Fertility and infant mortality trends in Nicaragua 1964–1993. The role of women's education

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Abstract

Objectives—To assess trends in fertility and infant mortality rates (IMR) in León, Nicaragua, and to examine the effect of women's education on these trends during 1964–1993, a period of rapid social change.

Design—Cross sectional survey, based on random cluster sampling. A retrospective questionnaire on reproductive events was used.

Setting—The municipality of León, which is the second largest city in Nicaragua, with a total population of 195 000 inhabitants.

Subjects—10 867 women aged 15–49 years, corresponding to 176 281 person years of reproductive life. Their children contributed 22 899 person years under 12 months of age to the IMR analysis.

Main outcome measures—Fertility rate (number of pregnancies per 1000 person years) for specific age groups and calendar periods, total fertility rate, and IMR.

Results—Fertility rates and IMR declined in parallel, especially during the 1980s. However, education specific fertility rates did not decline, but the proportion of educated young women increased from 20% to 46 %. This had also an impact on the overall IMR decline, although IMR reduction mainly took place among infants of women without formal education, decreasing from 118 to 69 per 1000 during the observation period.

Conclusions—In this demographic transition over three decades, fertility and IMR declined simultaneously. The decreasing trend in fertility was mainly explained by an increase in women's education, while the IMR decline seemed to be the result of health interventions, specially targeted to poorer groups of women and their infants. Thus, social differences in fertility rates remained unchanged, while equity in chances of child survival increased.

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Most demographic studies indicate that declines in fertility are usually preceded by a reduction in infant mortality rate (IMR).[1–3] This pattern is often seen as a consequence of economic development and modernisation, presumably because as families realise that more of their children are surviving they gradually reduce the number of pregnancies.[2,4] Nevertheless, declines in fertility and infant mortality seem to be influenced by a number of interwoven factors.[5] For instance, the status of women, often expressed as educational attainment, is considered to be one of the most important underlying factors.[6–11]

Nicaragua, with approximately 4 million inhabitants, has one of the highest annual population growth rates in Latin America, estimated at 3.4 per cent.[12–14] During the 1970s, Nicaragua was characterised by social inequities. For example, half of the population shared 16% of the national income, while 41% of the population lacked sufficient income to satisfy their basic nutritional needs.[15] Illiteracy was reportedly 52% in 1979 and infant mortality was 121 per 1000 live births.[16]

In 1979, the ruling Somoza dictatorship was overthrown and replaced by a revolutionary government. The new government initiated a broad programme of social and economic reforms, which led to a reduction of illiteracy and the expansion of primary health care services.[17,18] Between 1979 and 1983, health and education received a major share of the national budget.[18] In 1980, a nationwide campaign reportedly reduced illiteracy from 52% to 12% in less than a year. School enrolment rose from 501 000 in 1979 to over 1 000 000 in 1982.[16] The emphasis in health services was reoriented from secondary care to primary care and health education.[19] Efforts to improve the situation of women included increased access to education and jobs and the drafting of a new constitution explicitly granting women equal rights.[20,21] The second part of the 1980s was dominated by war and an economic crisis, during which the government was no longer able to sustain the formerly high levels of subsidies on social services and food within a war time economy.[22] Despite this, infant mortality was reduced during this period from 121 to 76 per 1000 live births between 1977 and 1983 and to 65 per 1000 by 1986.[23,24] This dramatic reduction has been largely attributed to three specific actions: diarrhoea treatment and prevention, measles immunisation, and increased literacy among mothers.[18]

In 1990, a new conservative coalition government initiated a series of measures to stabilise the country. Peace was achieved and hyperinflation was eventually controlled. The new economic policies included a restructuring of the economy, which led to such measures as the elimination of food and medicine subsidies, as well as dramatic reductions in public sector spending. This has placed an increasing burden on the poor, among them women and children.[25]

