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Evaluation of the Peru National Fertility Survey 1977-78

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The World Fertility Survey is an international research programme whose purpose is to assess the current state of human fertility throughout the world. This is being done principally through promoting and supporting nationally representative, internationally comparable, and scientifically designed and conducted sample surveys of fertility behaviour in as many countries as possible.
The WFS is being undertaken, with the collaboration of the United Nations, by the International Statistical Institute in cooperation with the International Union for the Scientific Study of Population. Financial support is provided principally by the United Nations Fund for Population Activities and the United States Agency for International Development.
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Preface

One of the major objectives of the World Fertility Survey programme is to assist the participating countries in obtaining high quality data through national fertility surveys. The high standards set by the WFS are expected to yield better quality data than typically obtained in the past, but this expectation in no way obviates the need for a detailed assessment of the quality of the data. It is recognized that such an evaluation will not only alert the analysts by identifying defects, if any, in the data, but also may throw light on the shortcomings of the WFS approach, which can be taken into account in the design of future fertility surveys.

It is in this context that, as part of its analysis policy, the WFS has initiated a systematic programme for a scientific assessment of the quality of the data from each survey. A series of data evaluation workshops is being organized at the WFS London headquarters with the dual objective of expediting this part of the work and of providing training in techniques of analysis to researchers from the participating countries. Working in close collaboration with WFS staff and consultants, participants from four or five countries evaluate the data from their respective surveys after receiving formal training in the relevant demographic and data processing techniques.

The first such workshop, involving researchers from four Latin American countries – Dominican Republic, Mexico, Peru and Venezuela – was held between July and October in 1979. The present document, which is a translation from the original Spanish, reports on the results of the evaluation of the data of the National Fertility Survey of Peru of 1977–8 and was prepared by Yolanda Céspedes, the participant from Peru. José Miguel Guzmán, Manual Ordorica and Gilberto Vielma, the other participants, contributed to the present evaluation through their ideas and discussions.

Dr Shea Oscar Rutstein, as the co-ordinator of the workshop, assumed a major responsibility in the successful completion of the work, while many other staff members also made significant contributions to it. Drs Noreen Goldman and Joseph Potter provided valuable assistance as consultants.

HALVOR GILLE
Project Director

1 Introduction

1.1 THE WORLD FERTILITY SURVEY

The International Statistical Institute, with the participation of national organizations, has promoted a programme of fertility surveys, denominated the World Fertility Survey (WFS). The main objectives of the programme may be summarized as follows:

1 To provide information that will allow the description and interpretation of the fertility of the population of the participating countries.
2 To increase these countries' capability to study their fertility and to carry out demographic studies. This aim applies particularly to developing countries.
3 To carry out comparative analyses of fertility and the factors that affect it, at an international level.

In order to fulfil these objectives WFS promotes the use of scientifically designed sample surveys. In general, the methodology consists of the selection of a sample of households from which information is collected regarding the general characteristics of the population, and in some instances of the dwelling itself, through the use of a household questionnaire. A subsample of women of childbearing age is then obtained, and they are interviewed by means of an individual questionnaire. The questionnaires applied are kept as standard as possible, in order to enable international comparisons and the development of a uniform tabulation program.

WFS surveys provide a measure of the levels and trends of fertility, infant and child mortality, and nuptiality. Evidently, the reliability of these measures will depend on the quality of the data collected and in spite of carefully formulated questions and strict quality control during the collection of the data, various situations still produce errors which affect the estimates. It is therefore essential to be absolutely certain about the quality of the data collected, especially in the developing countries. The possible biases must be considered, as well as their magnitude and the effect they may have in the estimation of the parameters.

A brief specification of these problems follows, with special emphasis on the errors affecting the pregnancy history.

1.2 THE PERU FERTILITY SURVEY

The Peru National Fertility Survey (Encuesta Nacional de Fecundidad, or ENAF; referred to here as the Peru Fertility Survey, or PFS) was carried out in 1977–8, as part of the WFS programme. It was sponsored by the United Nations Fund for Population Activities (UNFPA) and carried out by Instituto Nacional de Estadística (National Statistical Institute), now the Oficina Nacional de Estadística (National Statistical Office), through the Dirección de Demografia (Demographic Division).

Very little was known before the PFS about the explanatory factors of demographic levels and structures. With respect to the level and structure of mortality, fertility, nuptiality and internal migration, the National Demographic Survey (Encuesta Demográfica Nacional – EDEN), carried out by the National Statistical Office between October 1974 and November 1976, had provided recent information. Peru participated in the WFS programme with the following specific aims:

1 To provide basic elements to increase knowledge of fertility and its differentials.
2 To study recent trends in fertility and the determining factors associated with it.
3 To obtain information that would enable the study of the current levels of urban and rural fertility, and of other subsets of the population.
4 To provide data on the fertility of Peru that would allow comparisons at an international level.
5 To widen the national experience on demographic research.

Two surveys were carried out at the end of the 1960s that provided information on the fertility, and its regulation, of women aged 15–49. They were the National Survey on Urban and Rural Fertility (Programa de Encuesta de Fecundidad en América Latina – PECFAL), carried out in 1969, and the Survey on Induced Abortion, Knowledge and Use of Contraceptives (Programa de Encuesta sobre Abortos en América Latina – PEAL), carried out in the metropolitan area of Lima-Callao in 1970.

The results of these investigations and those obtained by the 1961 and 1972 censuses enable the study of the evolution of fertility over a period of approximately 16 years, when we add the findings of the 1977–8 PFS.

The design and selection of the PFS sample were based on a national sample frame drawn by the Oficina Técnica de Estudios de Mano de Obra (Technical Office for Labour Force Studies) of the Ministry of Labour. The sample is designed to give reliable estimates of means, ratios, proportions and totals for five planning regions, for urban-rural areas and for the whole country.

PFS used two types of questionnaires – the household schedule and the individual questionnaire. The household schedule was applied to 7688 occupied private dwellings which provided 7395 completed interviews. This questionnaire had two purposes: first, to obtain a population count and find out the main characteristics of all habitual residents in the household as well as of those who had slept in the dwelling the night before the date of the interview; and secondly, to identify all the ever-married women of childbearing age who would later be studied in more depth by getting them to answer the individual questionnaire.

All ever-married women (legally married, in a consensual union, widowed, divorced and separated) between 15 and 49 years of age listed in the household schedule (6062) were considered eligible for the individual interview. A total of 5640 women answered the individual questionnaire.

The individual questionnaire was divided into several sections. One of them, the pregnancy history, provides the total number of pregnancies, the outcome of each one and the date when it took place. With this information it is possible to carry out several analyses of demographic interest related to fertility patterns, levels and trends, mortality at early ages, intra-uterine mortality, etc. The other sections are devoted to the respondent's background, contraceptive knowledge and use, marriage history and current or last husband's background. All this information, which complements the pregnancy history, allows the identification of several of the explanatory factors of fertility behaviour.

As a substantial part of the population of Peru, particularly the inhabitants of rural areas, speaks only native languages, it was necessary to translate the questionnaires into three dialects of Quechua (Ancash, Ayacucho and Cuzco) and into Aymará (spoken in the southern Altiplano region).

The collection of the data was carried out by a director, a head of fieldwork, 13 female supervisors and 47 female interviewers, with the help of 6 male sampling assistants who were entrusted with the task of locating the selected dwellings and solving any sampling problems. Fieldwork was started on 15 July 1977 and completed on 18 July 1978. This apparently long period was due to several interruptions caused by climatic conditions and administrative problems. If we do not consider the interruptions, it took 7.5 months to complete the fieldwork.

The various stages which normally follow the data collection, such as editing/coding, consistency checks and tabulation, were carried out simultaneously with data collection and concluded on 30 August 1978. The First Country Report, published in March 1979, contains the survey's background, methodology, basic tabulations, and a very succinct analysis of nuptiality, fertility, contraceptive knowledge and use, fertility preferences, and maternity and child health care. It was presented in a seminar which took place in Peru in May 1979 with the financial aid of the ISI.

The pregnancy history of each woman interviewed enables us to obtain more refined fertility estimates than the ones obtained through the use of data related to the cumulative fertility up to the date of the survey. However, the quality of the estimates will depend on the accuracy of the data supplied by the respondents. Judging by the evidence in other surveys, data may be affected by various types of errors or biases caused by the omission or wrong placement of births in time, as well as by errors in the reporting of age, which will be discussed in the next chapter.

Therefore, before using the data for more detailed analyses, it is important to examine their reliability and to determine the direction of the biases. This data evaluation report is divided into seven chapters. Chapter 1 describes the background and purposes of the study. Chapter 2 discusses briefly, and solely for the purposes of illustration, the types of error and bias that may affect the data. (The substance of this chapter also appears in Guzmán (1980) *WFS Scientific Reports* no 14, 'Evaluation of the Dominican Republic National Fertility Survey 1975', and was written jointly by the people involved in the first data evaluation workshop.) Chapter 3 presents several tests used to establish the type and magnitude of the errors affecting the reporting of age and marital duration. Chapter 4 is devoted to an analysis of nuptiality data. It aims at detecting deficiencies in the reporting of marital status and age at first union. One of the techniques used in this evaluation consisted of reconstructing, from the marriage history of the PFS, the marital status at the date of the 1961 and 1972 censuses. The age at first union is analysed through the application of Coale's Nuptiality Model. Chapter 5 presents the application of various tests for internal consistency used to detect errors in the pregnancy history. The tests used were the ones developed by Brass and Potter, among others, and are intended to indicate any omission of births, or whether births have been wrongly placed in time. Reference is also made to the evaluation of cross-sectional fertility and cohort fertility. Chapter 6 examines the estimation of infant and child mortality through direct and indirect methods, based on the information about children ever born and children who have died. Chapter 7 is devoted to the presentation of the most important conclusions derived from this evaluation.

2 Errors and Biases which May Affect the Information in Fertility Surveys

2.1 SELECTION PROCEDURES

The definition of women eligible to be selected for the individual interview and the procedures for such selection vary in the World Fertility Survey according to country. In some cases all women of childbearing age registered in the household schedule have been included as eligible, irrespective of their marital status. In others, only those women who were ever in a legal or consensual union have been considered eligible to be selected for the individual interview. The first procedure was used in Peru. This subsample may be affected by the quality of the data on marital status from the household questionnaire, since data on the fertility of ever-married women who were reported single would not have been obtained.

2.2 ERRORS IN THE REPORTING OF AGE

The incorrect reporting of the women's ages results from a preference for certain digits and a transference of age. In general, greater concentrations of persons are observed in the ages ending in 0, 5, 8 and 2 at the expense of the adjacent digits. If age is obtained through reference to date of birth, preference may be given to the other digits, depending on the date of interview.

The shifting of age is a systematic tendency among the respondents and as a result some may declare a higher or lower age than their real one. One example of this type of error is that of women over 40 declaring themselves to be younger. This type of error has a very important impact on the estimation of measures in which the age of the women is involved.

The lack of reporting of the ages of the women may also distort the age structure. The Peruvian survey, therefore, tried to obtain an estimate of the woman's age during the interview. However, this estimation may also be an additional source of error, especially when the interviewer (or supervisor) derives her estimate by using data on characteristics such as parity or marital status.

Age transference can have important effects on estimated fertility rates. The biases that occur depend not only on the direction of transference (ie to older or younger ages than the real age), but also on the real age of the woman and whether or not transference is selective with respect to fertility. As an example, let us take the case of women whose real ages were 45–49 at the time of interview, but who reported ages 40–44. If these women were not different in their fertility from women of the same age reporting correctly, this transference would upwardly bias the estimate of children ever born to women 40–44 because older women in general have higher parity. This result holds true for all age groups. With respect to current fertility rates, however, a downward bias will occur for the age group 40–44 because women 45–49 have lower rates.

The result holds for women whose real age groups are 30 and above; the opposite is true for women really 20–24 reporting ages 15–19; and the situation is indeterminate for women really 25–29. Now let us see the effect on period fertility for the cohort of women reporting age 40–44. If the women who transferred to this group from 45–49 report the dates of their childbearing accurately, the ages at which they gave birth would be too low, inflating the rates for those ages less than 20 and deflating for ages 30 or greater: in other words the entire cohort fertility curve would be shifted to younger ages.

If the transferred women correctly report their ages at birth, then the age-specific rates for that cohort would be correctly reported but births would be transferred to later periods. Of course, if women report older ages, the errors introduced would be in the opposite sense from those above.

2.3 ERRORS IN THE RETROSPECTIVE INFORMATION

The accuracy of fertility estimates will depend on the quality of the data involved in both the numerator and the denominator of the rates. We have already described age-reporting errors which may affect the denominator of the rates; therefore we shall examine the factors which could affect the numerator, that is to say the live births.

The basic source of information on births is the maternity history of the respondent, in which all pregnancies are listed in chronological order, as well as the outcome of these pregnancies and the dates of their occurrences. In addition, the survival status of all live births at the time of the interview and age at death (if applicable) are also registered.

It must be pointed out that the women interviewed in each age group are the survivors of their respective cohorts, and therefore one must assume in using the maternity history for analysis that the fertility of the survivors does not differ from that of the women who have died. The bias from the non-fulfilment of this assumption will be greater for periods more distant from the time of the interview and will also be related to the level of adult mortality. If female mortality is high and differs according to the number of children, the level of past fertility will probably have been underestimated.

The data contained in the maternity history are obtained retrospectively, so that their quality depends on the respondents' capacity for remembering each of the events and the exact date each occurred, as well as on their willingness to report all their events.

Omissions

A frequent error in maternity histories is the omission of births. Generally, omission occurs more often among older women and for births that occurred long before the time of the survey. However, more recent births may also be omitted, mostly those that occurred in unstable unions. In addition children are more frequently omitted if they died during their first years of life or were living outside the home at the time of the interview. It has also been observed in countries with son preferences that more female births are omitted than male births.

When the omission concerns periods more distant from the time of the survey, its effect is to underestimate fertility in these periods, with the possible result of showing a false increase in fertility with time. The level of total fertility for the older women would thus be underestimated, and therefore the mean parity by age would show a decline in the later ages. On the other hand, when children of very young ages (at interview) are omitted, the level of fertility in the latest period is underestimated, which could give the impression of a recent decrease of fertility.

Goldman *et al* have found a high correlation between the poor information about age and the omission of births in a study on the quality of the data obtained in the Nepal Fertility Survey (Goldman *et al* 1979).

Misdating of Births

Incorrect reporting of dates of birth of a woman's children is another important source of distortion of the maternity history. The failure of some women to remember the dates at which their children were born may be important if there is a systematic tendency on the part of the respondents to transfer the birth date of their children nearer to or further from the time of the survey.

Analysing the data of surveys carried out in West New Guinea around 1962, Brass (1974) found some evidence for a shift in fertility to periods further removed from the time of survey, caused by a presumed tendency on the part of the interviewers to assume that the women had begun childbearing at a very young age. The effect of this distortion was to overestimate the fertility in the earlier periods and to show a false decline in the fertility in the younger ages for the later periods.

In an analysis of the data obtained in the Bangladesh Fertility Survey of 1976, Brass (1978) found evidence of other types of displacement. Specifically, it seemed that births which occurred during the last five years had been transferred to the previous period (5–10 years prior to the survey), and that births which had taken place in periods further in time were brought forward, many to this same period. The error, which mainly affects the older cohorts, creates a distortion in the trend of fertility, shown as an exaggerated decline of fertility in recent periods for the older ages.

Potter (1977a), starting from certain assumptions on the manner in which the displacements of births in time are produced, developed a simulation model to find out to what extent the fertility levels and trends obtained from the data contained in a maternity history could be distorted. In his model, the following assumptions are made: the more distant the births are from the time of the survey, the less exactly the interviewed women remember the date at which births occurred; and, if the maternity history is obtained through questions about the live births in the order in which they occurred, that is to say, starting with the oldest child, then the date a woman gives for any other birth after the first one is influenced by the information she has given about her previous births. In effect, the model assumes that the respondents report their births – at least those furthest removed from the time of the survey – in terms of birth-intervals, and that dates of birth are brought forward in time because of the reporting of a later date for the first birth or the exaggeration of the interval between successive births. Comparing the results of his model with the information obtained in surveys carried out in Bangladesh and El Salvador, Potter found that the distortions affecting the data of these surveys were of the type specified by his model (Potter 1977b).

3 Age Reporting

Two types of error can affect age reporting: heaping (preference for certain digits) and age transference (from one age group to another). The first type of error indicates a tendency of the respondents to prefer some digits and reject others when they declare their age. The second consists of the systematic reporting of an age that is either higher or lower than the actual age of the respondents.

In Latin America heaping occurs mainly in ages ending in 0 and 5. Peru follows this trend as well, as can be observed from figure 1 which shows the distribution of the whole population by single years of age according to the household schedule. Digits 8 and 2 follow in preference, while 1 and 9 are the most rejected ones. A similar trend is observed in the 1972 census data, also shown in the figure. One way of estimating the accuracy of age reporting is through the use of Myers' index ($0 \leqslant MI \leqslant 180$) which also measures the preference or rejection of each of the digits between 0 and 9. In general, low values of the index imply better quality of the information.

3.1 AGE IN THE HOUSEHOLD SCHEDULE

The value of Myers' index for the household survey was 15.2, which, compared to 13.3 for the 1972 census, clearly indicates that age reporting did not improve in the survey.

In order to compare the values obtained for Peru at an international level we may note that Myers' index for the 1970 census in Argentina is 1.8 for the total population, a figure which clearly shows Argentina's advantage in having more reliable data with which to carry out demographic analyses.

A calculation of the index for the household survey data by sex revealed that the high value obtained for the total population was due to the low quality of the data regarding the age of males. The index for males was 9.8 in 1972 and increased to 14.8 at the time of the 1977–8 survey. The index for women experienced only a very slight improvement from 16.7 to 15.5.

Thus notwithstanding the fact that the survey was

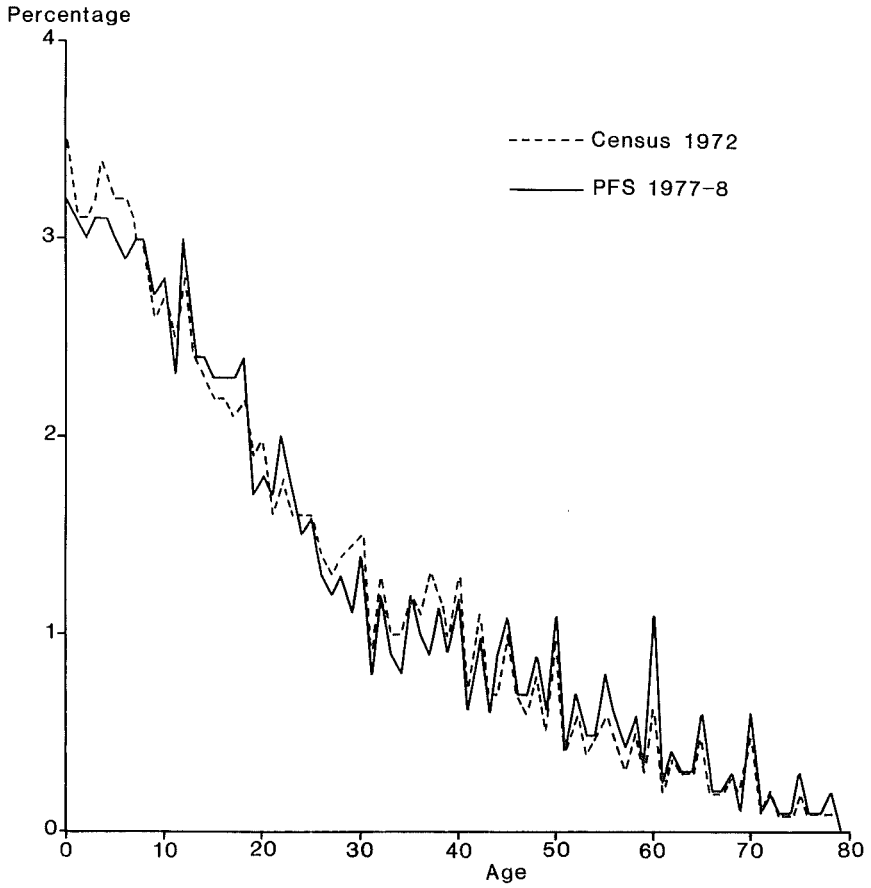

Figure 1 Percentage distribution of the total population by single years of age, according to the 1972 census and the Peru Fertility Survey 1977–8, household schedule

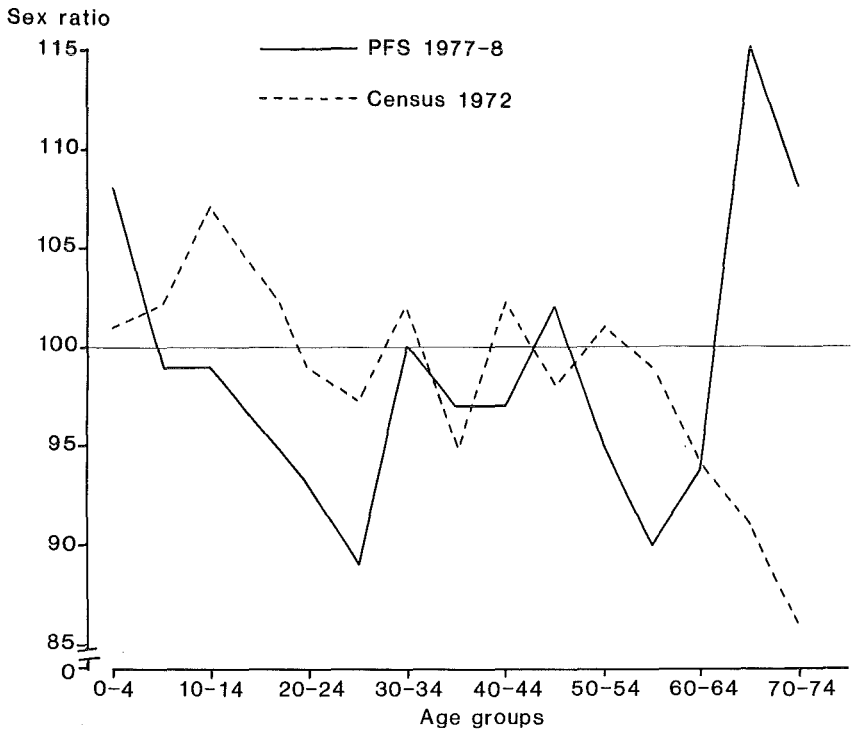

Figure 2 Sex ratios for five-year age groups, according to the 1972 census and the PFS 1977–8, household schedule

carried out by better trained field personnel than that usually employed for a census operation, it was not possible to obtain better information from the respondents regarding age. This situation could be due to the fact that the type of respondent has a great effect on the biases which occur in age reporting. In effect, even though both the census and the survey obtained the data on age in the same way, asking for age at last birthday, we cannot say that the type of respondent was the same in both studies. The 1972 census was carried out on a Sunday, when the population had been asked to remain stationary, and the information was provided by the head of the household, usually a male. For the household survey, on the other hand, it was usually a woman who supplied the information concerning all the members of the household. In Peru men have a significantly higher level of education and therefore the census data regarding age can be considered of better quality than that obtained through the survey, especially data concerning the males. When considering other data, like number of children ever born or deceased for example, the woman is of course a better respondent.

