the same fertility response. The results also imply that war crisis may facilitate an ongoing decline, probably with a subsequent recovery in peace time (Palloni et al.

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1996). These findings confirm the results from more recent studies on fertility during crisis periods in Ethiopia (Lindstrom and Berhanu 1999), Angola (Agadjania and Ndola 2002), and Rwanda (Hill 2004) which are inconclusive in terms of consistent or sustainable changes in fertility among all populations.

Although our study has addressed several important aspects of the recent changes in fertility in Eritrea and its underlying factors, there are still questions which we could not address. The effects of some important factors could not be explored because of either lack of information or deficiency in data that were collected. Probably, the most important ones are time varying information on socio-economic indicators, data on spousal separation, and indicators of women's autonomy or status.

Data limitation prevented us from evaluating further the impact of socio-economic status on fertility: this holds both for individual-level data and macro data on economic developments in Eritrea as a whole. Changes in such socio-economic indicators may affect fertility differently in different time periods. Increase in spousal separation is also likely to be one of the potential factors that contributed to the recent change in fertility. Lindstrom and Berhanu (1999) found that spousal separation was one of the mechanisms by which the civil war affected fertility during the short-term in Ethiopia. In the present study, since information on the exact timing of spousal separation is not available for our analyses, we are unable to consider this variable in our dynamic analyses. Improvement in women's status is also suggested to be an important indicator of women's ability to control their fertility (Hindin 2000; Mason 1993). It is argued that the lag in fertility decline and contraceptive use in developing countries, particularly in Africa is often attributed to gender inequality and patriarchy which encourages high fertility through the separate roles it assigns to men and women (Balk 1994; Caldwell and Caldwell 1985; Morgan and Niraula 1995). However, the amount of patriarchal control over women varies from place to place, could change over time and could be influenced by several other factors. In Eritrea, for instance, women fighters during the struggle for independence were active participants in the social, political and leadership of the liberation front. Such improvements in women's participation might have affected the roles of women in Eritrea. It is likely that women have enjoyed some level of autonomy which avails them the opportunity to take independent decisions on certain issues of reproduction

and fertility, but due to lack of timely information on the amount of progress gained in women's individual autonomy we could not assess its effect on fertility.

Finally, given the present political and economic situation of the country, it seems difficult to predict the future course of fertility in Eritrea. However, on the basis of the present findings, fertility in Eritrea may continue to decline gradually in the long-term future though the magnitude and nature of that decline may depend on socio-economic development and the political stability of the country. If the border conflict, which is still unresolved, continues or fighting resumes fertility may continue to be depressed because spousal separation will be maintained. Such an impact might be followed by a temporary recovery, but our main impression is nevertheless that the long-term development is set towards a reduced fertility in contemporary Eritrea.

## 7 Acknowledgements

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Annex

Table 8: List of variables used in the analysis of fertility together with the percentage distribution of births in each category

| Percentage in Category | | |
|---|---|---|
| Variable | First births | Higher order births_ |
| **Calendar period** | | |
| <1990 | 38.5 | 29.8 |
| 1990-92 | 14.3 | 15.6 |
| 1993-95 | 18.7 | 19.2 |
| 1996-98 | 15.6 | 19.0 |
| 1999-01 | 12.9 | 16.4 |
| **Age of mother at previous birth** | | |
| <20 | 47.2 | 15.6 |
| 20-24 | 36.0 | 30.3 |
| 25-29 | 12.9 | 26.9 |
| 30-34 | 3.1 | 18.1 |
| 35-39 | 0.6 | 7.4 |
| 40-49 | 0.1 | 1.7 |
| **Birth order** | | |
| 2-3 | - | 47.0 |
| 4-5 | - | 29.6 |
| 6-7 | - | 15.5 |
| 8+ | - | 7.9 |
| **Previous birth interval** | | |
| <18 | - | 22.7 |
| 18-23 | - | 18.0 |
| 24-35 | - | 31.1 |
| 36-47 | - | 13.2 |
| 48+ | - | 15.0 |
| Survival of preceding child | | |
| Alive | - | 92.6 |
| Dead | - | 7.4 |
| **Age at 1st marriage** | | |
| <16 | 35.3 | 39.8 |
| 16-19 | 36.4 | 34.3 |
| 20+ | 28.3 | 25.9 |
| **Childhood residence** | | |
| Rural | 79.0 | 90.6 |
| Urban | 21.0 | 9.4 |
| **Mother's education** | | |
| No education | 70.0 | 80.1 |
| Primary | 20.9 | 15.7 |
| Secondary and higher | 9.1 | 4.2 |
| **Region** | | |
| Southern Red Sea | 17.1 | 16.2 |
| Central | 12.5 | 10.6 |
| Northern Red Sea | 17.0 | 17.4 |
| Anseba | 16.9 | 18.1 |
| Gash Barka | 16.8 | 17.0 |
| Southern | 19.7 | 20.8 |
| **Total** | 5,931 | 17,531 |