There are no published population-based studies to date assessing the trends in fertility and infant mortality rates during this transitional period in Nicaragua. Therefore, the aims
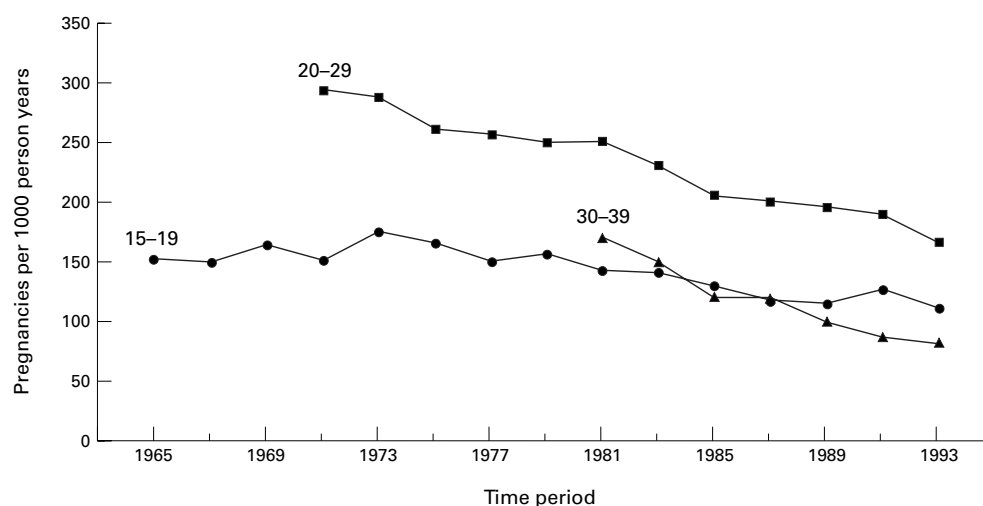
Figure 1   Fertility rate (pregnancies per 1000 person years) by age groups (15–19, 20–29, and 30–39) observed between 1964–93. Data were obtained from a reproductive and child health survey. León, Nicaragua 1993.

of this paper are to describe the development of fertility and infant mortality in León, Nicaragua from 1964 to 1993, and to analyse the association of women's education with fertility and infant mortality.

Methods

The study was carried out in León, a municipality with an estimated population of 195 000 inhabitants, 80% of whom lived in urban areas. León is situated about 100 kilometres north of the capital, Managua. Cotton production was the main source of income in the area, but production declined towards the end of the 1980s. Unemployment is as high as 49%, affecting women to a greater extent than men.[26] Most of the Spanish speaking population is of mixed white and native American origin, and 90% are Roman Catholics.

A cross sectional community based study was performed in 1993 involving a representative sample of households in urban and rural areas of León. Sample size was based on the estimated infant mortality rate.[27] Municipal population statistics validated by other local sources were used to divide the area into 208 geographical clusters of similar population size. Out of those, 50 clusters were randomly selected with probability proportional to the number of inhabitants in each cluster. A household was defined as all persons sleeping under the same roof during at least half of the past month. Maps of the study areas were prepared and all houses in the selected clusters were enumerated. All members of the household received additional numbers, which,

together with the household code, constituted unique identity numbers for all participants of the survey.[27] In 2% of the households, the residents declined to take part in the study. All women aged 15–49 years in this sample were interviewed in their homes by female field workers. A total of 10 867 women from 7789 households were asked about socioeconomic characteristics and their full reproductive history. To minimise recall bias, a local events calendar was used by the field workers. All forms were reviewed by a field supervisor and inspected by one of the principal researchers. Forms with missing data or inconsistencies were returned to the field. The study was ethically approved by the Medical Faculty in León, and by the Research Ethics Committee at Umeå university, Sweden.

Although reproductive information was collected from women who were between 15 and 49 years old at the time of interview, only data regarding the age interval 15–44 years were analysed. These data represent a cohort of 176 281 person years for reproduction analysis between 1964 and 1993. Because of the way the cohort was assembled, reproductive events in the age group 15–19 years could be followed from 1964, while the reproductive events of the age groups 20–29 and 30–39 years were followed from 1971 and 1981, respectively. All live births by these women 1964–93 yielded a cohort of 26 103 infants with 22 899 person years for infant mortality analysis.