The magnitude of the errors in reporting also differs according to area of residence. The Myers' index shows that urban respondents provided better information than those living in rural areas. For the former the index is 10.3 and for the latter, 25.6.

Figure 2 shows the sex ratios by five-year age groups for the Peru Fertility Survey and the 1972 census. There is a noticeable deficit of males between the ages of 15 and 29, especially in the survey. This has also been observed in other Latin American countries and apparently cannot be attributed to migration but rather to underenumeration of males. In the case of the survey, the nature of the study might have contributed to the interviewers putting more emphasis on the registration of women than of males.

Equally noticeable are the high sex ratios in the youngest and oldest age groups, which implies that there might have been an underenumeration of young girls (0–4 years old) and a transference of older men to higher age groups.

Figure 3 shows the composition by age and sex of the total population, both urban and rural. In it we can see that the decline in fertility mentioned before has taken place in the urban areas and it also shows omissions in the 0–4 age group, particularly of females and emphasized in the urban area. In fact, as far as omissions are concerned, there is hardly any difference between the 0–4 and 5–9 age groups for females in urban areas, whereas a difference of about 1 per cent is seen in the case of male children.

3.2 AGE IN THE INDIVIDUAL QUESTIONNAIRE

At this point it is interesting to analyse the quality of the data collected with the individual questionnaire, which was applied to all ever-married women (including in this term all women who have been in a marital union, be it legal or consensual) between 15 and 49 years old recorded in the household schedule. Apart from the age in completed years, the individual questionnaire obtained information on the month and year of birth of the respondent.

In the survey, all data concerning age and date of birth were collected and completed in the field and during the process of manual editing of the information. When the respondent was unable to provide her age or date of birth, the interviewer tried to obtain from her an estimate and as a last resort the interviewer herself tried to calculate the age, making a note of this in the questionnaire (Interviewer's Instructions, WFS 1975: 61). The age of 255 women (4.5 per cent) was obtained in this way, the women being mainly over the age of 40.

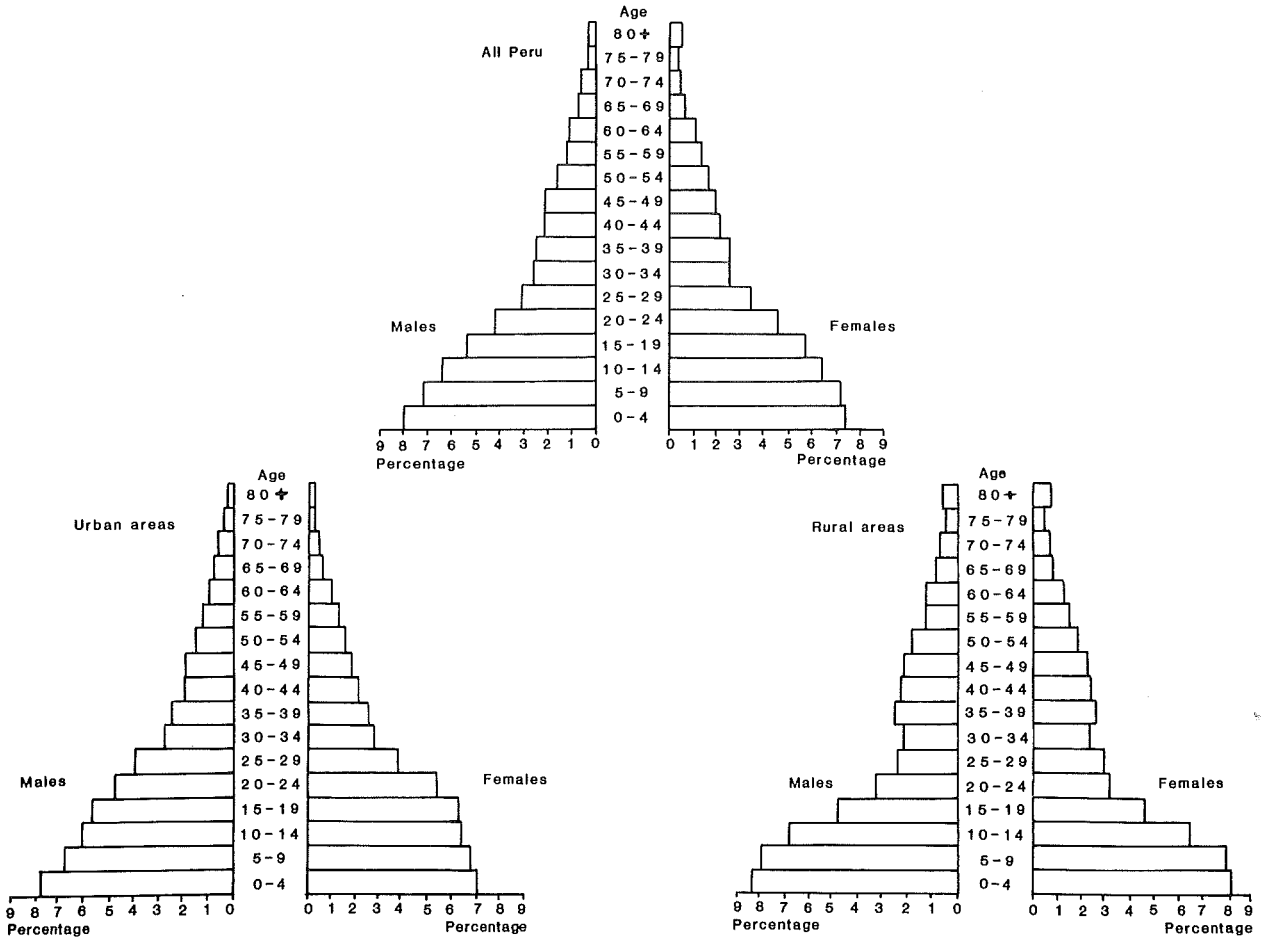

Figure 3 Percentage distributions of the population by sex and five-year age groups (population pyramids), for all Peru and urban and rural areas, household schedule

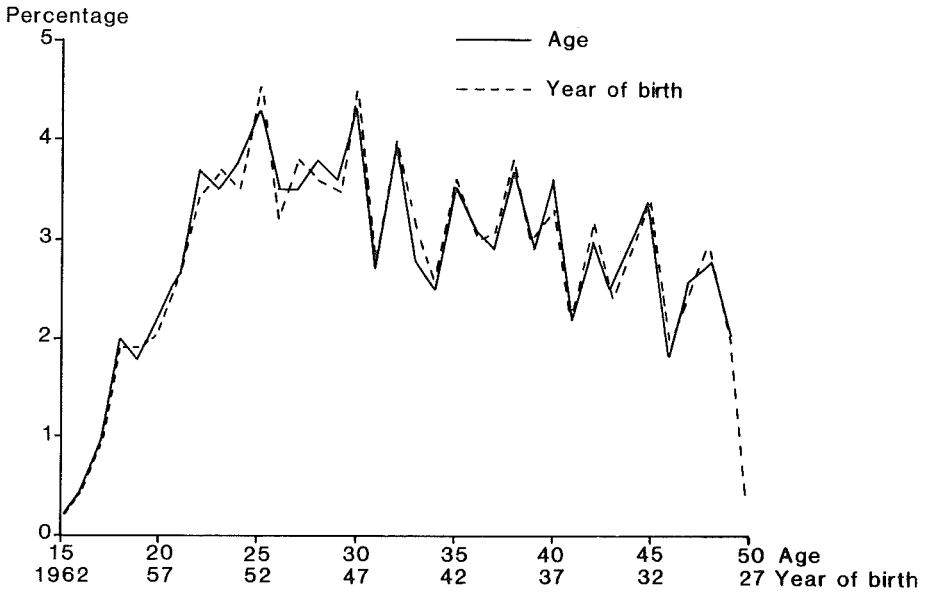

Figure 4 Percentage distribution of women ever in a marital union, 15–49 years of age, by single years of age, and by year of birth, PFS 1977–8

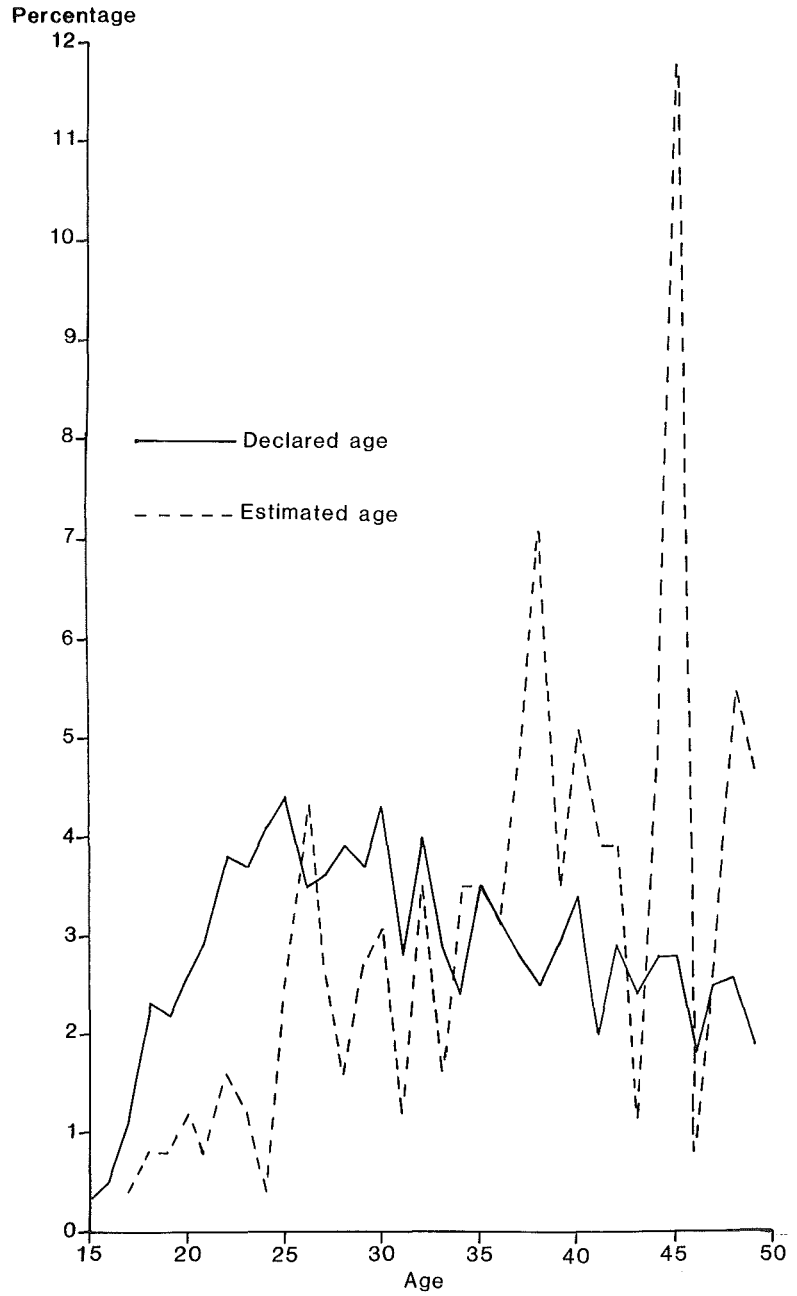

Figure 5 Percentage distribution of women ever in a union, 15–49 years of age, by single years of age, according to whether age was declared or estimated

The distribution of these women by single years of age is shown in figure 4, where we can see heaping in ages ending in 8, 5, 2 and 0. If the year shown in the figure is the year of birth, and bearing in mind that the survey was carried out mainly in 1977, we find that the preference shown for calendar years ending in 2, 7 and 9 bears relation to reported ages ending in 5, 0 and 8. This leads us to assume that in many cases the interviewers or the respondents estimated the year of birth from the age reported; this would be the only explanation of the heaping observed in digits 7 and 9 (which are usually rejected) for calendar years of birth. Rounding the calendar year of birth in 0 or 5, and alternatively in 8 or 2, and then estimating the woman's age, seems to have occurred much less frequently. It is easy to see how estimating the woman's age could have prevailed over estimating the year of birth, since age is asked before birth date and also because fieldwork experience has shown that respondents are more aware of their age than of their birth date.

If we draw up a figure of the distribution by age of the two groups of women (those whose ages have been estimated and those who reported their age) we can see that although both present large errors, there is a great difference in age reporting between the two groups. In fact, while the distribution of the former shows exaggerated peaks from age 35 onwards in ages ending in 0, 5 and 8, the distribution of the latter group is much more regular although there is still noticeable heaping in digits 0, 5 and 2 (see figure 5).

Estimating the age by the interviewer became more necessary and frequent the older the respondent was; thus, while 1.4 per cent of the younger respondents' ages (15–24)

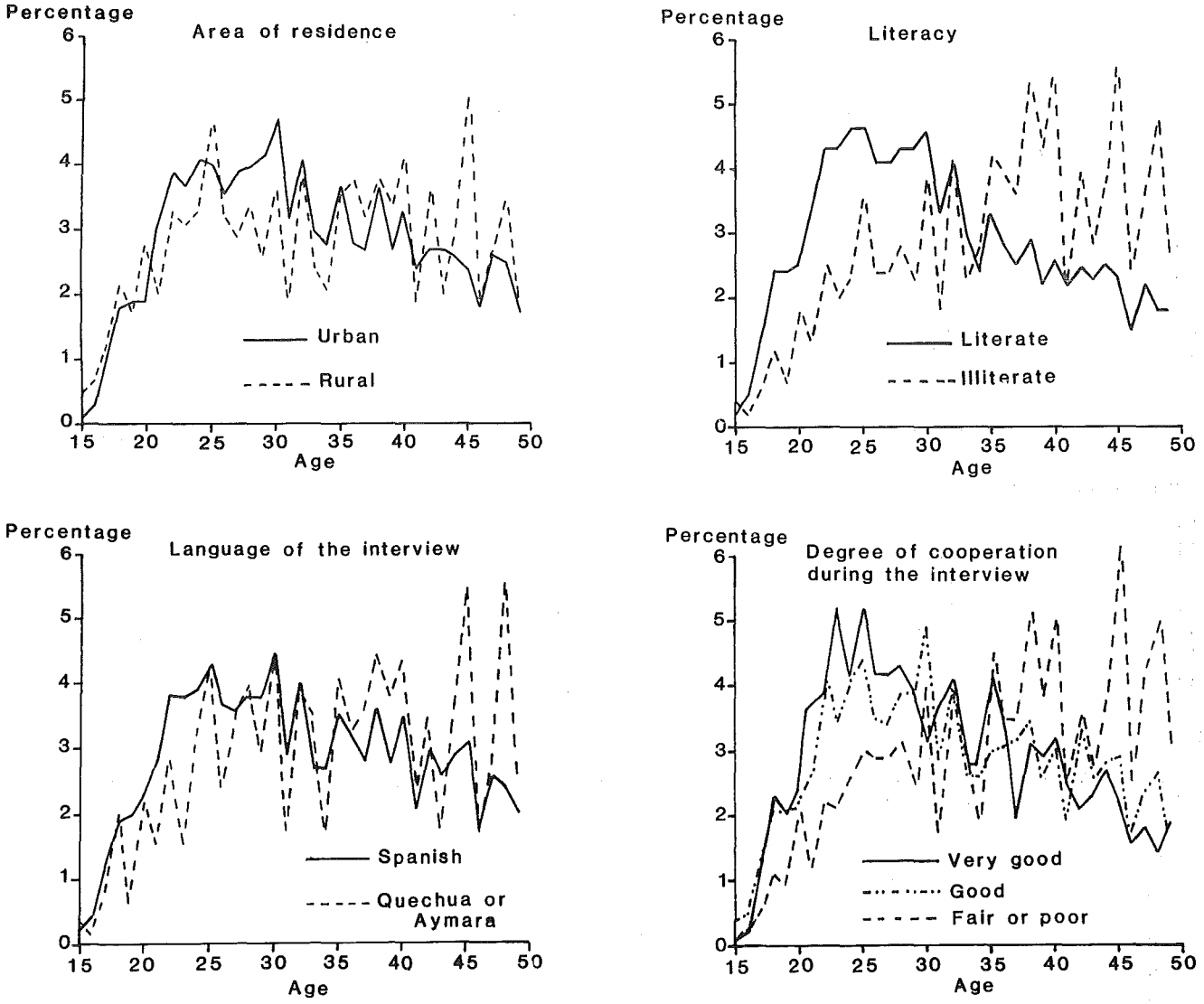

Figure 6 Percentage distribution of women aged 15–49, ever in a union, by single years of age, according to selected characteristics

were estimated, this figure increased to 3.4 for women aged 25–34, to 6.2 for those 35–44 and to 9.4 for those aged 45–49.

It must be pointed out that although it cannot be statistically proved, fieldwork experience indicates that the figures stated above are an underestimation of the real ones, because the interviewers did not always comply with the instruction of noting on the margin of the questionnaire when the age had been estimated by them or reported by the respondent. This instruction was given during training and also appears in the interviewer's manual. Nevertheless, the fact that there was no pre-coded box evidently contributed to the interviewers forgetting the recommendation.

The small number of cases makes it impossible to obtain cross-tabulations in order to identify other characteristics besides age that will differentiate these women. Nevertheless, it is possible to assume that the same biases which have been observed in this group concerning the age distribution, are also present in the women with estimated ages, whose number is unknown, and that these biases are related to other characteristics which will hopefully identify the women who do not know their age, for example low educational level.

We arrive at this conclusion after seeing the similarity between the curve presented by this small group of women whose ages have been estimated (figure 5) and those of all the illiterate women, those who only speak native dialects and those who live in rural areas (figure 6). In this respect, the Myers' index reveals better age reporting by urban women in the individual questionnaire and preference for and rejection of certain digits are accentuated in the rural area (see figure 6). The index reaches 10.0 among urban women and 17.2 among rural women. This differential is related to the percentage literate, which is higher in urban than in rural areas. The Myers' index for literate women was 7.6 and for illiterate ones 20.7.

According to this information, Myers' index shows that the metropolitan area of Lima and Callao, the most urbanized area of the country and that with the lowest

Table 1 Percentage distribution of all women and of women ever in a marital union, 15–49 years of age, by five-year age groups, according to the Peru Fertility Survey 1977–8 (PFS), the National Demographic Survey 1975–6 and the 1972 census

Age	Peru Fertility Survey 1977–8[a]	National Demographic Survey 1975–6[b]	1972 census
A All women			
15–19	24.5	23.3	22.9
20–24	19.7	18.3	19.0
25–29	15.1	14.6	15.5
30–34	11.2	11.9	12.5
35–39	11.3	12.0	12.2
40–44	9.4	10.8	9.8
45–49	8.8	9.1	8.1
Total	100.0	100.0	100.0
B Women ever in a union			
15–19	5.5	4.5	6.0
20–24	15.9	14.5	16.3
25–29	18.7	17.8	18.8
30–34	16.5	16.2	16.8
35–39	16.3	17.3	17.0
40–44	14.3	15.9	13.7
45–49	12.8	13.6	11.4
Total	100.0	100.0	100.0

[a] The figures for 'All women' are from the household schedule. The figures for 'Women ever in a union' are from the individual questionnaire.
[b] The figures are from the retrospective questionnaire.

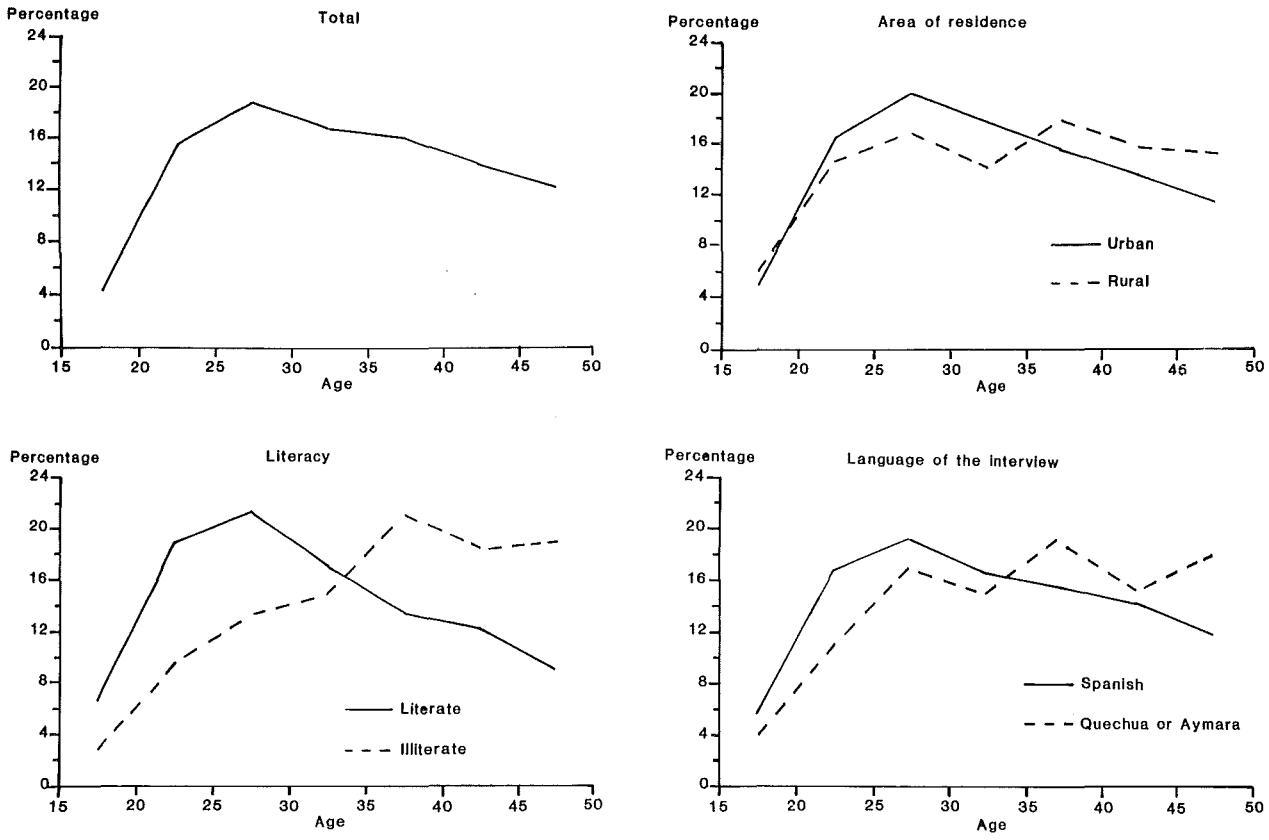

Figure 7 Percentage distribution of women aged 15–49, ever in a union, by five-year age groups, according to selected characteristics

illiteracy rate, has the best age reporting (9.1), followed by the rest of the large towns (9.6), the smaller towns (14.7) and finally the rural area (17.2).

The language spoken by the respondents and their degree of co-operation during the interview is also related to age reporting. Those who only speak native dialects such as Quechua and Aymará have an index of 25.1, while Spanish-speaking women reach an index of 10.4. Classified according to degree of co-operation in three categories: very good, good, and fair, the indexes obtained were, respectively, 9.7, 12.0 and 24.2.

Classification of the population in five-year age groups shows a more even distribution. Table 1 shows the survey data compared with the 1972 census data and with data from the National Demographic Survey carried out in 1975–6. In general, the distribution of the women included in the survey (of all women as well as of only the ever-married ones) is very similar to the distributions obtained from the other two sources; in all of them the percentage of women aged 35–39 is very similar to that of the preceding age group (table 1), whereas it should be smaller.

The fact that this bias is present in three different moments in time leads us to reject the assumption that demographic factors (such as migration for example) might have affected the population in this age group, or that the sample might have been biased; instead, it seems to be caused by a transference of women from the 30–34 age group to the 35–39 age group due to the strong attraction of the digit 5.

As we can see in figure 7, the problem of incorrect age reporting arises mainly from less educated women who live in rural areas. Obviously, this problem has implications on the estimation of demographic indicators and therefore it is essential to bear these results in mind during the evaluation of the data concerning the older women, since it is likely that the information provided by them will be more affected by this bias than that of the rest of the women.

One way of carrying out an internal control of the survey data is to compare the age of the respondent recorded in the household schedule with the one stated in the individual questionnaire. This consistency test showed 98 per cent of the women with the same recorded age in both questionnaires and 99 per cent with ages that would include them in the same five-year age group. This high consistency is undoubtedly due largely to the fact that the two sources are not independent since in many cases the information was obtained at the same time.

4 Nuptiality

Nuptiality is one of the variables that has a differential effect on women's fertility behaviour. Its study involves the analysis of events related to the formation or dissolution of unions. By a 'union' we mean the relatively stable cohabitation of a couple, regardless of whether this is legal, sanctioned by the Church, or consensual, that is, common law.

In connection with the events related to the formation of a union it is particularly interesting to study both the age at which women enter their first legal or consensual union, and the relative proportion of women in each type of union, because these are factors that greatly determine the level of fertility.

In this chapter we present an analysis of the errors that may be affecting the collection of data of the above kind in the survey. First we carried out an internal control of the relevant information obtained with the household schedule and the individual questionnaire; second we compared these data with similar ones from other sources (1961 and 1972 censuses); and finally, still aiming at the evaluation of the data, we tried to see to what extent the data conformed to the nuptiality model proposed by Coale (1971).

4.1 HEAPING IN NUPTIALITY DATA

The preference for digits 0 and 5, already noticed in age reporting, is again evidenced in the analysis of the distribution of the interval between date of first union and date of the survey. Intervals ending in the digit 7 are also important, as can be seen from figure 8.

This heaping is a result of the distribution obtained with the collection of date of first union, which was then used to determine the duration of the union. It is very likely that the preference shown for the first two digits (0 and 5) is due to the fact that the respondents had shown preference for these same digits when they reported indirectly the date of the legal or consensual union, that is to say, they either estimated the date themselves or they told the interviewer the number of years they had been in the union, which were then converted into calendar years 5, 10 or 15 years prior to the survey. On the other hand, some respondents were more inclined to state the date of marriage but they did this in years ending in 0, which resulted in heaping in intervals ending in 7 since the year in which most of the interviews were carried out was 1977.

The preferences mentioned above are more evident amongst illiterate respondents, those living in a consensual union and those living in rural areas (figure 8). It is worth noting that respondents with more recent unions (less than 15 years in a union) present greater irregularities in interval.

There is a working hypothesis that maintains that respondents who misreport their age have a tendency to misreport their marital duration interval as well. Figure 9 and the Myers' index seem to prove this: for women whose ages end in 0 and 5 the index for marital duration is 11.7, while for those who declared ages ending in the adjacent digits 1, 9, 4 and 6 the index is 7.3. The same trend can be observed, to a lesser degree, among the women who declared ages ending in digits 8 and 2.

4.2 MARITAL STATUS IN THE HOUSEHOLD SURVEY AND IN THE INDIVIDUAL QUESTIONNAIRE

Two questions were included in the household survey in order to improve the quality of the data collected on the marital status of the population aged 15 and over. The first one was aimed at finding out the marital status of the women at the time of interview: 'are you currently single, married, in a consensual union, widowed, divorced or separated?' If the respondent stated that she was single, she was asked the second question: 'have you ever been married or in a union?' If the answer was affirmative, then she must have been separated, divorced or widowed and therefore eligible for the individual interview, which was applied to all women over 15 years old who had ever been in a marital union.

In order to simplify the terminology, from now on we shall refer to all women who are married or in a consensual union as 'married'; the term 'currently married' will therefore include all women who are legally married or in a consensual union at the time of the survey, and the term 'ever-married' will include women who are divorced, separated or widowed either from a legal marriage or from a consensual union, as well as those currently in a union.

All ever-married women were interviewed by use of the individual questionnaire, in which they were asked a series of questions designed to obtain a complete marriage history: type and number of unions, dates of beginning and end of each union, as well as type of dissolution, if applicable. In view of the fact that the respondents had not always reported their marital status correctly or had not always answered the questions in the household schedule themselves, it was thought that there might be some differences between the answers obtained from the two questionnaires. It was necessary to find out what these differences were in order to determine the magnitude of the errors.

The discrepancies found were not very substantial; in only two per cent of the cases the information did not coincide. As we already mentioned in the chapter on age reporting the two sources are not independent and furthermore, despite the inclusion of a control question these data do not allow us to determine the possible overestimate in the number of single women that may have occurred. Further on, when we analyse the age at first marriage, we shall show some examples which suggest that there may have been such an overestimate.

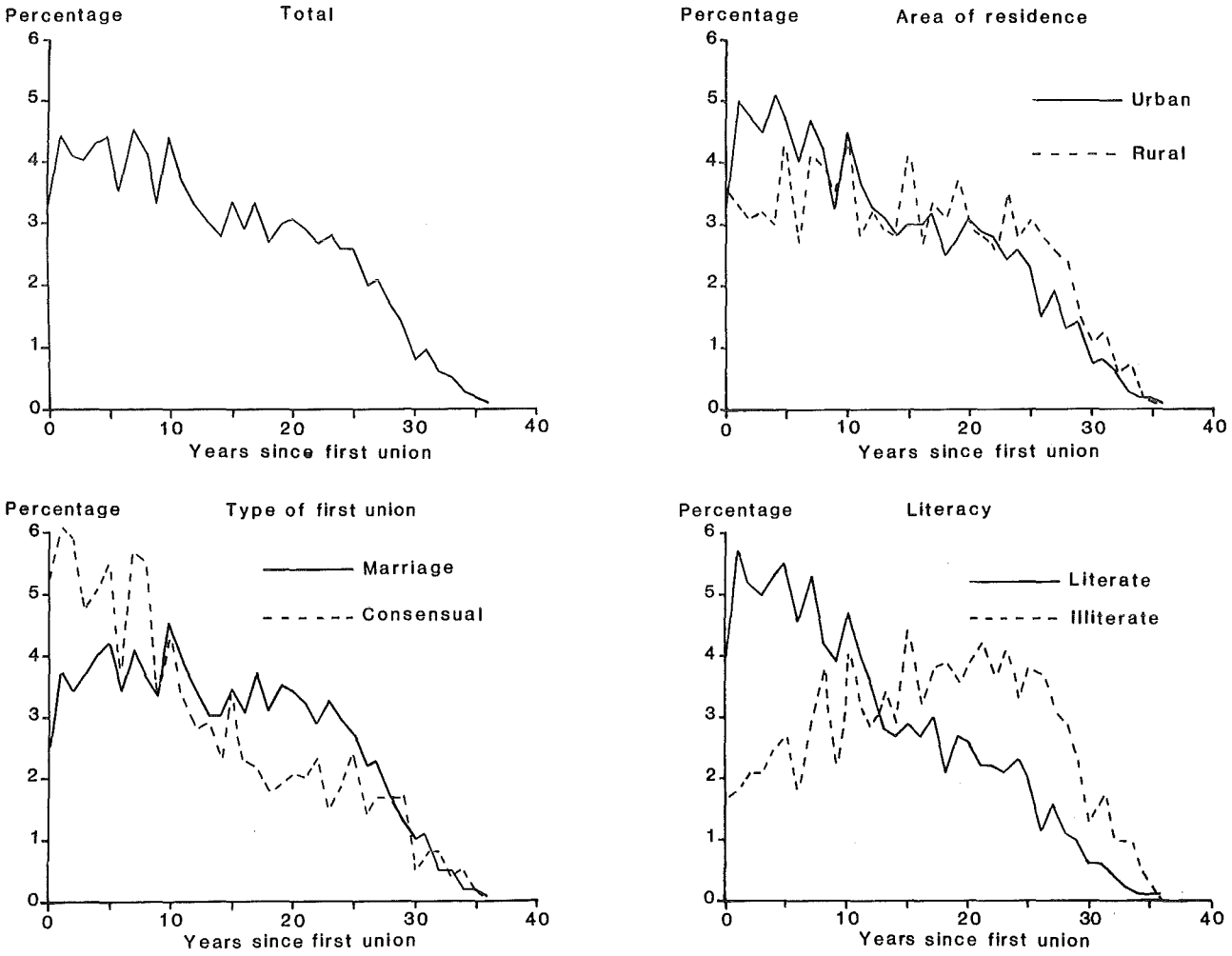

Figure 8 Percentage distribution of women ever in a union, by years since first union, total and according to selected characteristics

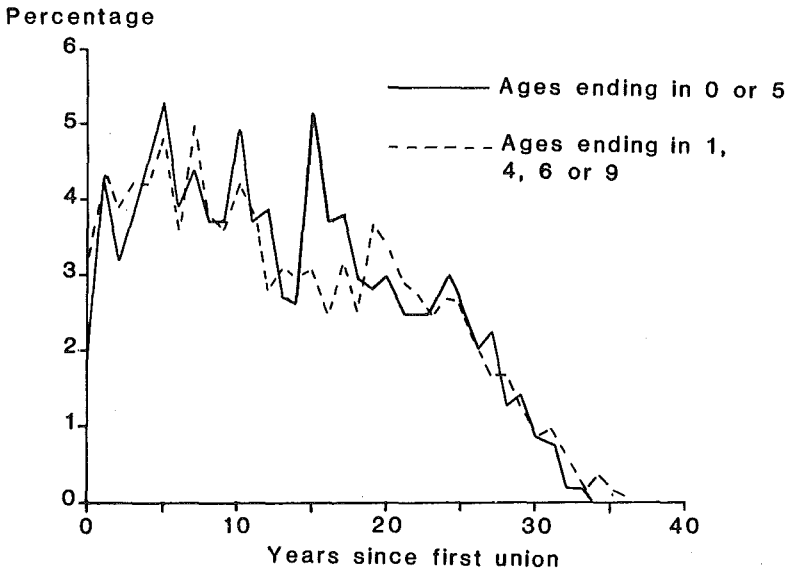

Figure 9 Percentage distribution of women ever in a union, by years since first union, according to terminal digit of current age

Table 2 Percentage of women ever in a union at the times of the 1961 and 1972 censuses, by five-year age groups, according to the censuses and reconstructed from the PFS

Age group	PFS (1961)	1961 census	PFS (1972)	1972 census
15–19	27.9	16.1	19.6	17.0
20–24	67.8	54.8	60.7	55.5
25–29	87.8	74.7	82.4	77.7
30–34	92.1[a]	82.1	91.0	86.0
35–39	–	85.1	94.0	88.9
40–44	–	85.5	94.8	89.4

[a] Corresponds to women 30–33.
Sources: Direccion Nacional de Estadística y Censos (1965)
Oficina Nacional de Estadística y Censos (1974)

If there was an overestimate of the number of single women, this would certainly affect fertility estimates. For example, if we take the number of women interviewed in the individual survey and adjust it according to the proportion of single women given in the household schedule, we will have the correct denominator for calculating fertility rates for all women from the individual survey. Nevertheless, the numerator will be underestimated if women who are widowed, divorced or separated were declared in the household schedule as single since their numbers of births will not have been taken into account because single women were not included in the individual survey. It is true that from the household schedule we have the total number of births to those women who have been identified as single, as well as the births they had had during the year immediately preceding the survey. With this information we could try to adjust the numerator, but this would mean relying on doubtful assumptions of constancy for analyses by cohort.

Underestimation of the fertility rates would in any case occur wherever the person who answered the household schedule misreported any woman's marital status: it is very unlikely here that he or she would have given a better answer to more complicated questions such as the number of children born to that women, particularly if the children in question do not live in the house or have died.

4.3 COMPARISON WITH THE CENSUS DATA

One way of evaluating the quality of the information on marital status obtained through a survey is by comparing it with data from other sources: in the present case such a comparison was made with the results of the 1961 and 1972 censuses. It was necessary first to estimate from the survey data the likely proportion of ever-married women at the time when the censuses were carried out. For this purpose we used the information on date of marriage provided by the individual questionnaire for all ever-married women, by age, and the proportion of single women recorded in the household schedule. Since the oldest age considered in the survey was 49, the highest age we could obtain from our estimate was 49 minus the number of years which had passed between the date of the survey and the dates of the censuses (ie a woman of 49 at the date of the survey would have been 32 in 1961 and 43 in 1972).

The percentages of ever-married women estimated from the survey data as at the dates of the 1961 and 1972 censuses are much higher than the percentages obtained by the censuses themselves, regardless of the age group

Table 3 Percentage distribution of women by marital status for five-year age-groups at the times of the 1961 and 1972 censuses, according to the censuses and reconstructed from the PFS

At the time of the 1961 census

	15–19		20–24		25–29		30–34	
Marital status	PFS	Census	PFS	Census	PFS	Census	PFS[a]	Census
Single	72.1	83.9	32.2	45.2	12.2	25.3	7.9	17.9
Legally married	20.0	9.1	54.1	34.9	67.6	52.0	75.2	60.0
In a consensual union	6.5	6.8	10.2	19.2	14.7	20.9	12.2	18.8
Widowed	0.5	b	1.0	0.4	1.6	1.0	1.5	2.2
Divorced and separated	0.9	0.2	2.5	0.4	3.9	0.8	3.2	1.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

At the time of the 1972 census

	15–19		20–24		25–29		30–34		35–39		40–44	
Marital status	PFS	Census	PFS	Census	PFS	Census	PFS	Census	PFS	Census	PFS	Census
Single	80.4	83.0	39.3	44.5	17.6	22.3	9.0	14.0	6.0	11.1	5.2	10.6
Legally married	11.3	8.3	42.5	32.8	62.7	52.0	70.0	60.5	70.5	62.8	69.2	62.9
In a consensual union	7.5	8.3	15.9	21.0	14.2	22.8	15.2	21.0	15.1	19.9	13.3	17.2
Widowed	0.1	0.1	0.3	0.4	1.0	1.0	1.3	2.0	3.1	3.3	5.5	6.0
Divorced and separated	0.7	0.3	2.0	1.3	4.5	1.9	4.5	2.5	5.3	2.9	6.8	3.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] Corresponds to age group 30–33.
[b] Less than 0.05 per cent.

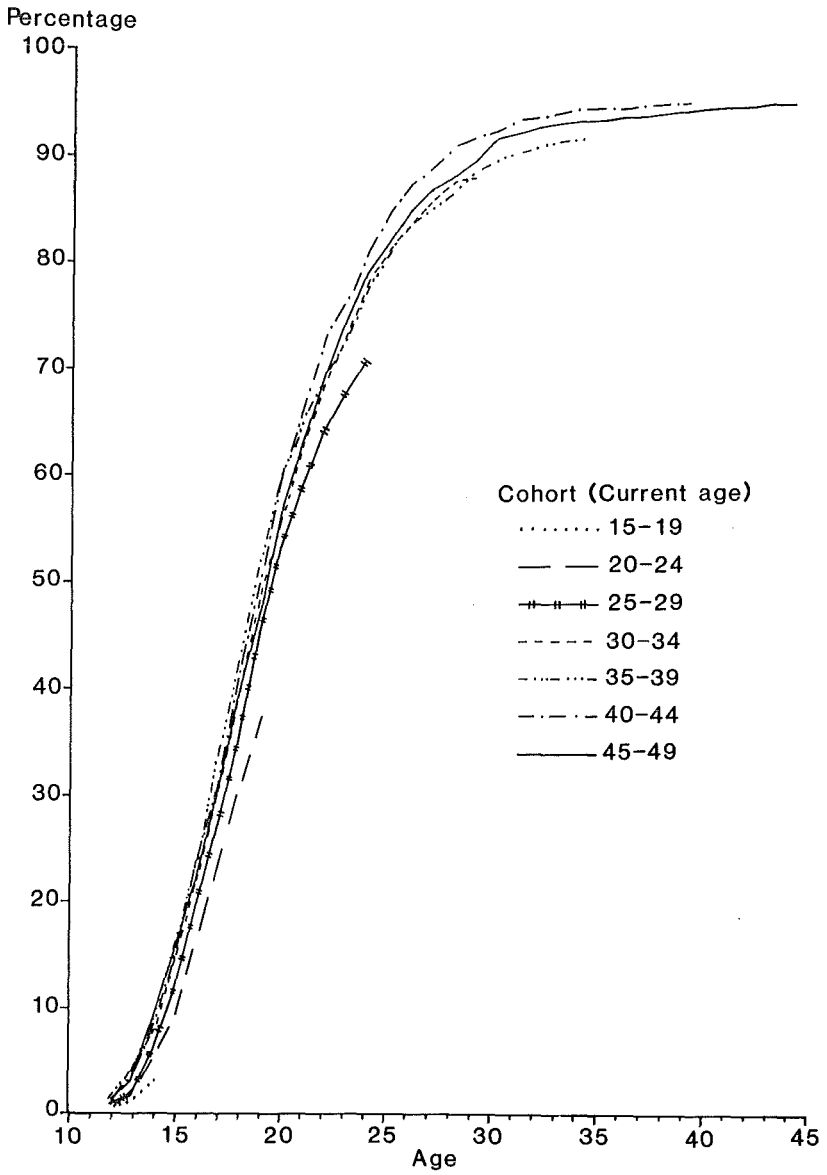

Figure 10 Percentage of women ever in a union at given ages for cohorts of current age, household schedule and individual questionnaire

analysed. This difference is most marked in the case of 1961 census, particularly in the 15–19 age group which is 73.3 per cent higher in the survey (table 2). This result was to be expected: censuses are not in general the best source of marital status information because they usually obtain information on legal marriages rather than on cohabitation in general.

Using the data produced by the survey on type of union, and on the date of entry and date of dissolution of each union it is possible to reconstruct the distribution of marital status in the past. This distribution is shown in table 3 which shows not only that the percentage of single women in all age groups is much higher in the censuses than in the data from the survey, but also that the censuses have underestimated the number of separated women as well as those married or in a union.

This result was to be expected if we consider the limited definitions of the censuses under which women widowed or separated from a consensual union were recorded as single. Furthermore, women in a consensual union have a well-known tendency to declare themselves single.

Nevertheless, if we analyse separately the figures for married women and for those in a consensual union we find, remarkably, a higher percentage of the latter in the censuses than in the reconstructed survey data. This could be a result of the fact that consensual unions tend to be legalized after a certain period of cohabitation, but this aspect was not studied in the survey since if the woman was with her first partner, only the current type of union was recorded. But it should be noted that both the Church and the local government authorities carry out annual campaigns in Peru designed to encourage the legalisation of consensual unions.