Fertility rate was defined as the number of pregnancies per 1000 person years for a specific age group and calendar period. Total fertility rate (TFR) was calculated as the total number of live births by women 15–44 years, and derived from the age specific incidences of live births per person years during a specific calendar period. Infant mortality rate was defined as cumulative incidence of death before 12 months of age, and derived from monthly mortality incidence rates calculated by life table technique (density method). Age adjusted infant mortality incidence rate ratios were calculated according to Mantel-Haenszel comparing different groups—that is, infants of

Table 1   Cumulative total fertility rate (total number of live births by women 15–44, given the age specific incidences of live births per person years during a specific calendar period) in León, Nicaragua for different time periods 1964–93

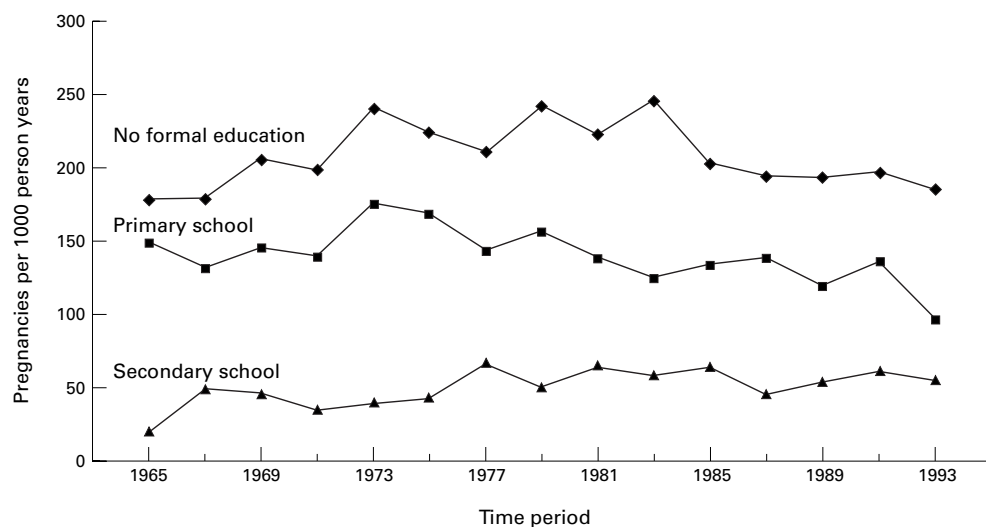|	Time period					
Attained age	1964–68	1969–73	1974–78	1979–83	1984–88	1989–93
20	0.7	0.73	0.71	0.67	0.55	0.55
25	2	2.03	1.86	1.82	1.55	1.55
30		3.3	2.93	2.87	2.35	2.29
35			3.83	3.64	2.95	2.79
40				4.24	3.31	3.02
45					3.51	3.14

Figure 2   Fertility rate (pregnancies per 1000 person years) among adolescents 15–19 years old by levels of education in different periods of time 1964–93.

adolescent mothers (15–19 years of age) with and without formal education. Fertility rates and infant mortality rates were also adjusted for maternal educational level, to explain the role of maternal education in the demonstrated time trends.

Women were classified as having no formal education if they were either illiterate or had not completed primary school. Women with formal education were further classified according to whether they had completed primary school or secondary or higher level of education. Data entry, data editing, and descriptive analysis were performed using EPI-INFO 6.02,[28] while QUEST epidemiological software was used for life table analysis.[29]

Results

Between 1964 and 1993, fertility (pregnancies per 1000 person years) decreased in all age groups (fig 1). The most marked decline occurred in the first half of the 1980s. Fertility rates among adolescents remained constant up to the beginning of the 1980s, when they began to decrease gradually. As expected, women between 20–29 years of age had the highest

fertility, but showed a steady decline in fertility from the early 'seventies and onwards, reaching almost half the level of 1970–71 some 20 years later. Older women (30–39 years in fig 1) also displayed a reduction in fertility, crossing over the level of the adolescents towards the end of the study period. The age specific birth rates from 1989–93 correspond to TFR (live births during a reproductive life span 15–44 years) of 3.14 children per woman, while from 1984–88 the total fertility rate was 3.51 children per woman (table 1).