4.4 AGE AT FIRST MARRIAGE

The Peru Fertility Survey data enable us to analyse the behaviour of the variable 'entry into first marriage' for the

Table 4 Mean age at first union and parameters A_0, K and C obtained by applying Coale's Model to the data of the individual questionnaire and the household schedule

Age at interview	Mean age at first union	Parameters[a]		
		A_0	K	C
20–24	22.7	11.7	0.975	0.927
25–29	21.2	11.7	0.836	0.886
30–34	20.9	11.7	0.807	0.932
35–40	20.4	11.6	0.770	0.982
40–44	20.6	11.9	0.764	0.952
45–49	20.9	11.6	0.822	0.950

[a] A_0: Age at which cohort begins to marry.
K: Rapidity of entry into first union compared to model pattern: K less than one means entry is more rapid.
C: Proportion of cohort ever in a union by age 50.

women in the different age cohorts (classified according to the five-year age groups at the time of the survey). For this we use the data on age at first marriage from the individual questionnaire. This information allows us to know the distribution of married women by age at first marriage. But, if we want to know the proportion of women first marrying at a given age with respect to the total female population (regardless of marital status), it is necessary to adjust the population sample interviewed with the individual questionnaire by the proportion of single women recorded in the household schedule.

This exercise enabled us to obtain, for each of the five-year cohorts, the cumulative frequencies of the women who at each age change status from single to married (figure 10). Since many of these women will be marrying after the date of the survey, entry into the married state has been truncated at the youngest age in the five-year cohort. The changes occurring in the nuptiality patterns are reflected in the cumulative curves. In the case under study, they suggest a slight change in the cohorts under 40 years of age from which it appears that women are delaying their entry into marriage.

Coale's Nuptiality Model may also be applied to data on first marriage in order to fit or smooth the data, and the resulting estimates may then be compared to the reported data, so indicating possible reporting errors. This model has been applied successfully to populations with very different nuptiality patterns. The model also makes it possible to estimate mean age of entry into first marriage because, apart from fitting the basic data, it allows the projection of first marriages that will occur in the future in the respective cohorts.

Analysis of the mean age at first marriage in each cohort shows a slight increase among Peruvian women. Only the two oldest cohorts (40–44 and 45–49) differ from this trend, contrary to what might be expected, showing higher values than those of the 35–39 cohort (see table 4). The higher mean in the last two age groups could be due to an overestimation of age at first marriage: this could have been caused either by the mortality differentials affecting particularly the less educated women living in rural areas who married earlier, or by the misreporting of age at first marriage.

With respect to the first possibility mentioned above, it is likely that the mortality differentials would have had a greater effect on women over 40 years of age; therefore, the sample of women interviewed could be more heavily weighted by surviving urban women who married late. The second and more feasible possibility is that the women in the last two cohorts might either have transferred the date of their first marriage to a period closer to the date of the survey, or have reported later unions as first marriages. Age reporting by older women has a greater degree of error, and this is particularly true of women in the 45–49 age group as can be seen from figure 10, where the nuptiality curve of that cohort is much lower than the one for women aged 40–44.

Looking in a very general way at the other indicators obtained through Coale's Nuptiality Model, it can be seen that the parameter A_0, that is to say the age at which women begin to marry, has remained almost stationary at just under 12. The increasing value of K, on the other hand, points towards a decrease in the speed of entry into marriage by age. Finally, the decrease of parameter C in the younger cohorts (expected final proportion of non-single women) is evidence of a slightly downward trend in nuptiality. In the case of C we notice some irregularities among women under 30 years old, particularly among the 25–29 age group, where the final proportion of non-single women is quite low (88.6 per cent).

Figure 11 enables the comparison, for each cohort, of the real and fitted values of the proportion of ever-married women according to age at first marriage. The extent to which the values coincide or differ will indicate the applicability of the model and the extent to which the projected mean ages for each cohort constitute acceptable parameters. In general, we can say that the model fits the data fairly well. The differences between the observed and fitted curves of the older cohorts is due to heaping in the survey data, which affects mainly women over 30 years of age, as we saw in chapter 2.

As reference, figure 12 shows the per cent distribution of ever-married and single women by single years of age at the time of interview. In both cases we can clearly see the preference for even numbers and for digits 0 and 5, transferences that cause the oscillations that can be observed in the percentages of ever-married women. In fact, even if marital status had been correctly reported, the observed percentage of ever-married women in a particular age group would be underestimated if they had transferred to another group, or if single women from other groups had been included in it. Conversely, the proportion in that particular group would be overestimated if ever-married women from other age groups transferred into it or single women transferred out.

Table 5 shows the mean standard error and 'P' value of mean age at first union, the former providing the confidence interval. For example, the 95 per cent confidence interval for the cohort 45–49 (all Peru) is 20.5 to 21.3 years. The 'P' value measures what is the probability that differences between the observed and the estimated data are random. The higher the 'P' value, the better the model fits the observed data. It should be noted that 'P' is particularly low for the 25–29 and 35–39 cohorts, indicating that the model does not fit very well the observed values of those cohorts. This could be due either to errors in the observed data or to a change in the nuptiality of the cohort that the

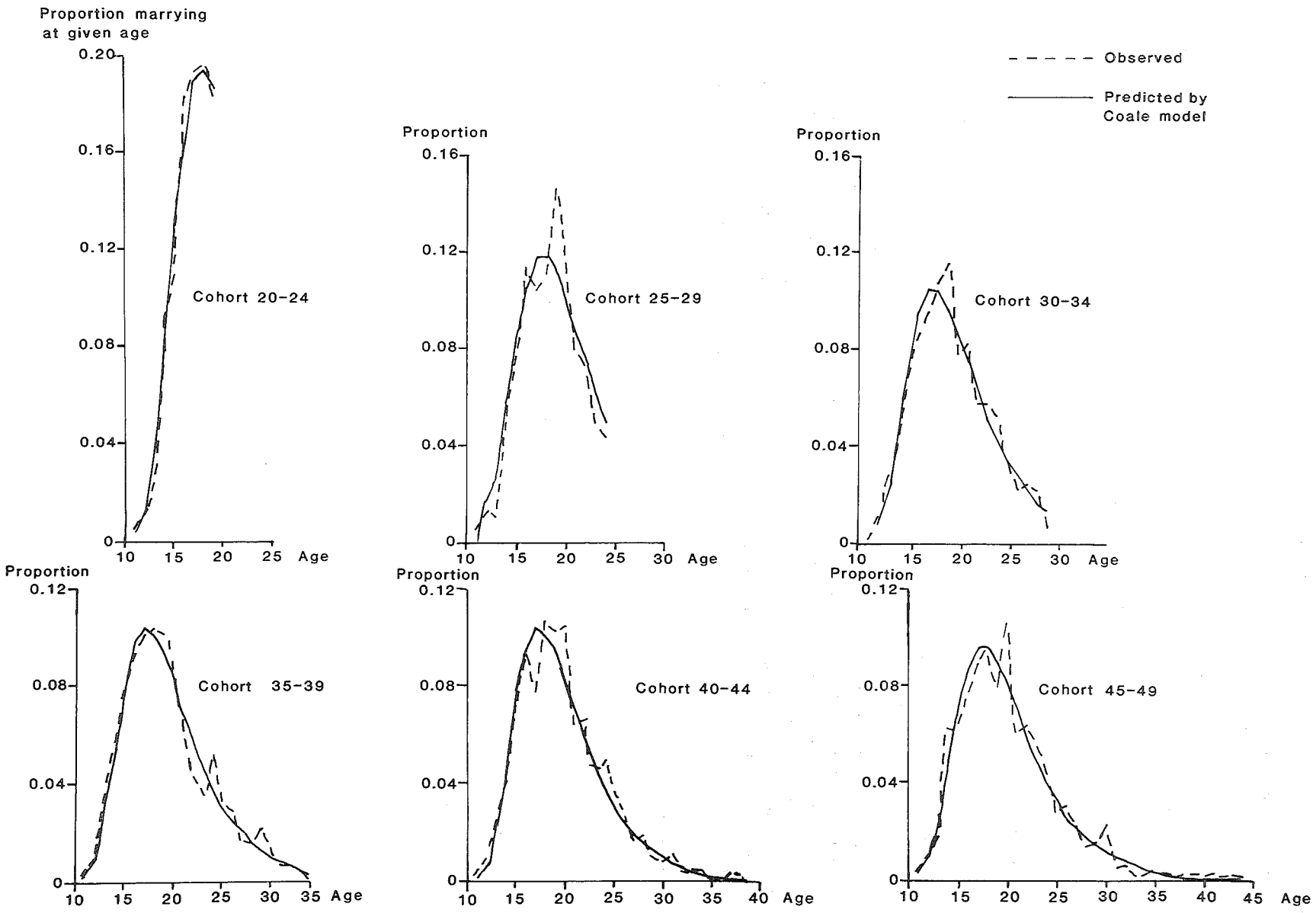

Figure 11 Proportion of women ever in a union by age at first union, for cohorts of current age, observed and predicted by the Coale model

Table 5 Mean age at first union, standard error of the mean and goodness of fit (P),[a] obtained by applying Coale's Model to data from the individual questionnaire (women ever in a union) for all Peru and separately for urban and for rural areas

	All Peru			Urban areas			Rural areas		
Age at interview	Mean age at first union	Standard error of the mean	P	Mean age at first union	Standard error of the mean	P	Mean age at first union	Standard error of the mean	P
20–24	21.3	0.323	0.578	21.3	0.412	0.035	20.2	0.567	0.347
25–29	20.9	0.235	0.000	21.8	0.308	0.015	19.0	0.264	0.001
30–34	20.6	0.197	0.265	21.2	0.247	0.268	19.5	0.267	0.092
35–39	20.3	0.178	0.006	20.7	0.240	0.075	19.5	0.242	0.067
40–44	20.5	0.177	0.513	20.9	0.230	0.530	19.8	0.267	0.813
45–49	20.9	0.206	0.172	21.1	0.259	0.985	20.5	0.307	0.246

[a] See text.

model cannot detect. The first possibility seems to be true for the 35–39 cohort.

The quality of the data was also evaluated by applying Coale's model to specific subgroups of ever-married women in order to see if there were any differences between them in the mean age at first marriage and if so, whether or not the differences followed the expected pattern. Previous investigations made us expect that the survey data evidence would show that rural women tend to marry earlier than those from urban areas (Instituto Nacional de Estadística 1978d). The results obtained, shown in table 5, prove that this expectation was true: age at first marriage of the former is, throughout every cohort, clearly younger than that of urban women.

It is obvious that the rural-urban migration that characterizes Peru has had some effect on the magnitude or accuracy of the means obtained for both areas of residence, but it is nevertheless interesting to point out the pattern followed by the differential, ie rural women marry earlier than urban ones. If we study this variable according to other social and educational characteristics of the women interviewed, we also find consistent differentials, which lead us to assume that these data are reliable. If we compare women who can read and write and women who speak Spanish with illiterate women and those who only speak native dialects, for example, we find that the former marry later, as can be seen from table 6. Even though characteristics such as literacy and language of the respondents were

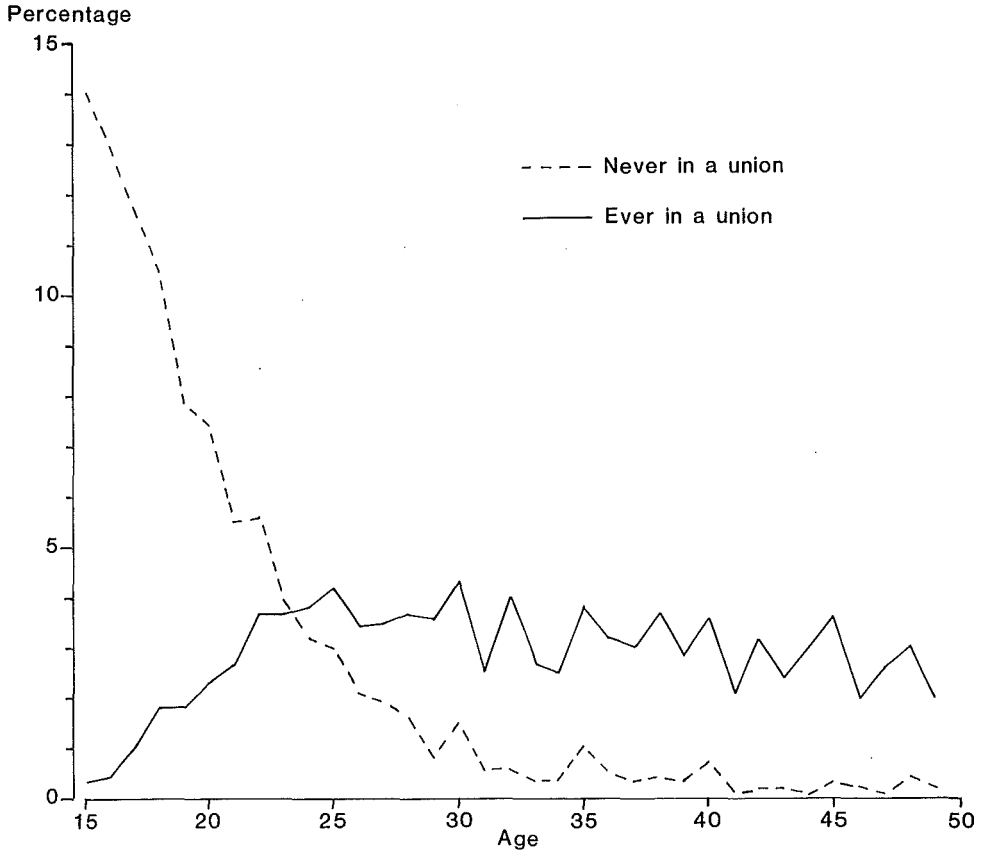

Figure 12 Percentage distribution of women aged 15–49, never and ever in a union, by single years of age

noted as at the time of interview and not as at the time of entry into a union, these hardly vary after the age of 15, so it can be safely assumed that the women's language and educational level had not altered in the interval.

In conclusion, although the information relating to older women shows evidence of errors in age reporting and the possible omission of young non-single women in the household schedule, these biases are not large enough to hide the increase in age at first marriage evident particularly in the younger cohorts. Also, the nuptiality differentials are consistent and in accordance with expected patterns.

Table 6 Mean age at first union by literacy and by language of interview estimated by the Coale Model

Age at interview	Literacy		Language	
	Literate	Illiterate	Spanish	Other
20–24	21.2	19.9	21.4	19.6
25–29	21.6	18.6	21.1	19.3
30–34	21.6	18.7	21.1	19.3
35–39	21.3	19.0	20.4	19.8
40–44	21.3	19.5	20.7	19.6
45–49	21.4	20.3	20.9	20.8

5 Fertility

One of the main sources of data for the study of fertility in Peru, ie the vital statistics from the registration system, suffers from serious deficiencies and this limits its use. Fertility levels and trends have been obtained mainly through indirect methods based on census information from 1876, 1940, 1961 and 1972. More recently in 1975–6, the National Demographic Survey (EDEN) was carried out thus making available the fertility levels for 1975. The total fertility rate obtained then was 5.3 (Oficina Nacional de Estadística 1978:7), the same as the one obtained for the present survey for the period 1976–8 (Oficina Nacional de Estadística 1979:145).

One important conclusion derived from more recent studies based on EDEN data is that fertility has started to decline in the country, but at a very slow pace and almost exclusively in the urban areas (Instituto Nacional de Estadística 1978b: 4). On the other hand, the exact moment when this decline started has not yet been established.

The PFS is a source that will not only enable us to corroborate the present fertility levels and explain their causality, but will also – and this is one of its main advantages – enable us to analyse the past trends. In this respect, it is worth mentioning that similar data is available in the country from two surveys that were carried out at the beginning of the 1970s and that together cover the entire national area. We refer to the Urban/Rural Fertility Survey (PECFAL) of 1969 and the Survey on Induced Abortion, Contraceptive Knowledge and Use in Metropolitan Lima (PEAL) of 1970, which will hereafter be referred to as PEAL-PECFAL.

This chapter includes a comparison of the fertility levels found in the PFS and in the PEAL-PECFAL in order to see if their results are consistent and in this way evaluate the quality and methodology used in both sources which, as mentioned before, are similar. Analysing together the results from both surveys will allow us to determine more precisely the trends in fertility, a topic that will later be analysed more exhaustively.

The information on live births used in this chapter is mainly derived from the pregnancy history disclosed by the individual questionnaire, which provides the birth date of every live birth born to ever-married women. This information, together with the date of birth or age of the respondent at the time of the interview, allows us to compute the mean number of children and the specific fertility rates for each cohort as well as for given periods in the past.

Since it is necessary to refer these indicators to the entire female population, the data concerning ever-married women in the individual questionnaire was first adjusted using the data on single women in the household schedule, which also contains information regarding the total number of live births born to all single women between the ages of 15 and 49 and to all women aged 50 or more. In order to help the women to remember the number of children ever had and thus avoid omissions, the following questions were asked: 'do you (does she) have any children of your (her) own living with you (her)?', 'do you (does she) have any children of your (her) own who do not live with you (her)?', 'have you (has she) had any children who later died?'. If 'Yes', 'how many sons and how many daughters?'.

Based on the total number of children declared in the household schedule by single women 15–49 years of age, an adjustment factor was used in order to add them to the number of children born to the ever-married respondents of the individual questionnaire (see appendix A).

The information contained in the pregnancy history is often affected by errors that may originate in misreporting of age by the respondents, omission of births or misplacement of these births in time, errors that could indicate changes in fertility that have not taken place.

In this chapter we will try to determine if these errors are present in the data and, if so, in which way they may be affecting the information. With this aim we will first examine, very superficially, the mean number of children ever born to women in each five-year age group as of the date of the survey; we will then analyse the fertility rates estimated for five-year periods prior to the survey and finally we will analyse the cohort fertility.

5.1 MEAN NUMBER OF CHILDREN PER WOMAN

One way of measuring fertility, the simplest and probably the best known way, is through the mean number of live births had by women throughout their reproductive life, up to the time of the survey.

Table 7 presents the mean number of children born to ever-married women obtained through the individual questionnaire and the mean number of children born to all the women, which we obtain by adjusting both the number

Table 7 Mean number of children ever born to ever-married women and to all women, by current age

Current age	Mean number of children	
	Ever-married women	All women
Total	4.5	3.9
15–19	1.0	0.2
20–24	2.0	1.1
25–29	3.2	2.5
30–34	4.5	4.0
35–39	5.9	5.4
40–44	6.6	6.3
45–49	7.0	6.7

Table 8 Mean number of children per women by age group, in 1961 and 1972 according to the PFS and the censuses, compared to the results obtained by the National Demographic Survey (EDEN)

					1975–6	
	1961		1972			
Age	PFS	Census[a]	PFS	Census[b]	PFS[c]	EDEN[d] (retrospective mode)
15–19	0.27	0.17	0.19	0.23	0.16	0.14
20–24	1.47	1.20	1.23	1.35	1.08	1.01
25–29	3.03	2.66	2.74	2.88	2.55	2.55
30–34	4.12[e]	3.96	4.35	4.23	4.05	3.95
35–39	–	5.11	5.64	5.54	5.45	5.22
40–44	–	5.73	6.42	6.17	6.27	6.04
45–49	–	5.98	–	6.39	6.66	6.18

[a] Direccion Nacional de Estadística y Censos (1965) II, 90–1.
[b] Oficina Nacional de Estadística y Censos (1974) 308–16.
[c] By age at PFS (1977–8) interview.
[d] Oficina Nacional de Estadística (1979) 8.
[e] 30–33 years.

of live births and the female population, using data from the household survey.

Quite often the data collected in censuses and retrospective surveys on children ever born are affected by omissions probably due to recall lapses, which seem to increase with age. It is thought that women forget to mention particularly those children who were born a long time ago, those who died soon after birth or those who do not live with them any longer. These omissions are likely to occur because censuses include very few questions regarding the number of children ever born, a problem that could be overcome in research studies by including a pregnancy history, as has been done in the PFS. We will try to prove if this statement is correct.

Table 8 compares the mean number of children per woman obtained in the PFS with the data from the 1961 and 1972 censuses and from the National Demographic Survey of 1974–5 (according to the results on retrospective fertility from the special investigation introduced in the last round of the EDEN). The mean number of children from the PFS has been reconstructed by means of a procedure consisting of establishing, for each group of women, the cumulative fertility as of the date of the respective censuses. The PFS results are very consistent with those from EDEN although systematically somewhat higher in the PFS (this is probably a consequence of the application of the pregnancy history in the PFS which allowed the detection of more live births than the EDEN, where census type questions were used).

However, the differences are remarkable when compared to the census averages. We should point out here, though, that due to deficiencies in the questionnaire design of the 1972 census, a high number (27 per cent) of women aged 15–49 did not answer the question on number of live births, which obviously distorted the fertility level measured through the mean number of children and consequently the level of the fertility rates, which also are indirectly derived from those means.

Because of this, the 1972 census means used in the comparison have been corrected by a computer program that assigned children to women who had not declared them. The procedure consisted in randomly assigning the children according to the woman's age, marital status and educational level.

The adjusted means for the 1972 census are higher in the first three age groups and lower in the three other age groups than the PFS means. These results do not allow us to determine which source provides the best information since it is not possible to know how accurately the values were assigned to the census data.[1] A possible indication that perhaps the PFS data are better is the fact that the census means show an increase in fertility in the intercensal period which, in view of other investigations (PEAL-PECFAL, for example), seems less likely than the clear decrease evidenced by the reconstructed PFS data, for the three dates under study. In any case, the assigned means for women aged 30–49 are the closest ones to the PFS results, these being at the most 4 per cent higher, for women aged 40–44, than the census data. Differences favouring PFS are higher when we consider the 1961 census, reaching 59 per cent in the case of women aged 15–19 (0.1 children).

From the above it is possible to say that the quality of the information on the mean number of children obtained in the PFS is good and more exhaustive than that provided by the other sources. However, considering that the information on age supplied by the older cohorts is less reliable, and that this is also the case with those living in rural areas and with illiterate women, we are justified in suspecting that the reporting of live births may also have been more affected among these women by biases arising from omissions and misreporting of age, errors that can not always be perceived clearly in the five-year age groups examined above.