The gradient of fertility rates according to three levels of women's education attainment remained unchanged during the whole 30 year period (data shown for women 15–19 years) (fig 2). This pattern was consistent across other age groups. The decline in crude fertility rate was associated with a marked increase in women's education, for example, the proportion of adolescents that had completed primary school more than doubled from the 1960s to the beginning of the 1990s (from 20% to 51 %). The TFR during 1989–93 of a woman without formal education was 4.15 children, while the corresponding figures for women with primary
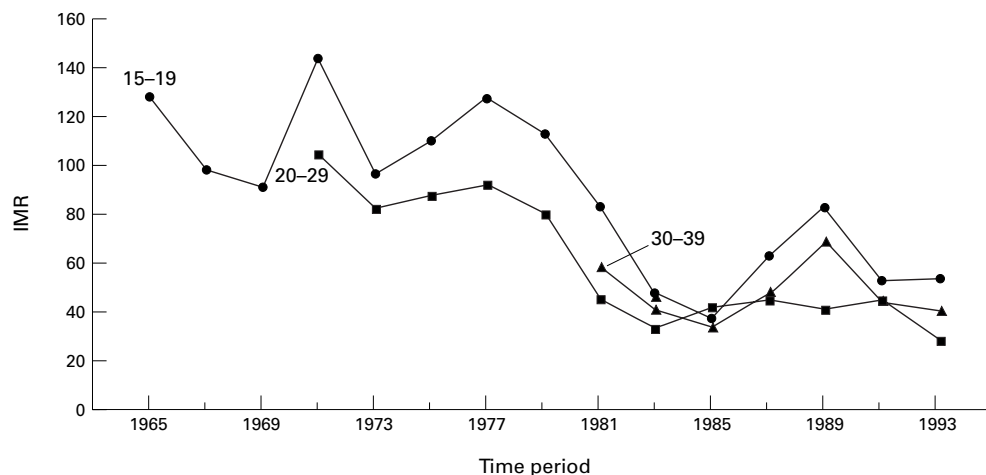

Figure 3   Infant mortality rate (deaths before 12 months of age per 1000 live births) for mothers of different age groups (15–19, 20–29, and 30–39) in different periods of time 1964–93.

Table 2   Deaths before one year of age per 1000 live births, relative risk (Mantel-Haenszel adjusted for age) of infant death if mother is educated compared with having no formal education, the proportions of mothers having formal education and the proportion of deaths being prevented by education, if the association between education and mortality is causal. Adolescent mothers (15–19 years)

	IMR					
Years	Formal education	No formal education	RR_{mh}	95% CI	Educated (%)	Prevented fraction (%)
1964–68	53	118	0.44	0.21, 0.94	20	11
1969–73	51	132	0.37	0.21, 0.66	25	16
1974–78	84	134	0.61	0.42, 0.89	34	13
1979–83	44	94	0.45	0.28, 0.71	37	20
1984–88	40	68	0.59	0.36, 0.97	46	19
1989–93	49	69	0.70	0.46, 1.06	51	15

IMR = Infant mortality rate; RR_{mh} = relative risk for infant death adjusted for age.

school and secondary school or higher was 2.71 and 2.16, respectively.

The IMR decreased markedly in the period 1979–85 for each maternal age group (fig 3). For the youngest mothers the IMR decreased from 120 per 1000 to 40 per 1000 in six years, while the infants of older mothers (20–29 years) showed a reduction from 80 to 40 per 1000 live births in the same period. Three peaks of infant mortality could be noted during the study period: in 1970–71, in 1976–77, and in 1988–89. These peaks were most evident among infants born to the youngest mothers.

The reduction of IMR observed during the study period occurred mainly among infants of mothers without any formal education (data shown for adolescent mothers, table 2). This pattern was also seen among infants of older mothers. The proportion of infant deaths prevented by maternal education, assuming a causal association, varied between 11 and 20 per cent during the study period (table 2).