In order to prove this assumption we analysed the mean number of children born to all ever-married women by single years of age. The averages obtained appear in figure 13. It was expected to find that the means increased with the woman's age, but this was not so. After reaching the age of 47 the curve declines, which could be interpreted as evidence of omission because, under the assumption that the fertility has remained constant, ages after 47 should show the same value.

[1] These values are located between the censal means which we have denoted minimum and maximum. In the first case, we assume that women who did not answer the question have no children, while the maximum means assume that women who did not reply have the same reproductive behaviour as those who did. The results were as follows:

	Ages						
Censal means	15–19	20–24	25–29	30–34	35–39	40–44	45–49
Minimum	0.15	1.08	2.47	3.86	5.02	5.64	5.92
Assigned	0.23	1.35	2.88	4.23	5.54	6.17	6.39
Maximum	0.33	1.64	3.09	4.45	5.62	6.28	6.57

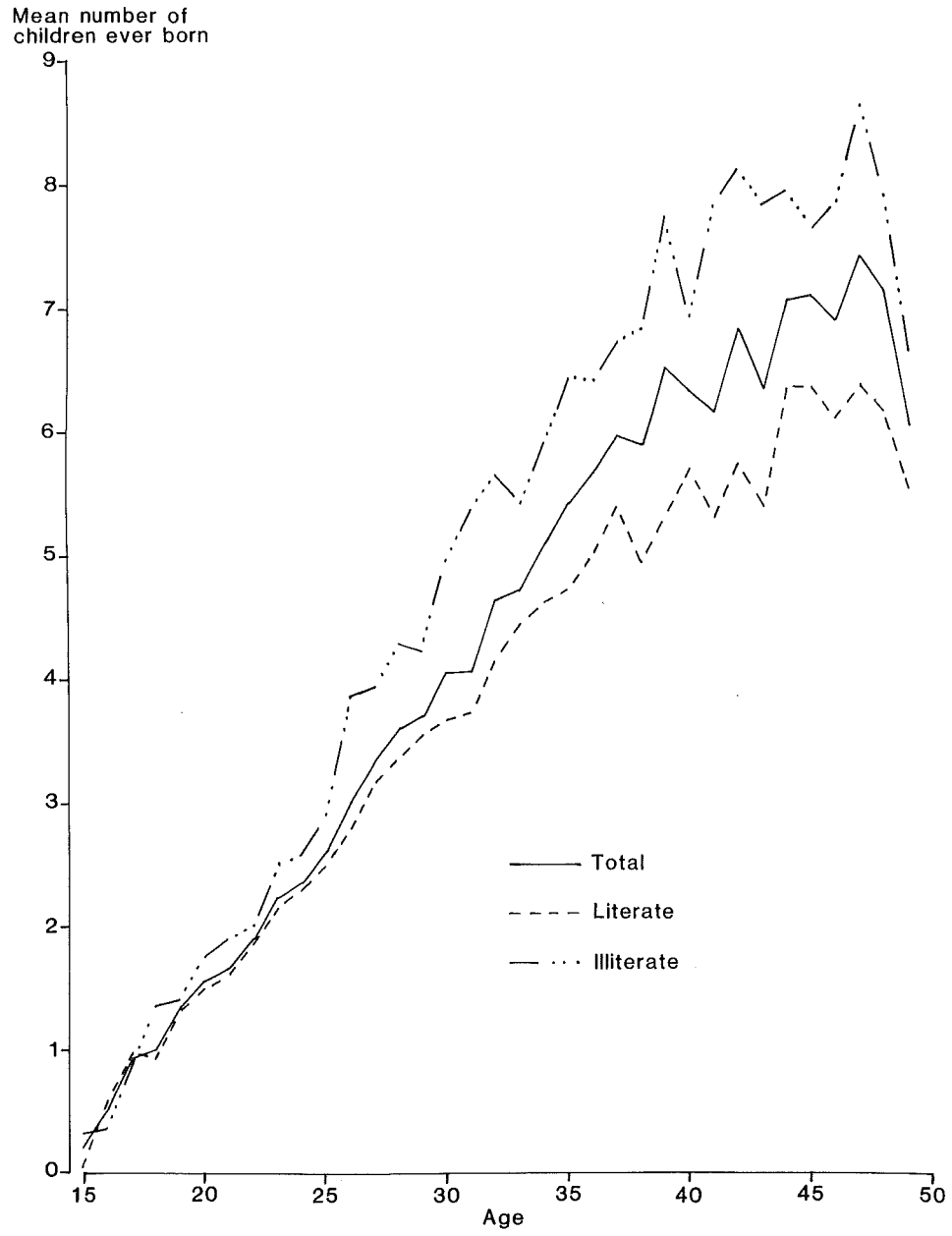

Figure 13 Mean number of children ever born, by single years of age, for women ever in a union, total and according to literacy

Another possible cause of the decline in the mean lies in the fact that women with high fertility may have been reported as over 50 years old, thus being excluded from the individual interview. This is quite reasonable if we consider that high fertility is related to educational level and misreporting of age.

In order to identify which types of women were causing this behaviour, the women were classified in two groups, literate and illiterate, and the same result was obtained, as was the case when they were classified by urban and rural area of residence. Furthermore, literate women were classified by number of years of schooling, and once again the same results were obtained both among those who had between one and two years of education and among those with seven or more.

The means presented in figure 13 show that the main irregularities appear at the age of 38 and they steadily increase until the end of the reproductive period. Irregularities are also seen among the younger women but are less accentuated. The fluctuation of the means may be due not only to omissions but also to errors in age reporting which, as we saw in chapter 3, become greater after the age of 35; nevertheless, part of this behaviour could be explained by sampling errors.

Distortions caused by age misreporting can affect the means even though the women might have provided the correct number of live births. The decline in the mean number of children for illiterate women between 40–45 years of age (digits that are very attractive to women reporting their age) could be due, for example, to a transference into those ages by younger women who would therefore show as having less children. If instead of younger women there had been a transference of older ones, the mean would have been overestimated. This might have been what happened among the literate women of the same ages, although in this case it could be explained by the inclusion

Table 9 Age-specific and cumulative fertility rates, by calendar year, 1947–76, PFS 1977–8

	Age-specific fertility rates							Cumulative rates up to exact age					
Years	15–19	20–24	25–29	30–34	35–39	40–44	45–49	25	30	35	40	45	50
1947	123.19												
1948	96.72												
1949	106.05												
1950	122.15												
1951	111.87	227.14						1.7					
1952	130.97	269.83						2.0					
1953	148.94	296.45						2.2					
1954	117.53	311.82						2.1					
1955	130.90	290.42						2.1					
1956	113.86	307.64	331.09					2.1	3.8				
1957	142.33	312.50	327.03					2.3	3.9				
1958	127.28	246.68	321.57					1.9	3.5				
1959	147.93	313.42	339.60					2.3	4.0				
1960	132.31	294.27	326.56					2.1	3.8				
1961	117.62	275.52	307.64	306.06				2.0	3.5	5.0			
1962	127.80	264.49	310.20	300.63				2.0	3.5	5.0			
1963	108.72	260.48	304.86	309.01				1.8	3.4	4.9			
1964	97.45	295.86	290.56	297.94				2.0	3.4	4.9			
1965	133.64	299.49	316.26	299.14				2.2	3.7	5.2			
1966	97.62	247.21	294.84	272.37	196.34			1.7	3.2	4.6	5.5		
1967	135.02	295.29	298.81	274.59	190.64			2.2	3.6	5.0	6.0		
1968	112.41	276.81	299.95	273.45	209.77			1.9	3.4	4.8	5.9		
1969	90.88	288.98	328.16	249.21	204.52			1.9	3.5	4.8	5.8		
1970	111.31	291.44	307.69	277.52	208.15			2.0	3.6	4.9	6.0		
1971	100.93	250.60	277.11	241.97	177.53	125.12		1.8	3.1	4.4	5.2	5.9	
1972	91.94	281.79	329.17	255.40	197.61	93.86		1.9	3.5	4.8	5.8	6.2	
1973	94.57	262.51	268.59	267.39	167.56	109.28		1.8	3.1	4.5	5.3	5.8	
1974	91.69	247.73	272.18	270.86	166.50	97.21		1.7	3.1	4.4	5.2	5.7	
1975	85.02	248.41	260.85	216.41	181.17	88.50	28.08	1.7	3.0	4.1	5.0	5.4	5.5
1976	93.78	222.16	256.75	230.26	145.38	89.98	26.95	1.6	2.9	4.0	4.7	5.2	5.3

of younger women whose ages had been estimated by the interviewer as older under the assumption that the more children they had the older they must be. In fact, it is very difficult to isolate the effects of omission and age misreporting.

5.2 RECENT TRENDS AND CURRENT LEVELS OF FERTILITY

In the previous section we showed that the retrospective fertility measured by the PFS provides acceptable results. We shall now try to assess the quality of the data regarding current fertility by means, in the first place, of an analysis of past fertility trends. Later, using other sources of information, we shall compare the PFS specific fertility rates with those obtained in EDEN and in PEAL-PECFAL.

The fertility rates calculated for the calendar years 1947–76 shown in table 9 enable us to determine what has been the tendency or the behaviour over time and to see if it is possible to identify when the decline in fertility began. These rates were obtained by dividing the total number of live births, according to year of birth and age of the mother at that time, by women-years (sum of the months lived by the women in each calendar year at a given age, divided by 12) of the corresponding periods and ages.

In those age groups for which we had the information, the estimated rates for periods prior to the 1960s show a certain stability, particularly for women aged 20–24 and 25–29 during the 1956–9 period. But from 1960 the rates seem to indicate a more accelerated decline. The trend towards a decline can also be observed in the columns containing the mean number of children cumulated up to given ages (obtained by accumulating the respective rates). For example, with the rates for 1961 a 35 year old woman would have reached an average of five children; 15 years later a woman of the same age would have an average of one child less, which is a reduction of 20 per cent.

Some years show irregularities; for example, the cumulative rates for 1967 and 1972 are higher than those of the adjacent years, thus indicating the possibility of heaping having taken place when the birth date was calculated, being based on the child's age.

In order to smooth the irregularities apparent in the annual series caused by chance, or heaping on either age or birth date, we present rates for three-year periods in table 10 and figure 14. This new series also shows that the decline in the fertility rates started in the period 1959–61.

Rates corresponding to women aged 20–24 and 25–29 for the three-year periods 1965–7 and 1968–70 show small increases compared to the preceding three-year period, which could be a consequence of the effect indicated

Table 10 Fertility rates by age groups and cumulative rates, by three-year periods 1947–76, PFS 1977–8

	Respondent's age						Cumulative number of children up to exact date				
	15–19	20–24	25–29	30–34	35–39	40–45	25	30	35	40	45
1947–49	107.9										
1950–52	121.8										
1953–55	132.1	299.5					2.2				
1956–58	127.9	288.8	325.9				2.1	3.7			
1959–61	132.4	294.0	324.4				1.8	3.5			
1962–64	110.6	273.3	301.7	302.6			1.9	3.4	4.9		
1965–67	122.1	280.6	303.2	281.8			2.0	3.5	4.9		
1968–70	104.9	286.1	311.7	266.7	207.5		2.0	3.5	4.8	5.9	
1971–73	95.7	265.1	291.3	255.0	181.0	108.1	1.8	3.3	4.5	5.4	6.0
1974–76	90.2	238.9	263.0	238.9	164.1	91.9	1.6	3.0	4.2	5.0	5.4

by Potter: that the women might have advanced the date of birth of the children towards the date of the survey. However, the pronounced decline in the older ages does not provide supporting evidence of the effect mentioned. The increase of the rates in the younger ages is very small, and could be due to sampling errors.

Summarizing what we have seen so far, we can say that fertility rates show a declining trend which is more clearly seen from the 1960s onwards. On the other hand, both the mean number of children and the rates show some evidence of omissions and misreporting of age, two points which will be more exhaustively analysed in the section on fertility rates by cohorts.

With respect to the comparison of the PFS data with those from other sources, the first results observed are presented in table 11 and figure 15. There we can see the PFS rates for 1974–6 and the EDEN rates for 1975, for the prospective and retrospective modes. (In the prospective mode of the EDEN survey, the rates were obtained by dividing the number of live births born during the observation period to women of certain ages by the time lived by the whole female population of the same ages; in the case

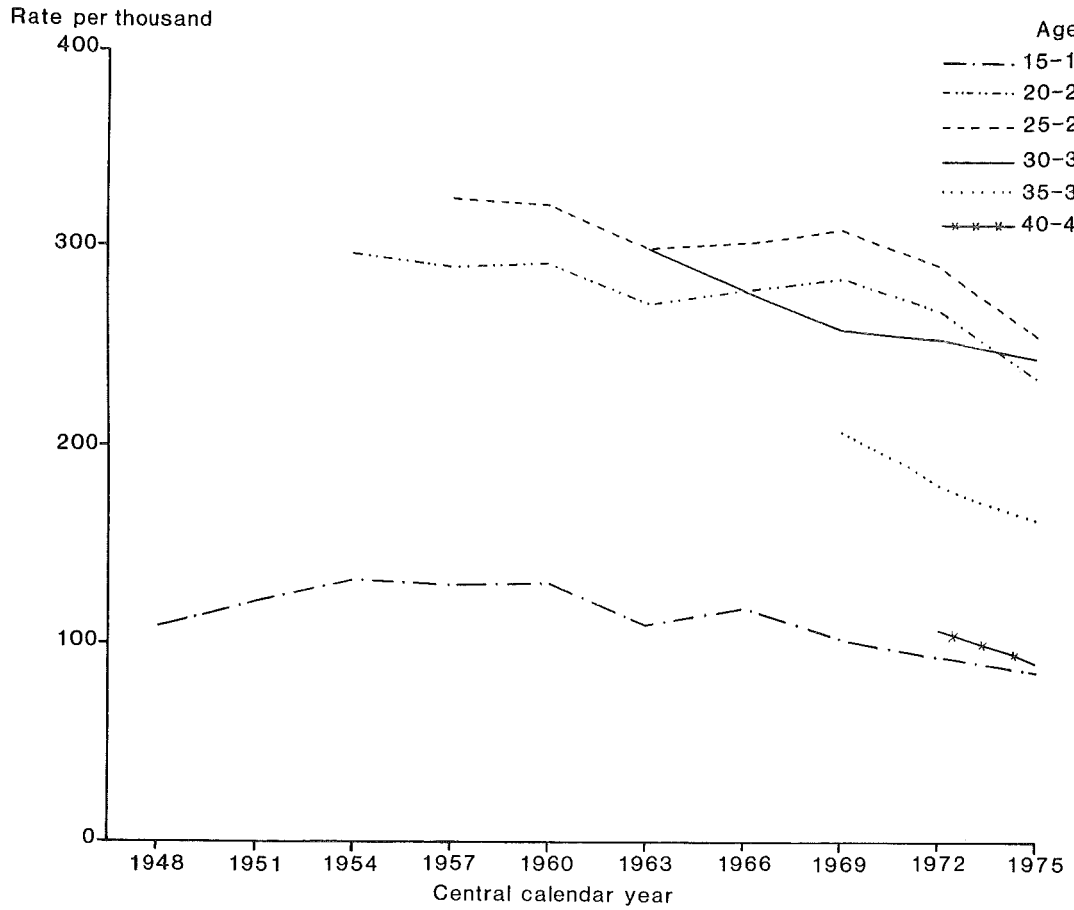

Figure 14 Age-specific fertility rates for three-year calendar periods

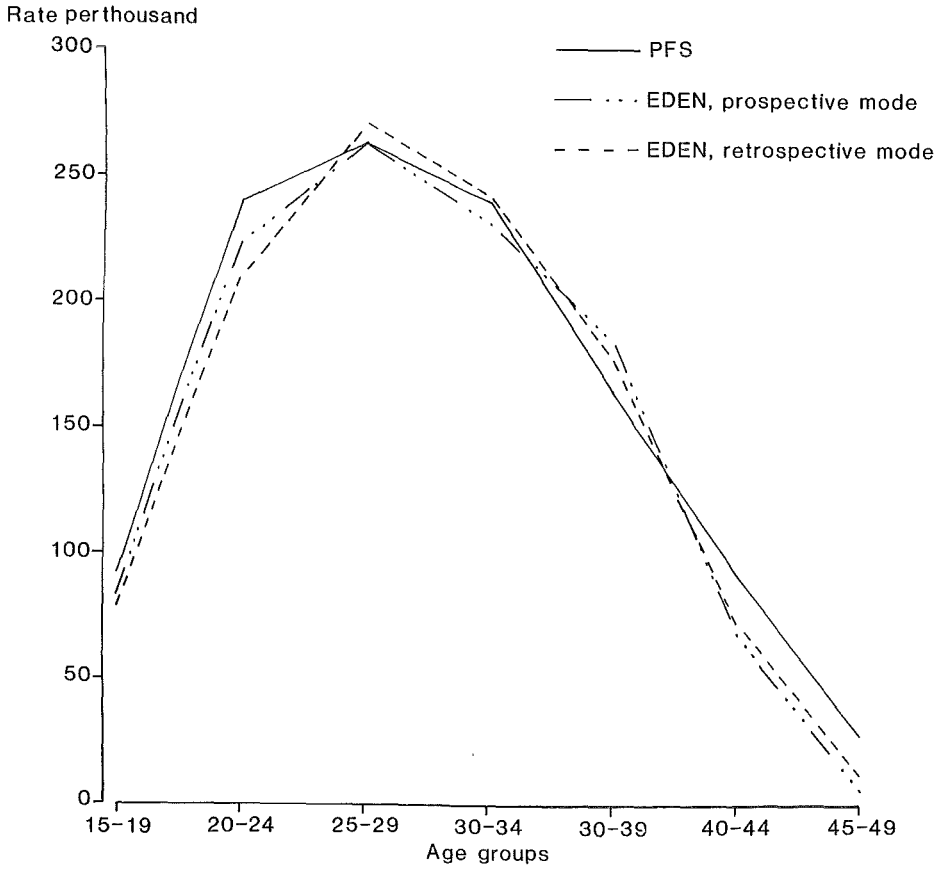

Figure 15 Age-specific fertility rates for 1976–8 according to the PFS, and for 1975 according to EDEN

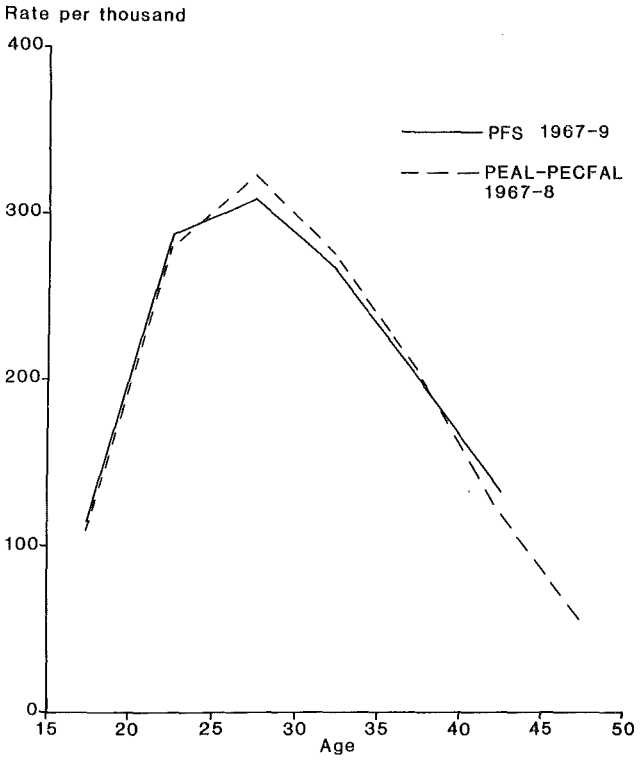

Figure 16 Age-specific fertility rates for 1967–9 according to the PFS, and for 1967–8 according to PEAL-PECFAL

of the retrospective mode, the number of live births born in the 12 months prior to the date of the survey to mothers of certain ages was divided by the total number of women-years lived in the same age groups. In order to be able to compare both sets of rates, the rates of the retrospective survey were transferred six months, under the assumption that on average the women were six months younger when they gave birth than at the time of interview.)

As can be seen from figure 15, the results are similar as far as the structure of the rates is concerned, especially the retrospective version; the main differences can be observed in the 35–39 age group, for which the PFS shows lower values. For the age groups 40–44 and 45–49, however, the PFS is higher than the other two sources. Although these differences could be explained by omission of births or errors in the reporting of age that could be affecting PFS and EDEN in a different way, they could also be due to sampling variability because the differences are not significant. In any case, they are only slight variations, since the specific rates lead to very similar total fertility rates: 5.6 for PFS and 5.3 for both versions of EDEN.

Equally encouraging are the results obtained by comparing the PFS rates with those obtained from the birth history of the PEAL-PECFAL surveys. Indeed, as can be seen from table 12 and figure 16, the results are very similar when we compare the PFS rates for 1967–9 with the PEAL-PECFAL ones for 1967–8. The cumulative fertility up to age 45 is 6.6 in both surveys. This result is particularly relevant if we consider that we are comparing the data from

Table 11 Age-specific fertility rates according to the PFS for the period 1974–6 and to the National Demographic Survey (EDEN), prospective and retrospective versions, for 1975

Age group	PFS 1974–6	EDEN 1975 Prospective version	EDEN 1975 Retrospective version
15–19	90.2	79.0	82.4
20–24	239.4	209.7	224.6
25–29	263.3	270.8	263.3
30–34	239.2	241.3	230.5
35–39	164.4	177.2	183.2
40–44	91.9	71.9	67.2
45–49	27.5[a]	11.2	5.4
TFR	5579.5	5305.5	5283.0

[a] 1975–6.
Source: Instituto Nacional de Estadística (1978b): 7

the most recent PEAL-PECFAL survey, with those from around ten years before the data of the PFS, a period in which it is assumed that the information is more liable to have errors in the reporting of births.

The comparison of the rates for the 1964–6 period shows again the same curve for both surveys, but slightly lower levels in the PFS (figure 17).

The difference in the rates for women aged 25–29 is not statistically significant but the pattern could be reflecting a slight omission of births. Total fertility up to age group 35–39 is 6.4 in PEAL-PECFAL and 6.0 in the PFS.

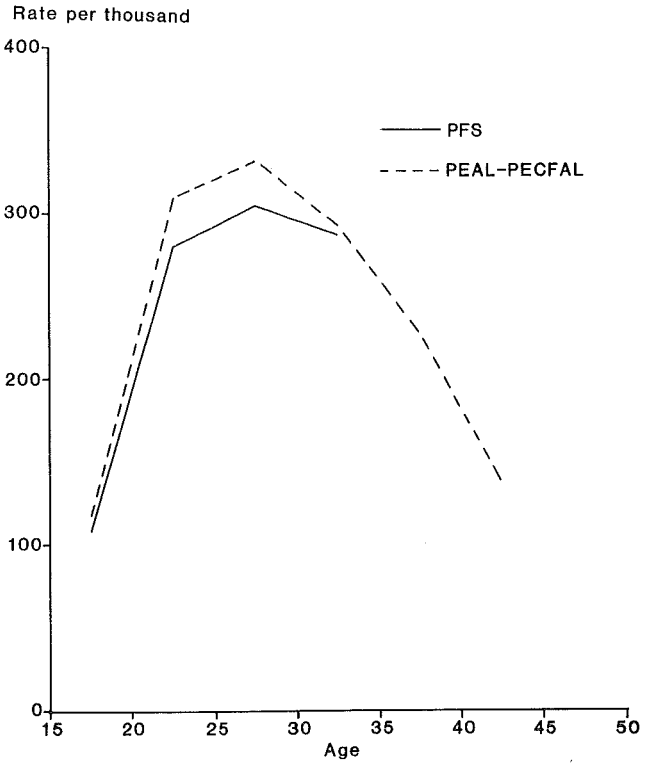

Figure 17 Age-specific fertility rates for 1964–6 according to the PFS and PEAL-PECFAL

5.3 ANALYSIS OF FERTILITY BY COHORTS

In the preceding sections we examined fertility through the mean number of children per woman and the age-specific fertility rates by calendar years. These measurements, although they are the best known, present certain disadvantages. The first measurement represents the number of children born to the women since the beginning of their reproductive life up to the time of the survey, thus referring to a period prior to the survey that is different for the women in each age group. The age-specific rates, on the other hand, have the disadvantage that the births used to estimate the rates are classified according to the year in which they took place and to the age of the women at the time of the birth, and therefore these women come from two different cohorts.

Longitudinal or cohort rates, which constitute the subject of analysis in this section, present the advantage that through them it is possible to examine the fertility experience of a selected group of women throughout their childbearing period. This set of women (cohort) is defined according to their age at the time of the survey. The births required for estimating the cohort rates must be obtained taking into account the year in which they occurred and the age of the mother at the time of interview.

In order to analyse the quality of the information which relates to the whole country we have developed table 13, which contains in its upper section the fertility rates by age for the different five-year periods prior to the survey. For a proper interpretation of these data we must keep in mind that to examine the fertility experienced by each of these cohorts in each age group, that is to say the children born to them in the different periods, we must examine the rates horizontally. To examine the fertility experienced by the different cohorts at the same age (the rates are designated by the central age) we must examine the rates that are shown diagonally, from left to right. Finally, to analyse the fertility of the different cohorts during one period, we must examine the rates vertically. The cohort-period fertility rates are shown in figure 18, where we can see the behaviour of the rates in a more objective way. Table 13 also shows the cumulative cohort rates up to the end of each period (P_i) and the cumulative rates for periods up to a determined age in each of the cohorts (F_i). If we denote f_{xy} as the fertility rate of cohort x in period y, then

$$P_i = \sum_{y=1}^{y=i} f_{iy} \quad \text{and} \quad F_i = \sum_{x=1}^{x=i} f_{xi}$$

The analysis of the cumulative rates by periods (F_i), up to age 40–44 enables us to distinguish important declines in fertility between the periods 5–9 and 0–4 years prior to the survey, a decrease of 13 per cent, from 6.1 to 5.3 births. If we compare the cumulative fertility up to age 35–39, the decline in fertility in the two periods closest to the survey was also 13 per cent, almost three times bigger than the reduction experienced in the periods 10–14 and 5–9 years prior to the survey.

In order to find out if these differences were not caused by omissions, birth transferences or misreporting of age, we shall examine the rates experienced by the cohorts in each period as well as the magnitude and direction of the changes, if there were any.

Table 12 Age-specific fertility rates according to the PFS and to the abortion and urban/rural fertility surveys (PEAL-PECFAL)

	PFS			PEAL-PECFAL		
Age group	1961–3	1964–6	1967–9	1961–3	1964–6	1967–8
15–19	118	110	113	123	115	105
20–24	267	281	287	303	308	279
25–29	308	301	309	350	332	324
30–34	305[a]	290	266	295	293	276
35–39	–	–	202	245	226	206
40–44	–	–	133	–	141	119
45–49	–	–	–	–	–	55
Cumulative fertility up to ages						
30–34	4.99	4.91	4.88	5.36	5.24	4.92
40–44	–	–	6.55	–	7.07	6.55
TFR	–	–	–	–	–	6.82

[a] Ages 30–32 for 1961 and 30–31 for 1962.

Table 13 Cohort-period fertility rates by cohorts and periods and their ratios

	Five-year periods prior to the survey							
Cohort	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39
A Cohort-period fertility rate (per 1000 women)								
15–19	31.9	0.2						
20–24	176.4	37.3	1.0					
25–29	259.1	203.9	45.2	0.7				
30–34	249.6	297.7	207.1	49.1	0.9			
35–39	213.6	295.6	304.8	218.0	58.8	1.8		
40–44	132.3	229.1	294.9	314.2	231.7	47.0	0.9	
45–49	50.1	155.2	257.2	310.5	324.8	193.9	50.1	1.1
B Cumulative cohort rates (P_i)								
15–19	0.158	0.001						
20–24	1.071	0.190	0.003					
25–29	2.545	1.249	0.229	0.004				
30–34	4.022	2.774	1.285	0.250	0.005			
35–39	5.463	4.395	2.917	1.393	0.303	0.009		
40–44	6.251	5.590	4.444	2.969	1.398	0.240	0.005	
45–49	6.714	6.464	5.687	4.401	2.849	1.225	0.256	0.005
C Cumulative period rates (F_i)								
15–19	0.158[a]	0.001						
20–24	1.040	0.188	0.001					
25–29	2.336	1.207	0.229	0.004				
30–34	3.584	2.696	1.264	0.249	0.005			
35–39	4.652	4.174	2.788	1.339	0.299	0.009		
40–44	5.313	5.319	4.263	2.910	1.457	0.244	0.005	
45–49	5.564	6.096	5.549	4.462	3.081	1.214	0.255	0.005
D Ratios (P_iF_i)								
15–19	1.000							
20–24	1.030	1.011						
25–29	1.090	1.035	1.003					
30–34	1.122	1.029	1.017	1.004				
35–39	1.174	1.053	1.046	1.040	1.014			
40–44	1.177	1.051	1.043	1.020	0.959	1.010		
45–49	1.207	1.060	1.025	0.986	0.925	0.982	1.002	

[a] Assuming an F of 0.001 for 10–14.

Table 14 Percentage of decline[a] of cohort fertility rates between five-year periods, PFS 1977–8

Age at end of period	Periods prior to the survey (years)					
	0–4	5–9	10–14	15–19	20–24	25–29
15–19	15.75	17.34	7.93	16.58	+ 25.10	6.13
20–24	13.51	1.51	5.02	5.92	+ 19.50	
25–29	12.96	2.33	3.00	3.25		
30–34	15.55	+ 0.22	5.00			
35–39	6.78	10.91				
40–44	14.76					

[a] + indicates an increase.

Table 14 shows the percentage of decline of the cohort rates between periods, revealing that the main decline in fertility took place in the last two five-year periods, and that apart from the 35–39 cohort, the decrease has been uniform for all the age groups. The smaller decline of the 35–39 age group may suggest an error in the reporting of age. The bias would be due to a transference of women aged 30–34 with high parity to the 35–39 age group, an error that was evident during the analysis of the women's age structure in chapter 3.

This transference of the women from one age group to another would have caused, for the 35–39 cohort, an overestimate of its fertility in the two more recent five-year periods and an underestimate in earlier periods. Thus, these overestimated rates would result in an underestimate of the decline for the 35–39 age group and an overestimate of the decline for the 30–34 age group.

The error of birth transferences at younger ages can be detected by examining the cumulative fertility up to ages 40–44 of the two oldest cohorts, which are supposedly more affected by this type of error. Women of the cohort 45–49 had borne 6.5 children, a slightly higher average than that of the 40–44 cohort; however, if we examine the fertility experienced by these two cohorts in earlier periods,

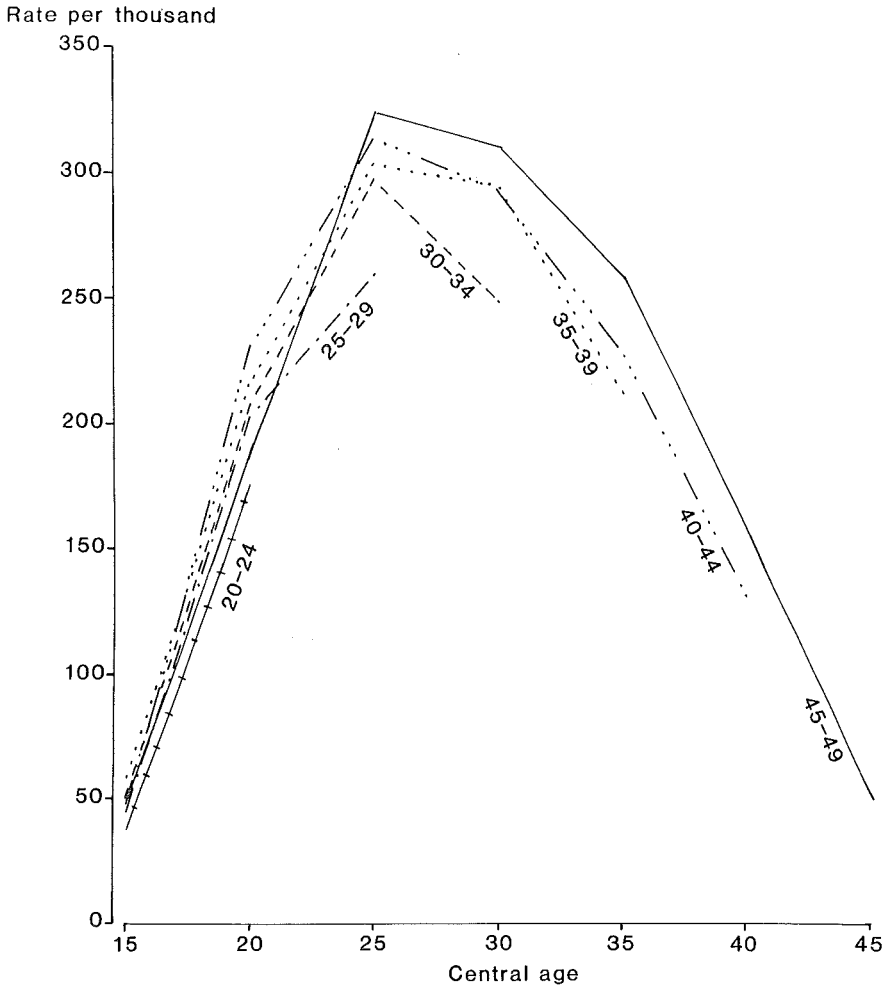

Figure 18 Cohort-period fertility rates, shown according to central ages for five-year cohorts

Table 15 Urban areas: cohort-period fertility rates, cumulative cohort and period rates and P/F ratios, PFS 1977–8

Cohort	Periods prior to the survey							
	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39
A Cohort-period fertility rates								
10–14	–							
15–19	28.86	0.00						
20–24	153.43	27.91	0.00					
25–29	230.83	179.73	40.74	0.83				
30–34	228.06	286.67	201.94	46.39	1.11			
35–39	173.40	259.62	285.26	202.56	53.85	1.28		
40–44	103.46	194.31	286.54	318.85	223.46	37.69	0.38	
45–49	33.18	130.45	236.54	301.82	313.18	181.82	47.27	1.82
B Cumulative cohort rates (P_i)								
10–14	–							
15–19	0.144	0.000						
20–24	0.907	0.140	0.000					
25–29	2.261	1.111	0.208	0.004				
30–34	3.821	2.681	1.247	0.238	0.006			
35–39	4.880	4.013	2.715	1.288	0.276	0.006		
40–44	5.823	5.306	4.335	2.902	1.308	0.190	0.002	
45–49	6.232	6.066	5.414	4.230	2.720	1.155	0.245	0.009
C Cumulative period rates (F_i)								
10–14	–							
15–19	0.144	0.000						
20–24	0.911	0.140	0.000					
25–29	2.066	1.038	0.204	0.004				
30–34	3.206	2.472	1.213	0.236	0.006			
35–39	4.073	3.770	2.640	1.249	0.275	0.006		
40–44	4.590	4.741	4.072	2.843	1.392	0.195	0.002	
45–49	4.756	5.393	5.257	4.352	2.958	1.104	0.238	0.009
D P_i/F_i ratios								
15–19	1.000							
20–24	0.996	1.000						
25–29	1.094	1.070	1.020					
30–34	1.192	1.085	1.028	1.008				
35–39	1.198	1.064	1.028	1.031	1.004			
40–44	1.269	1.119	1.065	1.021	0.940	0.974		
45–49	1.310	1.125	1.030	0.972	0.920	1.046	1.029	

we see that the older cohort has a late pattern, that is to say a lower cumulative fertility up to age 25–29, than the 40–44 cohort, becoming equal at 30–34 and greater at higher ages. This older cohort seems to have transferred births of the period 25–29 years before the survey to the 20–24 period and the births from this one to the 15–19 year period. However, this type of transference does not alter the analysis of trends since it pertains to earlier periods and we are interested in examining the fertility of the last 15 years.

These results are consistent with the transference of date of first union, which also seemed to be evident in this cohort during the analysis of nuptiality. One can therefore expect transferences of the date of first union to be related to transference of first births.

Once we have established the presence of biases in the data, although they are not very pronounced, it is interesting to find out what sectors of the female population have contributed to the erratic behaviour of the rates for the whole population. At the same time, it is important to establish the differences in levels between those sectors and to try to identify which have been more affected by changes in fertility; the extent to which these differences are or are not related to the findings of other sources will provide an evaluation of the quality of the PFS data.

With this aim in mind we chose the type of area of residence and degree of literacy for comparison purposes. It is worth noting that current areas of residence may not be the place of residence at the time of the child's birth due to the high rural to urban migration in the country. However, the results for the last five-year period may be less affected by migration. It is also important to note that the definition of 'urban' in this study is that used for the 1972 census: any group of at least 100 dwellings, contiguous

Table 16 Rural areas: cohort-period fertility rates, cumulative cohort and period rates and P/F ratios, PFS 1977–8

	Periods prior to the survey							
Cohort	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39
A Cohort-period fertility rates								
10–14	0.60							
15–19	37.48	0.60						
20–24	244.19	65.15	2.28					
25–29	260.60	261.58	55.67	0.49				
30–34	296.95	321.95	218.29	54.88	0.61			
35–39	280.32	355.32	337.23	243.62	67.02	2.66		
40–44	177.64	283.99	308.16	306.95	244.71	61.63	1.81	
45–49	73.65	189.84	285.71	322.54	340.95	210.79	53.97	
B Cumulative cohort rates (P_i)								
10–14	0.003	0.003						
15–19	0.190	0.337						
20–24	1.558	0.337	0.011					
25–29	3.222	1.589	0.281	0.002				
30–34	4.463	2.979	1.369	0.277	0.003			
35–39	6.431	5.029	3.253	1.567	0.348	0.013		
40–44	6.924	6.036	4.616	3.076	1.541	0.317	0.009	
45–49	7.387	7.019	6.070	4.641	3.029	1.324	0.270	
C Cumulative period rates (F_i)								
10–14	0.003							
15–19	0.190	0.003						
20–24	1.411	0.329	0.011					
25–29	3.044	1.637	0.290	0.002				
30–34	4.529	3.246	1.381	0.277	0.003			
35–39	5.931	5.023	3.067	1.495	0.338	0.013		
40–44	6.819	6.443	4.608	3.030	1.562	0.321	0.009	
45–49	7.187	7.392	6.037	4.642	3.266	1.375	0.279	
D P_i/F_i ratios								
15–19	1.000							
20–24	1.104	1.024						
25–29	1.058	0.971	0.969					
30–34	0.985	0.918	0.991	1.000				
35–39	1.084	1.001	1.061	1.048	1.030			
40–44	1.015	0.937	1.001	1.015	0.987	0.988		
45–49	1.028	0.950	1.005	1.000	0.927	0.963	0.968	

to each other is considered an urban area as well as all district capitals. This urban population may include provincial capitals that present characteristics of rural populations.

In view of the results obtained through other sources and through the PFS data we expected to find lower fertility levels and more pronounced decreases among the urban and more educated women. We also expected to find less errors and biases in the data provided these women. If we compare the urban and rural fertility rates we can see that the former are lower; the rates can be seen in the upper sections of tables 15 and 16 and are illustrated in figures 19 and 20. Without exception, the urban rates are lower than the rural ones. Although the cumulative rates by periods (F_i) show an increase in the rural fertility for the period 5–9, followed by a decline in the period 0–4 (which could be pointing to the effect mentioned by Potter in the sense that transferred births tend to be concentrated mainly in that period), the analysis of the cumulative rates by cohorts (P_i) dismisses the possibility of this kind of bias and points to the effects of sample variability and of a possible overestimation of women with high parity who would have transferred to the 35–39 cohort.

The cumulative rates (P_i) for the oldest rural cohort are lower than those for the next oldest cohort, up to ages 35–39, which shows evidence of omission or transference of births in the 45–49 cohort, a bias that is also present in the urban area, though not in the same proportion.

The bias detected in all the women of the 35–39 cohort is more noticeable in the rural area. We mentioned that this group's fertility had been overestimated for the first two periods and underestimated for the others because of the presence there of women aged 30–34. This transference would explain why the highest point in the cohort under

Table 17 Per cent of decline[a] of period fertility rates between five-year spans, by area

Age at end of period	Periods prior to the survey					
	0–4	5–9	10–14	15–19	20–24	25–29
A Urban areas						
15–19	3.40	31.49	12.18	13.85	+ 42.88	20.27
20–24	14.63	11.00	0.31	9.35	+ 22.90	
25–29	19.48	+ 0.49	10.53	+ 1.81		
30–34	12.16	0.39	5.06			
35–39	10.76	17.95				
40–44	20.68					
B Rural areas						
15–19	42.47	+ 17.03	+ 1.44	+ 8.11	+ 18.75	+ 14.19
20–24	6.65	+ 19.83	10.40	0.45	+ 16.09	
25–29	+ 1.44	4.53	+ 9.86	9.97		
30–34	16.43	+ 15.30	4.46			
35–39	1.29	0.60				
40–44	6.43					

[a] + indicates an increase.

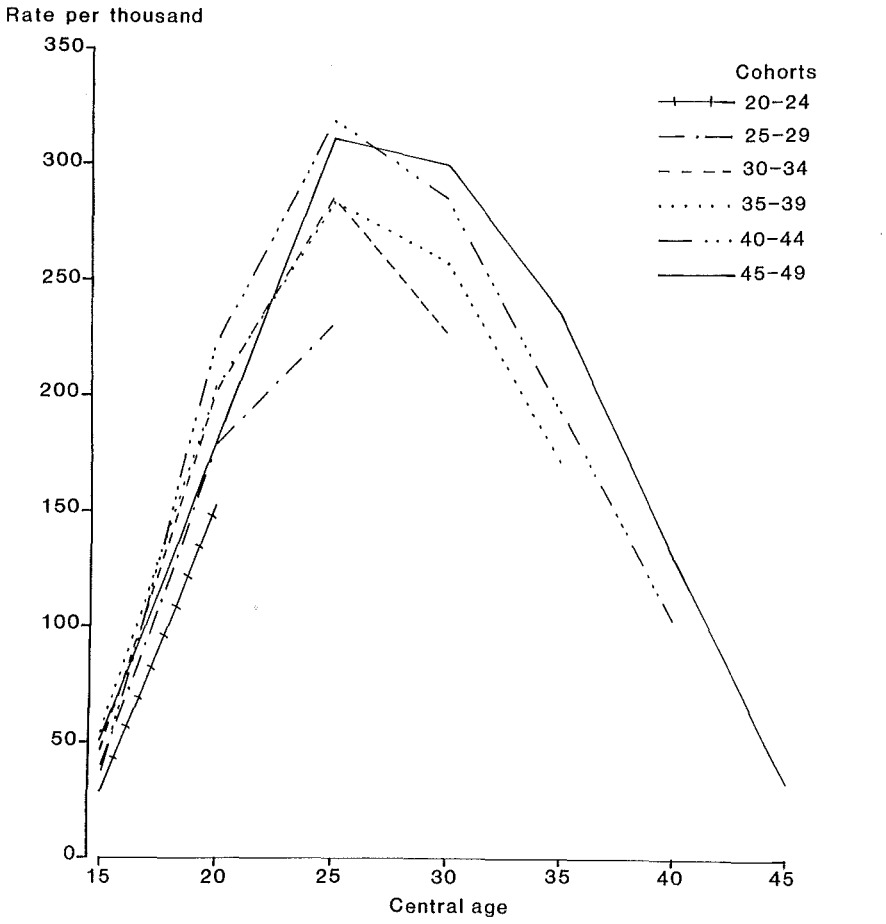

Figure 19 Urban areas: cohort-period rates shown at given central age

Table 18 Literate women: cohort and period fertility rates, cumulative cohort and period rates, P/F ratios, PFS 1977–8

Cohort	Periods prior to the survey							
	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39
A Fertility rates								
10–14	0.20							
15–19	28.60	0.20						
20–24	161.50	32.90	0.27					
25–29	243.47	186.01	36.75	0.37				
30–34	221.20	273.37	183.97	38.32	0.82			
35–39	171.94	250.80	273.18	188.28	39.43	–		
40–44	89.31	186.58	275.47	289.95	205.87	29.35	–	
45–49	34.95	121.51	217.74	289.79	311.83	166.67	34.41	1.61
B Cumulative cohort rates (P_i)								
10–14	0.001							
15–19	0.144	0.001						
20–24	0.973	0.166	0.001					
25–29	2.333	1.116	0.186	0.002				
30–34	3.588	2.482	1.115	0.196	0.004			
35–39	4.618	3.758	2.504	1.139	0.197	–		
40–44	5.428	4.981	4.048	2.671	1.176	0.147	–	
45–49	5.892	5.718	5.110	4.021	2.573	1.013	0.180	0.008
C Cumulative period rates (F_i)								
10–14	0.001							
15–19	0.144	0.001						
20–24	0.952	0.166	0.001					
25–29	2.169	1.096	0.185	0.002				
30–34	3.275	2.462	1.105	0.193	0.004			
35–39	4.135	3.716	2.471	1.135	0.201	–		
40–44	4.581	4.649	3.848	2.630	1.231	0.147	–	
45–49	4.756	5.257	4.937	4.079	2.790	0.980	0.172	0.008
D P_i/F_i ratios								
15–19	1.000							
20–24	1.022	1.000						
25–29	1.076	1.018	1.005					
30–34	1.096	1.008	1.009	1.016				
35–39	1.117	1.011	1.013	1.004	0.980			
40–44	1.185	1.071	1.052	1.016	0.955	1.000		
45–49	1.239	1.088	1.035	0.986	0.922	1.034	1.047	

study is seen at the ages 30–34, which is precisely the period when the transferred women were 25–29 years old, that is to say, when they were at an age where the fertility level reaches its highest peak. At this point in the curve the rate for these women is even higher than the rates for the two older cohorts. It seems that their means are higher than the means for women who belong to the group into which the others have transferred.