Fertility rates and IMR for adolescent women were adjusted for education. As indicated by the stratified analysis (fig 2), the adjusted fertility rates remained constant during the whole period (fig 4). Both the adjusted and unadjusted IMR figures, however, declined from 120 to 50 per 1000.

Discussion

This community-based study in León (Nicaragua) demonstrates a simultaneous reduction in fertility rates and IMR, especially during the 1980s. The expansion in women's education explained most of the fertility decline, while the reduction in IMR mainly affected infants of women having no formal education.

The study area is to a large extent representative of the Pacific regions of Nicaragua, and the descriptive trends found are comparable to the results of a recent national reproductive health survey.[30] Therefore, it is likely that the findings are representative of the Nicaraguan population at large.

A possible source of selection bias in this retrospective study is the loss of women from the cohort at baseline, either because of out-migration or deaths. Women emigrating abroad may have had higher education, higher socio-economic class, lower fertility, and better child survival than the average woman. This may have contributed to a minor under-representation of the fertility and infant mortality pattern of the higher education group of women up to the end of the 1970s. However, it seems unlikely that this bias would influence the trends in the education specific rates and the association between education, fertility, and infant mortality presented. Another limitation is that older women may have had greater difficulties in remembering pregnancies and births during the 1960s and 70s. However, reproductive events and infant deaths are rarely forgotten in this culture, and a local events calendar was used to assist in the dating of events. Some authors have found that informants with low education level may be more prone to under-report mortality of their offspring.[9] However, if this was the case, the observed difference in IMR trends would have been even more pronounced.

The IMRs showed a rapid decline during the study period. However, three major peaks tem-
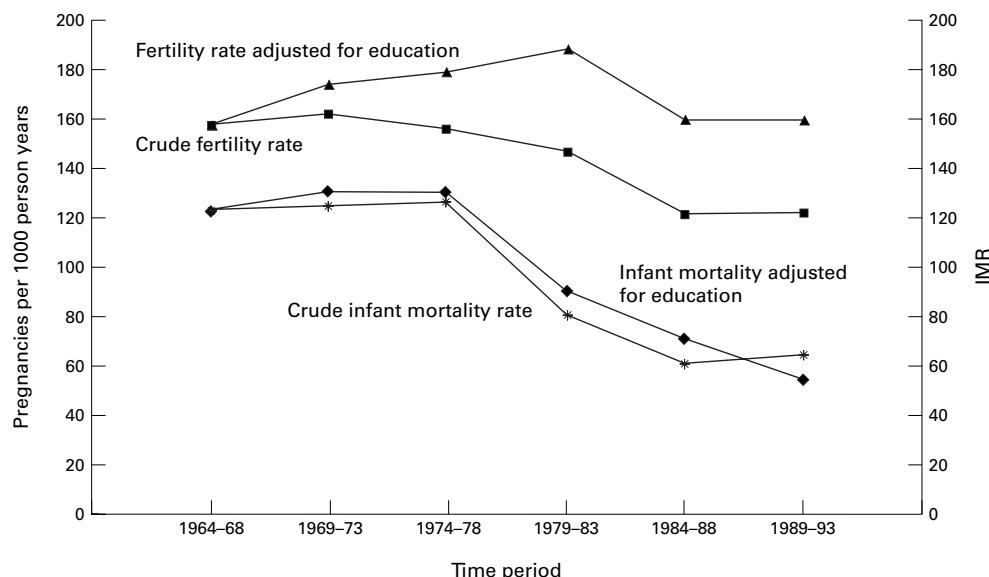

Figure 4   Fertility rates (pregnancies per 1000 person years) and infant mortality rates (IMR), crude and adjusted for education among adolescents (15–19 years of age), during the period 1964–1993 in León, Nicaragua 1993.

porarily interrupted the overall trend. The first peak (1970–71) is explained by local health consequences of a volcanic eruption in the area coinciding with a national epidemic of measles and gastroenteritis. The peaks in 1976–77 and in 1988–89 are related to the increased intensity of war conditions during both periods and to the severe economic crisis, which ensued during the latter period.