The transference into higher age groups is not too surprising in the case of Peruvian women. Apart from what we have just analysed, we have seen in chapter 3 that the data suggested this possibility. Brass (1978) states that when the women do not know their age and have a high parity, the interviewers tend to assign them higher ages; in addition, the climatic conditions of the *sierra* and the type of work they have to undertake in the rural areas tend to increase the aging process of the women, as does the high number of pregnancies. All these factors would contribute towards influencing the interviewers into assigning the women an older age than their real one.

Another noteworthy fact is the behaviour of the rates for the women under 20 years old. The per cent of decline in the last five-year period in the rural area is very high in relation to the declines observed in the other groups and with respect to the decline seen in the urban women aged 15–19 (table 17). It is possible that this was a real decline due to an increase in the age at first union in view of the fact that rate is even higher for the urban women aged 15–19 in the same period, but the possibility of error cannot be completely dismissed.

Since there is a high correlation between area of residence and literacy it is likely that the above findings

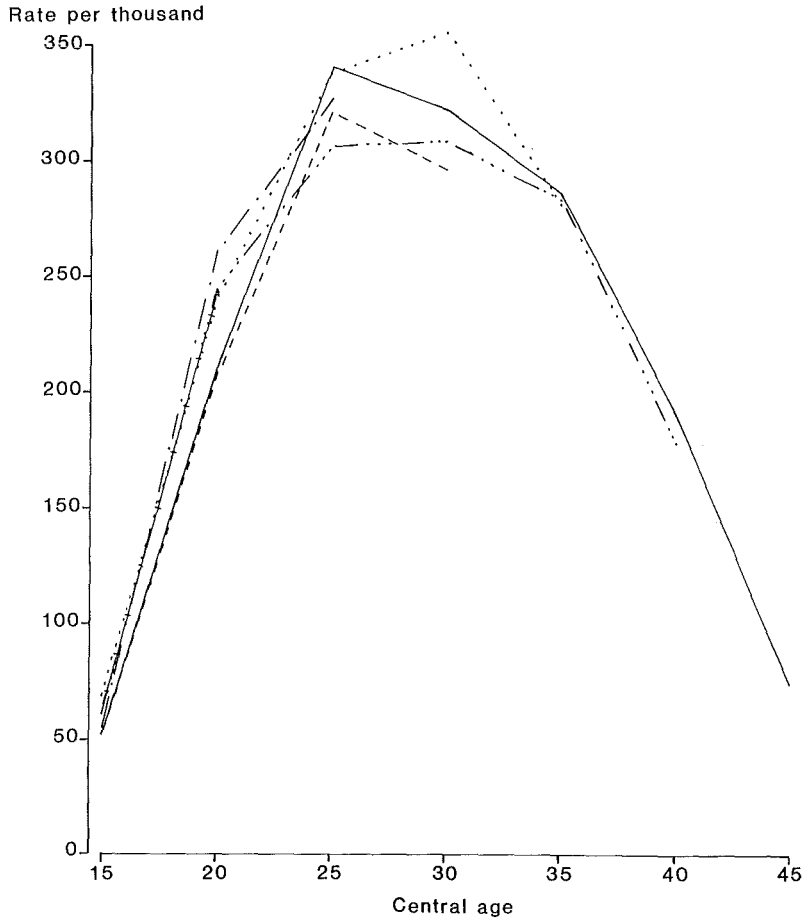

Figure 20 Rural areas: cohort-period rates shown at given central age

concerning urban and rural areas will be maintained when the rates for literate and illiterate women are compared. As tables 18 and 19 show, this is in fact the case.

5.4 ANALYSIS OF FERTILITY ACCORDING TO BIRTH ORDER

The cumulative rates of first births may help to confirm the omissions or transferences observed in the total rates. If these rates also show a tendency to decline with time for the older cohorts, it will then be possible to state that there have been omissions. By accumulating the rates of first births we obtain the proportion of women who become mothers. The assumption is based on the fact that the proportion does not change significantly in countries that are experiencing moderate changes in fertility.

An analysis of this proportion at a national level for the two older cohorts does not seem to show inconsistencies: in both cases around 93 per cent of the women became mothers (table 20). If we compare the proportion of mothers by areas we find that, as expected, the proportion is smaller in urban areas for the younger ages and very similar in both areas for older ages (tables 21 and 22). However, two rural cohorts show striking values: the proportion of women aged 30–34 is less than their urban counterpart (85 vs 89) and the 35–39 cohort reaches 95 per cent, which is even higher than the one for the oldest rural cohort. This situation could be a consequence of the transference of the rural women from the 30–34 year age group to the 35–39 age group.

It is only when we accumulate the rates by periods (F) that we perceive great differences which are in contrast with the slight differences found in the cumulative cohort rates. In urban areas, the proportion of women who have become mothers by the age of 40–44 years is 83 per cent in the period 5–9 and 77 per cent in the period 0–4, a decrease of 6 per cent; in rural areas, however, the proportion who are mothers by age 40–44 is 73 per cent in the most recent period and 99 per cent in the one before, an important decrease of 26 per cent, with similar decreases observed in the other age groups. Since such a high reduction in rural areas in such a short time is unreasonable we must therefore attribute it to an overestimate of the rate for the 25–29 cohort in the period 5–9 years before the survey, due to the transference of births from the most recent period.

The synthetic proportion of mothers for the whole country has its highest value (0.959) accumulated up to the 25–29 age group in the period 20–24 years prior to the survey. Since the first birth rates for this period are higher than those of neighbouring periods, this extremely high proportion appears to be a real period effect.

Table 19 Illiterate women: cohort and period fertility rates, cumulative cohort and period rates, P/F ratios, PFS 1977–8

	Periods prior to the survey							
Cohort	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39
A Fertility rates								
10–14	0.75							
15–19	52.99	0.75						
20–24	257.57	61.26	2.21					
25–29	314.95	267.77	75.08	1.99				
30–34	316.67	355.13	260.90	74.36	1.28			
35–39	267.28	353.32	354.54	256.29	84.21	4.12		
40–44	187.17	282.89	319.25	333.69	264.71	69.52	2.14	
45–49	64.75	187.99	295.56	330.65	337.34	220.37	64.75	
B Cumulative cohort rates (P_i)								
10–14	0.004							
15–19	0.269	0.004						
20–24	1.605	0.317	0.011					
25–29	3.299	1.724	0.385	0.010				
30–34	5.042	3.458	1.683	0.378	0.006			
35–39	6.554	5.217	3.451	1.723	0.442	0.021		
40–44	7.292	6.356	4.942	3.346	1.677	0.358	0.011	
45–49	7.507	7.183	6.243	4.765	3.112	1.426	0.324	
C Cumulative period rates (F_i)								
10–14	0.004							
15–19	0.269	0.004						
20–24	1.556	0.310	0.011					
25–29	3.131	1.649	0.386	0.010				
30–34	4.715	3.425	1.691	3.332	0.006			
35–39	6.051	5.191	3.419	1.663	0.427	0.021		
40–44	6.987	6.606	5.015	3.332	1.751	0.368	0.011	
45–49	7.311	7.545	6.493	4.984	3.438	1.470	0.334	
D P_i/F_i ratios								
15–19	1.000							
20–24	1.031	1.023						
25–29	1.054	1.045	0.997					
30–34	1.069	1.010	0.995	0.990				
35–39	1.083	1.005	1.009	1.036	1.035			
40–44	1.044	0.962	0.985	1.004	0.958	0.973		
45–49	1.027	0.952	0.961	0.956	0.905	0.970	0.970	

5.5 P/F RATIOS FOR COHORT FERTILITY

Another way of detecting biases in the information is through the use of the P_i/F_i ratio method proposed by Brass (1978) in connection with the placement of births in time under which he denominates error in the magnitude of the reference period. The value of P_i is merely the result of the accumulation of the rates up to the end of the period for each of the F_i cohorts, and of the accumulation of the rates for different cohorts up to a certain age, for each of the periods. Assuming that fertility has remained constant, the P_i/F_i ratio should be equal to 1, as long as there are no errors in the data. If these two assumptions are not met, the ratio will be different from 1 and it will be necessary to analyse the results in order to determine if the ratio's behaviour is due to real changes in fertility or to errors in the data. For example, if it is higher than 1, this means either that the current fertility of the women (F_i) has decreased or that it has not been correctly reported (in that births reported correspond to an earlier period than the one under study, or that births have been omitted). If the ratio is less than 1, it means that the fertility has increased, or that the women have reported births that belong to another period, or that there have been omissions of births in the past.

For the whole country (table 23) the P_i/F_i values for the period prior to the survey are higher than 1 and show a tendency to increase with age, which is an indication either that the fertility has declined or that the births attributed to the last five-year period in fact belong to another period. In each case these characteristics are accentuated by age.

Table 20 Fertility rates of first births, by cohorts and periods, cumulative cohort and period rates, P/F ratios, PFS 1977–8

Cohort	Periods prior to the survey							
	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39
A Cohort period first birth rates								
10–14	0.18							
15–19	21.83	0.18						
20–24	72.58	25.29	0.58					
25–29	37.58	78.22	32.92	0.73				
30–34	12.79	48.66	78.82	34.35	0.95			
35–39	5.60	13.20	42.20	81.00	40.00	1.60		
40–44	0.47[a]	5.17	13.87	37.84	95.42	32.43	0.94	
45–49	0.26[a]	2.12	4.50	12.72	55.36	75.23	36.29	0.79
B Cumulative cohort rates (P_i)								
10–14	0.001							
15–19	0.110	0.001						
20–24	0.495	0.133	0.003					
25–29	0.747	0.559	9.168	0.004				
30–34	0.878	0.814	0.571	0.177	0.005			
35–39	0.918	0.890	0.824	0.613	0.208	0.008		
40–44	0.931	0.928	0.903	0.833	0.644	0.167	0.005	
45–49	0.936	0.935	0.924	0.902	0.838	0.562	0.185	0.004
C Cumulative period rates (F_i)								
10–14	0.001							
15–19	0.110	0.001						
20–24	0.473	0.131	0.003					
25–29	0.661	0.522	0.168	0.004				
30–34	0.724	0.765	0.562	0.175	0.005			
35–39	0.753	0.831	0.773	0.580	0.205	0.008		
40–44	0.755	0.857	0.842	0.770	0.682	0.170	0.005	
45–49	0.756	0.867	0.864	0.833	0.959	0.546	0.168	0.004
D P_i/F_i ratios								
15–19	1.000							
20–24	1.047	1.015						
25–29	1.131	1.072	0.004	1.006				
30–34	1.213	1.064	1.016	1.056				
35–39	1.219	1.071	1.067	1.056	1.016			
40–44	1.232	1.084	1.072	1.083	0.944	0.981		
45–49	1.238	1.078	1.069	1.083	0.875	1.028	0.996	

[a] Less than 5 births.

External sources enable us to state that the first alternative is in fact true: fertility in the country is declining and this is the main cause for the behaviour of the P_i/F_i ratio. Because of this, the ratios computed for the subgroups of the population are aimed at establishing if the data contain errors that may have contributed to increase the observed trend. The P_i/F_i ratios for urban and literate women behave as expected during a fertility decline. Those for young women are very close to 1 and the rest increase with age. The magnitude of the ratio in the first two age groups, particularly in the 20–24 group, implies an important decline in the fertility of the younger ages, a circumstance that, as we concluded while analysing the fertility rates by cohorts and periods, could be due to a later entry into a union or to errors in the data.

Another test consists in applying the P/F ratio distinguishing between first births and births of order 4 or more (table 24). In this case as well we find that when we compute the P/F ratio for the whole population, it is higher for births of the first order than for all births, contrary to what happens when only marital fertility is decreasing, which would indicate that a large part of the decline in fertility is due to an increase in the age at birth of the first child and therefore in the age at first union. In the case of urban women the behaviour is as expected, that is to say, the ratios are higher for births to women with high parity and also show the expected trend: they are low in the first ages and increase progressively with age.

After having studied the behaviour of the fertility rates and tried to identify the errors that could be affecting

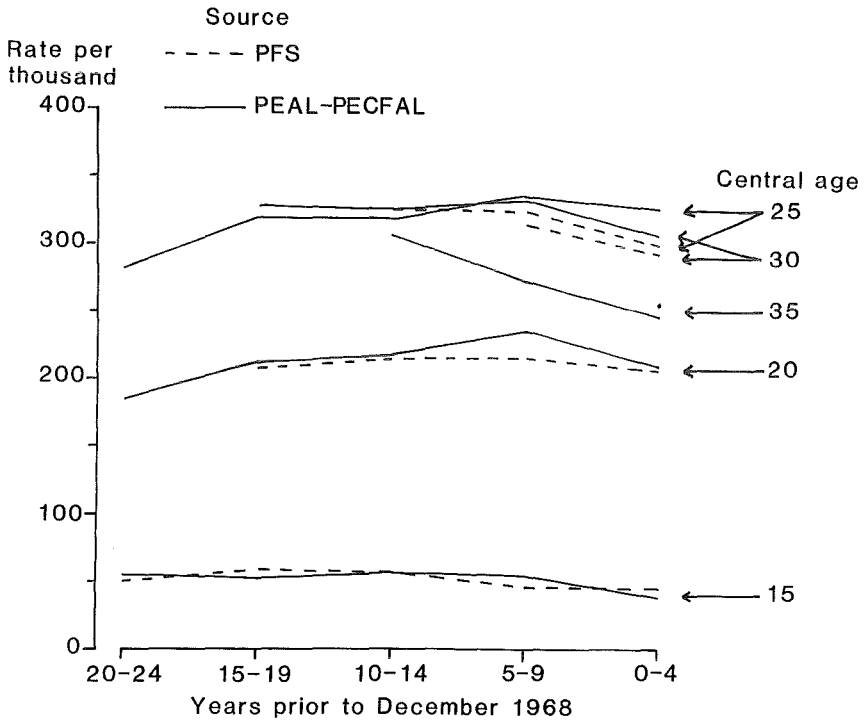

Figure 21 Cohort-period fertility rates at central ages for periods prior to December 1968, according to the PFS and PEAL-PECFAL

Table 23 P/F ratios for the period 0–5 years before the survey, by area of residence and literacy of the respondents, PFS 1977–8

Cohort	Total	Urban	Rural	Literate	Illiterate
20–24	1.030	0.996	1.104	1.022	1.031
25–29	1.090	1.094	1.058	1.076	1.054
30–34	1.122	1.192	1.085	1.096	1.069
35–39	1.174	1.198	1.084	1.117	1.083
40–44	1.177	1.269	1.015	1.105	1.044
45–49	1.207	1.310	1.028	1.239	1.027

error. To achieve this, we shall analyse the sex ratio at birth and the proportion of children who have died.

Sex Ratio at Birth

The sex ratio of 104.2 obtained for all live births recorded in the survey shows no evidence of a selective omission of births of one sex or the other. However, if we estimate it by classifying the respondents according to certain characteristics we find that there are differences or deviations with respect to the average, some of them quite important (table 26). Such is the case with births corresponding to the period 25–29 years before the survey, where the ratio rises to 113, and with births reported by the younger women at the time of the survey (15–19 and 20–24) for whom the ratio reaches 115. On the other hand, the ratio shows values close to 100 (fairly low) in the rural area for illiterate women and in the periods 5–9 and 10–14. It is much lower still in the 30–34 cohort. Many of the ratio's variations may be explained by sampling errors.

Proportion of Children who Died

Another test to detect omissions examines the possibility that children who died at a very early age tend to be omitted more frequently. Table 27 shows the proportion of children who died by current age of the mother. The proportions show the expected increase as the age of the woman increases, for the total for both sexes as well as for the sons. In general, the proportions for daughters follow the same pattern. However, the expected increase is not present for ages 25–29 and 30–34 suggesting omission of daughters who died by the second group, or omission of surviving daughters by the group aged 25–29. One can also observe an excessive mortality among mothers aged 20–29 which would be consistent with an omission of living daughters. But both explanations seem less reasonable when we examine the sex ratios for these groups shown in table 27.

Table 28 shows the proportion of children who died before the age of five, by period of birth. Here we can see the expected pattern with respect to a decline in mortality through time, but there is also evidence of excessive female mortality in the periods 20–24 and 25–29 years before the survey. In the next chapter we shall examine infant and child mortality in more detail.

From what we have analysed up to now in this chapter, we can conclude that the most noticeable errors are the following:

1 The two older cohorts (40–44 and 45–49), and particularly the latter, are the ones most affected by the omission of births. Nevertheless, this type of error is not too great. The recall factor seems to play an important role in the reporting of live births for both cohorts, showing that even the more educated women

Table 24 P/F ratios for the period 0–5 years before the survey, by birth order of the children and place of residence of the respondents

Cohort	Births of order one		Births of order four or more		P/F	
	P	F	P	F	Births of order one	Births of order four or more
A Total						
20–24	0.495	0.473	0.082	0.081	1.047	1.023
25–29	0.747	0.661	0.642	0.619	0.131	1.037
30–34	0.878	0.724	1.622	1.485	1.213	1.092
35–39	0.918	0.753	2.855	2.425	1.219	1.177
40–44	0.931	0.755	3.565	3.055	1.232	1.167
45–49	0.936	0.756	4.029	3.298	1.238	1.222
B Urban						
20–24	0.446	0.444	0.055	0.054	1.004	1.019
25–29	0.708	0.662	0.513	0.477	1.069	1.075
30–34	0.889	0.734	1.411	1.191	1.211	1.185
35–39	0.901	0.770	2.370	1.910	1.170	1.241
40–44	0.942	0.773	3.125	2.397	1.219	1.304
45–49	–	–	3.561	2.556	–	1.393
C Rural						
20–24	0.642	0.553	0.164	0.159	1.161	1.031
25–29	0.830	0.668	0.951	0.975	1.243	0.975
30–34	0.854	0.714	2.085	2.173	1.196	0.960
35–39	0.947	0.730	3.660	3.479	1.297	1.052
40–44	0.915	0.730	4.257	4.333	1.253	0.982
45–49	0.930	0.733	4.683	4.696	1.269	0.997

omit children, probably those who were born a long time before the time of the survey. However, there is the possibility that this might have been confined to a sample of low parity women, since the high parity women under 50 would have reported their age as being over 50 and would therefore have been excluded from the individual questionnaire.

2 The oldest cohort (45–49) shows evidence of transference of births in the sense of reporting births that took place in earlier periods as having occurred at periods closer to the time of the survey, mainly in the period 20–24 and to some extent in the period 15–19 years before the survey. On the other hand, the sampling error mentioned above could account for the apparent transference. However, this bias does not affect the analysis of fertility trends in the 15 years prior to the survey, which is the period we are interested in.

3 Misreporting of age would have resulted in an overestimation of the more recent trends of the 35–39 cohort, as a result of the transference of women aged 30–34 to the 35–39 age group.

The PFS rates have been compared and found consistent with those from EDEN (1975) and from PEAL-PECFAL (1967–8). Between 1967–8 and 1976–8 fertility declined

Table 25 Comparison between cohort and period fertility rates obtained through the PFS (A) and PEAL-PECFAL (B) (reference date December 1968)

Age group in December 1968	Periods prior to December 1968				
	0–4	5–9	10–14	15–19	20–24
15–19 A	43.4				
B	39.2				
20–24 A	207.3	46.7			
B	210.3	53.6			
25–29 A	299.1	215.7	59.8		
B	327.5	236.4	58.1		
30–34 A	291.0	322.0	215.8	59.8	
B	307.8	335.4	216.9	53.5	
35–39 A	253.8	314.3	325.4	209.6	50.1
B	247.3	333.2	319.8	212.0	53.9

Table 26 Sex ratio of live births according to some characteristics of the respondents, PFS 1977–8

Characteristic	Sex ratio (%)	Characteristic	Sex ratio (%)
Total	104.23	*Periods prior to the survey*	
		0–4	107.71
Place of residence		5–9	101.10
Urban	106.01	10–14	101.03
Rural	101.74	15–19	104.71
		20–24	106.98
		25–29	113.21
Literacy			
Literate	105.46		
Illiterate	102.73		
		Respondent's current age	
Birth order			
Order 1	107.71	15–19	114.57
Order 2 and 3	103.56	20–24	115.42
Order 4 and more	103.14	25–29	104.36
		30–34	98.38
		35–39	103.25
		40–44	105.29
		45–49	104.67

Table 27 Proportion of children who died, by sex and by current age of the mother[a]

Current age group	Proportion of children who died		
	Total	Males	Females
15–19	0.109	0.112	0.105
20–24	0.125	0.120	0.130
25–29	0.143	0.141	0.145
30–34	0.156	0.169	0.144
35–39	0.193	0.200	0.186
40–44	0.214	0.224	0.204
45–49	0.251	0.252	0.250
Total	0.191	0.196	0.186

[a] Only women interviewed with the pregnancy history.

Table 28 Proportion of children born at least five years before the survey and who died before the age of five ($_5q_0$), by sex and by periods prior to the survey

Periods prior to the survey	Live births	Deaths of children less than 5 years old	Proportion who died
Males			
25–29	497	159	0.320
20–24	1287	291	0.226
15–19	1956	435	0.222
10–14	2556	488	0.191
5–9	3139	512	0.163
Total[a]	9527	1906	0.200
Females			
25–29	439	146	0.333
20–24	1203	279	0.232
15–19	1868	383	0.205
10–14	2530	435	0.172
5–9	3105	481	0.155
Total[a]	9247	1755	0.190

[a] Also includes periods 30 or more years before the survey.

by around 22 per cent, a remarkable reduction if one compares it with the 33 per cent decline in Colombia between 1968 and 1978, and if one also considers that in Peru the implementation of population policies approved in 1976 is just beginning, while in Colombia there is an established family planning programme.

In conclusion, the tests carried out show evidence that the pregnancy history is not seriously affected by omission of births. The magnitude of errors of this kind is not big enough to invalidate the results. This is proved by the acceptable child mortality levels, trends and differentials obtained for the majority of the cases analysed, which are also consistent with the results from other sources available in the country.

In general, the errors observed are due to incorrect reporting of age by the women.

Finally, we can say that although the tests show that the survey data are not free of errors, these are not so considerable as to invalidate the results. Although there is a little evidence of transference and omission of births, this does occur in the earliest periods but seems to be limited to rural and illiterate women, who constitute a minority of the population under study. On the other hand, women living in urban areas at the time of interview (62 per cent) and literate women (69 per cent) provided more accurate information which revealed the expected patterns. The relative weight provided by these women has minimized the biases for the whole population thus allowing us to appreciate the decreasing trend in fertility, a phenomenon that has accelerated since the beginning of the 1960s.

With the exception of the younger women (15–19) fertility has hardly declined in rural areas: therefore we can attribute the main part of the fertility decline to urban areas.

6 Infant and Child Mortality

In this chapter we shall examine the information collected in the PFS with the purpose of measuring the mortality levels in the first years of life.

6.1 ESTIMATES BASED ON INDIRECT METHODS

The household schedule recorded the total number of live births and the total number of children who died, for single women. Combining this information with the one derived from the pregnancy history of the ever-married women, we obtained the mean number of children ever born and the proportion of children who died, for all the women by age group. This information is presented in table 29 where we can see, as was expected, that the proportion of children who died increases with the women's age.

The mean number of children per woman in the groups between 15 and 49 years of age and the proportion of deceased children of women between 20 and 34 years old enabled us to estimate through indirect methods the probability of death from birth up to 2, 3 and 5 years of age. The results obtained with this type of information can be compared with those already available for the whole country on the basis of censuses and other sample surveys. Furthermore, the findings of these indirect estimates of the PFS can be compared with those obtained through the use of direct methods.

We used the indirect method proposed by Brass (1974) and the variant of this method developed by Sullivan (1972), taking into consideration the four families of the model mortality tables of Coale and Demeny (1966). The results are shown in table 30 and as can be seen there, both methods arrive at almost identical results. The estimates of $_2q_0$ are consistent with the values found using the 1972 census data (Instituto Nacional de Estadística 1977: 15) and those from the EDEN 1975–6 (Instituto Nacional de Estadística 1978a: 27). In both estimates we used the Sullivan variant assuming the 'West' mortality pattern. In the case of the census, the $_2q_0$ representing the two years 1967–8 reached 0.169 and in the EDEN it showed for 1970 a value of 0.135 which, compared to the 0.131 obtained for the PFS for 1972–3, indicates that mortality is decreasing in the country. The method does not allow us to obtain acceptable results of the probability of death during the first year of life ($_1q_0$) and therefore we preferred to estimate this probability from the value found for l_2. The value of l_2 that implies a certain level of mortality enabled us to find the corresponding value for l_1, from which we then derived $_1q_0$. The results of the estimate based on the l_2 from the 'West' family are presented in table 30.

The value of 0.107 obtained for both sexes using the 'West' family can be compared to the value obtained from the pregnancy history for the period 1–5 years prior to the survey. In this case, $_1q_0$ is calculated directly from the deaths of children under one year old born in that period. The $_1q_0$ thus obtained, 0.096, is very similar to that found through the indirect estimate and lower than the value obtained with the information from the EDEN (Instituto Nacional de Estadística 1978a: 70), the rate for which was 0.114 for the 1970–5 period. Considering the time elapsed between the two surveys the results are quite consistent.

Table 29 Mean number of children ever born and proportion of children who died, by five-year age groups, household survey and individual questionnaire

Current age	Mean number of children	Proportion who died
15–19	0.16	0.11
20–24	1.08	0.12
25–29	2.55	0.14
30–34	4.05	0.16
35–39	5.45	0.19
40–44	6.27	0.21
45–49	6.66	0.25
Total	3.9	0.19

6.2 ESTIMATES BASED ON DIRECT METHODS

The pregnancy history of the individual questionnaire also registered the birth dates of each live birth for all deceased children, as well as the age at death, information that allows the direct computation of mortality indicators.

Infant and Child Mortality through Time

The infant and child mortality indicators shown in table 31 and figure 22 were obtained directly from the information extracted from the pregnancy history related to births and

Table 30 Estimate of the probability of death between birth and exact ages based on the proportion of children surviving, by current age of the mother according to Sullivan's method ('West' family)

Mother's Age	Exact Age	Probability of death		
		Both sexes	Males	Females
20–24	2	0.131	0.126	0.137
25–29	3	0.143	0.140	0.146
30–34	5	0.154	0.164	0.143
–	1[a]	0.107	0.103	0.111

[a] Based on estimated values of l_2.

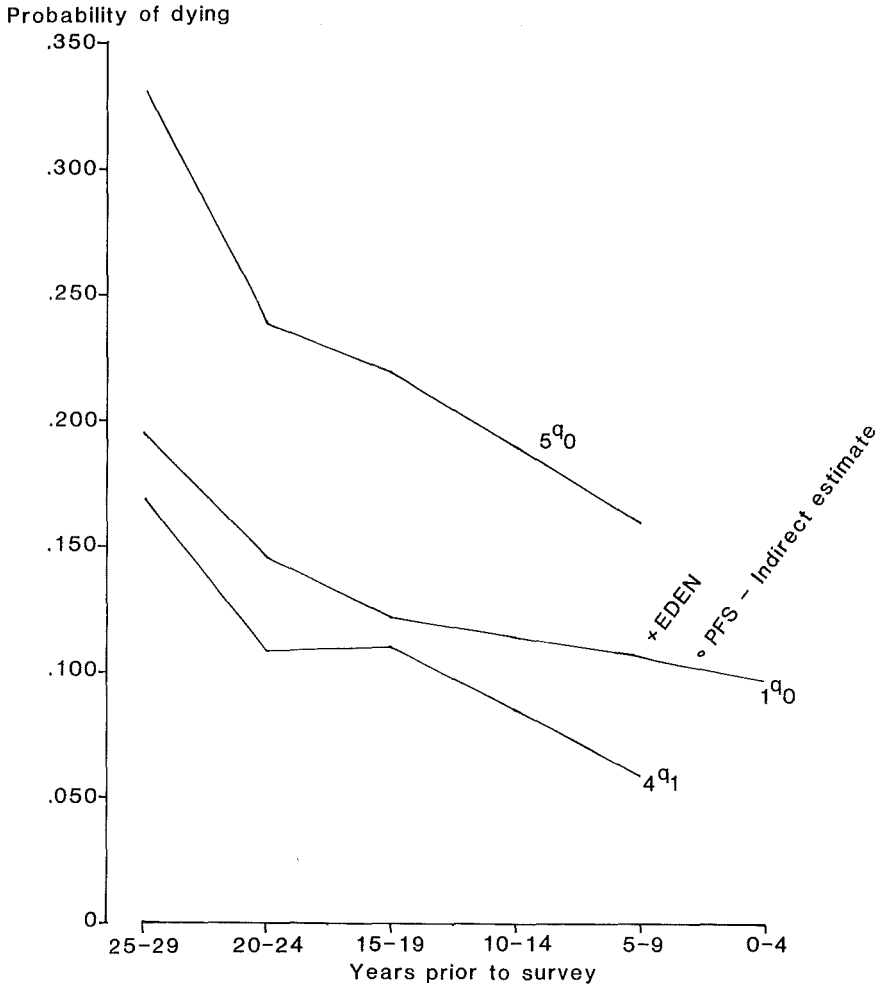

Figure 22 Direct estimates of the probabilities of dying before completing one year of age ($_1q_0$), before completing five years of age ($_5q_0$) and between exact ages one and five years ($_4q_1$), for five-year periods prior to the survey

deaths of children that occurred from 1 to 29 years prior to the survey. The $_1q_0$, $_2q_0$ and $_5q_0$ have been calculated for each five-year period of the time under study, taking into account the sex of the children.

With respect to both the evolution of mortality through time and the differentials by sex, the data reflect the expected behaviour to some extent, that is to say, a constant decline of infant and child mortality and higher infant male mortality compared to female mortality. There are some exceptions, however: in the case of the $_1q_0$ calculated for the 1–4 years before the survey and the $_2q_0$ for the 2–4 years prior to the survey there is almost no difference by sex. The $_5q_0$ also shows, for the periods 20–24 and 25–29, values that do not follow the trend and that show no differences by sex. Finally, the computation of $_1q_0$ and $_4q_0$ shows that after the first year of life, female mortality is higher than male mortality throughout the whole period. This differential, contrary to what may have been expected, has also been seen in other investigations (eg Somoza 1979). It is not difficult, therefore, to accept this behaviour in the case of Peru if we consider also the cultural pattern of machismo that is so deeply rooted in the population.

The considerable drop in the two earliest periods of the $_1q_1$ and $_4q_1$ for both sexes could be showing a selective transference of live births who have survived their first year of life, from the period 25–29 years before the survey to the period 30–34 years before the survey. The effect is more remarkable in the case of males and we can see that the $_1q_1$ declines by 54 per cent and the $_4q_1$ by 44 per cent. For females the reductions are of a lesser degree but even so they alter the general pattern observed, reaching 13 per cent in the case of the $_1q_1$ and 28 per cent in the case of the $_4q_1$.

Mortality of Children under the Age of Five

In order to determine the existence of differential omissions by sex, we calculated (table 32) the proportion of children deceased before five years of age according to several characteristics considering the sex of the live births. We take this proportion instead of the proportion deceased before one year old in order to reduce the effect of possible errors in the reporting of the age at which the child died.

If our starting point is the universally known trend of infant mortality of more deaths among the male sex than the female, we can say that in general our figures are consistent, except in some cases which we will now discuss. Apparently there is no difference in female and male mortality in rural areas. However, if we consider that the sex ratio at birth for this area was rather low (101), we suspect higher omission of boys than of girls who died in

Table 31 Probability of death from birth to ages one year ($_1q_0$), two years ($_2q_0$) and five years ($_5q_0$), by sex and periods prior to the survey, PFS 1977–8

Probability of death	Periods prior to the survey					
	0–4	5–9	10–14	15–19	20–24	25–29
A Both sexes						
$_1q_0$	0.096[a]	0.107	0.114	0.122	0.146	0.195
$_2q_0$	0.127[b]	0.138	0.154	0.179	0.194	0.266
$_5q_0$	–	0.159	0.189	0.219	0.238	0.330
$_1q_1$	–	0.035	0.045	0.065	0.056	0.088
$_4q_1$	–	0.058	0.085	0.110	0.108	0.168
B Males						
$_1q_0$	0.094[a]	0.114	0.128	0.137	0.153	0.197
$_2q_0$	0.127[b]	0.144	0.161	0.187	0.191	0.276
$_5q_0$	–	0.162	0.189	0.221	0.228	0.324
$_1q_1$	–	0.034	0.038	0.058	0.045	0.098
$_4q_1$	–	0.054	0.070	0.097	0.089	0.158
C Females						
$_1q_0$	0.096[a]	0.101	0.099	0.107	0.139	0.192
$_2q_0$	0.126[b]	0.133	0.148	0.170	0.197	0.254
$_5q_0$	–	0.156	0.188	0.216	0.249	0.337
$_1q_1$	–	0.036	0.054	0.071	0.067	0.077
$_4q_1$	–	0.061	0.099	0.122	0.128	0.179

[a] One to four years prior to the survey.
[b] Two to four years prior to the survey.

the rural area. This is reasonable if we accept that the excess of male mortality is usually accentuated in the less developed areas. Therefore, if the women tend to forget their deceased children regardless of the sex, and if there is a higher proportion of deaths among boys than girls, it is possible that mothers tend to more omit male children.

The proportion of deceased daughters is also higher than that of the sons among the group of women aged 15–19 and 20–24 at the time of the survey. At first glance the sex ratio at birth for these cohorts (110) suggests an omission of deceased girls which, instead of decreasing the proportion would tend to increase it, thus increasing the inconsistency with the male rate. In any case, the surviving girls who were not included in the pregnancy history should be considered, because only in this way would the proportion of females be less than the propor-

Table 32 Proportion of children who died before five years of age ($_5q_0$), by sex and by certain characteristics of the respondents, PFS 1977–8

Characteristics	Proportion deceased		Characteristics	Proportion deceased	
	Males	Females		Males	Females
Total	0.200	0.190			
Mother's area of residence[a]			*Birth order*		
Urban	0.165	0.142	1	0.175	0.167
Rural	0.250	0.256	2 and 3	0.197	0.184
			4 or more	0.216	0.206
Literacy			*Mother's age* (in years)		
Literates	0.136	0.121	20–24	0.175	0.232
Illiterates	0.270	0.264	25–29	0.164	0.169
			30–34	0.180	0.145
			35–39	0.200	0.181
			40–44	0.206	0.194
			45–49	0.219	0.227

[a] At the date of the survey.

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Appendix A Method of Adjusting the Components of the Fertility Rates

Since we required the fertility rates for all women of childbearing age for periods prior to the survey, it was necessary to estimate these rates on the basis of the data obtained in the individual questionnaire. Due to the fact that the PFS interviewed in depth with the individual questionnaire only those 'eligible' women who reported themselves (or who were reported by someone else) as having been in a marital union, legal or consensual, it was necessary to make several adjustments both to the numerators and to the denominators before proceeding to estimate the fertility rates and the mean numbers of children ever born. The adjustments were as follows:

1 The number of live births shown by the individual questionnaire (numerator) had to be adjusted to compensate for births to non-eligible women of childbearing age.
2 The number of respondents (denominator) had to be adjusted in order to estimate the total number of women of childbearing age.
3 There had to be an adjustment for non-response to the individual questionnaire.
4 An adjustment had to be made for the difference between the absolute value of the weights of the data derived respectively from the household schedule and from the individual questionnaire.

These adjustments should be applied to both cohort-period fertility rates and age-specific rates for calendar years, as well as to the mean number of children ever born. The adjustments were made while tabulating the numerators and the denominators separately by adjusting the basic weight of each case.

In order to follow the logic of these adjustments we will apply them to the estimate of a specific fertility rate for a cohort of women during a period of time prior to the survey, both on a five-year basis. We define them as follows:

$$SFR_c^p = B_c^p / W_c$$

The fertility rate of cohort c in the period p is equal to the total number of live births B in the period p to all the women in the cohort c divided by the total number of women W in the cohort. We estimate B_c^p by $({}_IB_c^p/r_c) \times s_c$ where ${}_IB_c$ is the number of live births to women interviewed with the individual questionnaire, s is an adjustment for births to non-eligible women of childbearing age (single) and r_c is an adjustment for the non-interview (non-response) of eligible women in cohort c.

We estimate W on the basis of the number of women interviewed of the cohort c:

$$W_c = \Sigma ({}_IW_i \times t_i)$$

where ${}_IW_i$ is the number of women interviewed of single year of age i from the individual questionnaire, and $t_{i'} = W_{i'}/{}_IW_{i'}$ where age i′ is the age according to the household schedule. The factor $t_{i'}$ has two components:

$$t_{i'} = (1/u_{i'}) \times (1/r_{c'})$$

which are the inverse of the proportion of women ever married according to age in the household schedule ($u_{i'}$) and the inverse of the response rate for cohort c′ of the household schedule ($r_{c'}$).

For some of the women interviewed, the age reported in the household schedule is different from that reported in the individual questionnaire. Although we assume that the age declared in the individual questionnaire is more accurate because it was reported by the woman herself, we used the age reported in the household schedule for calculating the adjustment factors because this information was available for all the women of childbearing age. Nevertheless, age given in the individual questionnaire was used in the tabulation for the fertility rates themselves, retaining the adjustments calculated on the basis of age in the household survey. For example, if a woman is reported as 30 years old in the household survey and as 29 years old in the individual questionnaire, the adjustment for 30 years old was applied and she was tabulated in the 25–29 cohort.

To estimate the adjustment factor for births to non-eligible women of childbearing age s_c we tabulated the total number of live births to non-eligible women in the household schedule ${}_HL_c$ and to interviewed women ${}_IL_c$ in the individual questionnaire. Since the weight basis for both questionnaires differed by a constant factor k, it was necessary first to compensate for this difference. This was done by dividing ${}_HL_c$ by the quotient of the total sums of the weights. Thus

$$s_c = [{}_HL_c/k + {}_IL_c/r_c]/({}_IL_c/r_c)$$

where k is the weight adjustment factor and r_c is the response rate to the individual questionnaire by cohort c (the number of eligible women in cohort c divided by the number of interviewed women in that cohort).

Putting all the factors together we have:

$$SFR_c^p = \frac{\frac{{}_IB_c^p}{r_{c'}} s_c}{\Sigma {}_IW_i t_{i'}} = \frac{\frac{{}_IB_c^p}{r_{c'}} \left[\frac{{}_Hp_c^L/k + {}_Ip_c^L/r_c}{{}_Ip_c^L/r_c}\right]}{\Sigma W_i \left(\frac{1}{u_{i'}}\right)\left(\frac{1}{r_{c'}}\right)}$$

The adjustment factors calculated are shown in tables A1, A2 and A3.

Table A1 Response rate

Age cohort c'	Women eligible (1)	(1)[a]	Women interviewed (2)	Response rate $r_{c'} = (2)/(1)^a$
15–19	1 189	331	313	94.54%
20–24	3 510	977	895	91.58
25–29	4 005	1 115	1 056	94.70
30–34	3 467	965	929	96.24
35–39	3 573	995	920	92.48
40–44	3 098	863	805	93.32
45–49	2 873	800	722	90.26
Total	21 714	6 046	5 640	93.28%

[a] Adjusted by dividing by k for the difference in weight:

$$R = \frac{20\,256 \text{ (original weight)}}{5\,640 \text{ (new weight)}} = 3.5915$$

Table A2 Calculation of adjustment factors for numerators to take account of births to women not eligible for individual interview

		Births					
Age cohort[a] (1)	Response rate (2)	From household schedule tab. (3)	Adjustment by k (4) = (3)/k	From individual questionnaire tab. (5)	Adjusted by $r_{c'}$ (6) = (5)/(2)	Total number of births (7) = (4) + (6)	Adjustment factor for births to non-eligible women (8) = (7)/(6)
15–19	0.9454	106	30	324	343	373	1.0875
20–24	0.9158	285	79	1 788	1 952	2 031	1.0405
25–29	0.9470	280	78	3 421	3 612	3 690	1.0216
30–34	0.9624	148	41	4 175	4 338	4 379	1.0095
35–39	0.9248	215	60	5 408	5 848	5 908	1.0103
40–44	0.9332	68	19	5 302	5 682	5 701	1.0033
45–49	0.9026	92	26	5 044	5 588	5 614	1.0047
Total		1 194	333	25 462	27 363	27 696	1.0122

[a] For consistency, age is based on the age reported in the household schedule.

Table A3 Adjustment factors for estimating the total number of women from the number of interviewed women

Age at interview with household schedule	No of women from household schedule (1)	No of respondents		Adjustment factor $s_i = (1)/(3)$
		Tabulated (2)	Fitted (3) = (2) x k	
15	1855	14	50	37.10
16	1754	25	90	19.49
17	1709	61	219	7.80
18	1739	108	388	4.48
19	1403	105	377	3.72
20	1447	123	442	3.27
21	1302	148	532	2.54
22	1521	207	743	2.05
23	1306	206	750	1.76
24	1218	209	751	1.62
25	1308	243	873	1.50
26	1007	197	708	1.42
27	1005	200	718	1.40
28	1001	212	761	1.32
29	890	205	736	2.21
30	1124	246	884	1.27
31	608	145	521	1.17
32	938	231	830	1.13
33	640	163	585	1.09
34	577	138	496	1.16
35	935	209	751	1.25
36	765	178	639	1.20
37	689	168	603	1.14
38	853	202	725	1.18
39	651	165	593	1.10
40	879	205	736	1.19
41	471	121	435	1.08
42	725	176	632	1.15
43	541	134	481	1.12
44	650	167	600	1.08
45	823	200	718	1.15
46	454	102	366	1.24
47	583	145	521	1.12
48	723	165	593	1.22
49	447	116	417	1.07

[a] Adjusted for difference in weight by multiplying by k: 3.5914893.