The major decline in the IMR took place in the late 1970s and early 1980s. In contrast with the results by Sandiford *et al*, our results show peaks that coincided with periods of social and economic crisis and war.[24] During those years, people were mobilised in literacy and vaccination campaigns and primary health care was expanded into rural areas that had no access to health services.[31–33] The results of these public health efforts can be clearly seen in the improved infant mortality (fig 3). Because of these improvements, Nicaragua was selected in 1981 and 1982 for a WHO award to "the greatest achievement" of the year in health care in a developing country.[17] It is worth noting that despite the ongoing war and economic hardship the mortality figures continued to decline throughout the 1980s.[23 24]

The decline in fertility during the same period has received somewhat less attention. Age specific fertility fell between 20–30% in all age groups during a relatively short period of time during the 1980s, apparently without a significant latency period after the decline in infant mortality. This reduction despite war and economic crisis indicates that, although poverty and high fertility are in general linked, poverty should not be considered a prohibitive obstacle to reduction in fertility.[34]

Of particular interest is the steady decline in adolescent fertility during this period. We have previously shown that the average age of sexual debut of both sexes rose in the 1980s, largely as a result of increased educational attainment.[35]

The educational expansions during the 70s and 80s resulted in 46% of 15–19 year old girls in 1984–88 having formal education as compared with only 20% in 1964–68. The relation between educational level and fertility among teenage mothers is illustrated in figure 2; the gap between the three groups was maintained during almost the entire study period. As indicated by the stratified analysis (fig 4), the overall decline in fertility rates seemed to be the effect of the expansion of education in Nicaragua during this period, specifically the increase in female education.[17 18 20 36] Thus, there were no indications of any major decrease in fertility for any of the educational groups, while the size of the primary and secondary school groups increased (fig 2, table 2). It has also been shown that large increases in educational attainment, such as those that occurred in Nicaragua during the beginning and middle 1980s,[19] have typically occurred slightly before or around the same time as fertility declines.[37] These results support the view that girls who have had uninterrupted education are more likely to have greater aspirations, career goals, and plans for the future, and are more likely to use contraception effectively.[35 38 39]

KEY POINTS

- Fertility and infant mortality rates have declined simultaneously over the past three decades in Nicaragua.
- The decrease in fertility rates was mainly explained by increase in women's education, while the decline in infant mortality rates seemed to be the result of increased health care accessibility, especially for mothers with low or no education.
- Despite social unrest and economic crisis an overall decline in fertility rates can be achieved through social priorities, for example, expansion of women's education.
- Social differences in fertility rates were maintained, while the social gap in infant mortality decreased drastically. Improved access to reproductive health care is needed, especially for poorer classes, if equity in planning of pregnancies is to be achieved.

The education of girls is believed to influence fertility through several different mechanisms.[5 6] Education promotes change in the traditional roles and status of women. Families raise their aspirations for their educated girls, as well as increase the girls own self esteem and goals.[38] In this way, education also increases the possibilities of the girls to make independent decisions. Continued education causes many women to marry later in life. Having a job or profession of her own may also influence her decision to have fewer children to pursue her profession and to earn a salary.[8 40]

Education of the mother is also claimed to increase child survival.[9] However, the major explanations to the reduced IMR during the studied period were not related to education. IMR adjusted for education did not differ much from the crude IMR development (fig 4). The decrease in IMR may be explained by other related factors, such as improving quality and access to health care services for the poorest sectors of society.[24] This resulted in greater equity in chances of child survival towards the end of the 1980s.

Thus, although the declines in fertility and infant mortality were parallel, the underlying mechanisms seem to differ. In the case of fertility decline the expansion in women's education played an important part, while the IMR decline may have been caused by the expansion of social and health services to disadvantaged groups. Social differences in fertility rates were maintained, while the gap in child survival was drastically reduced. Sustained efforts to maintain low fertility and infant mortality levels are important for both health and demographic purposes,[41] while expansion of family planning programmes are needed to increase equity in fertility and planning of pregnancies.[42]

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