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Illustrative Analysis: Evaluating Fertility Levels and Trends in Colombia

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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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L'Institut International de Statistique avec l'appui des Nations Unies, a été chargé de la réalisation de ce projet en collaboration avec l'Union Internationale pour l'Etude Scientifique de la Population. Le financement est principalement assuré par le Fonds des Nations Unies pour les Activités en matière de Population et l'Agence pour le Développement International des Etats-Unis.
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El proyecto está a cargo del Instituto Internacional de Estadística en cooperación con la Unión Internacional para el Estudio Científico de la Población y con la colaboración de las Naciones Unidas. Es financiado principalmente por el Fondo de las Naciones Unidas para Actividades de Población y por la Agencia para el Desarrollo Internacional de los Estados Unidos.
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Contents

TABLES

FIGURES

Preface

One of the main concerns of the World Fertility Survey has been the analysis of the data collected by the participating countries. It was decided at the outset that, in order to obtain quickly some basic results on a comparable basis, each country would produce soon after the field work a 'First Country Report', consisting of a large number of cross-tabulations with a short accompanying text. Precise guidelines for the preparation of the tables were produced and made available to the participating countries.

It was also recognised, however, that at later stages many countries would wish to study in greater depth some of the topics covered in their first reports, or indeed new but related subjects, using more refined analytic techniques. In order to assist the countries at this stage a general 'Strategy for the Analysis of WFS Data' was outlined, a series of 'Technical Bulletins' was started, dealing with specific methodological issues arising in the analysis, and a list of 'Selected Topics for Further Analysis of WFS Data' was prepared, to serve as a basis for selecting research topics and assigning priorities.

It soon became evident that many of the participating countries would require assistance and more detailed guidelines for further analysis of their data. Acting upon a recommendation of its Programme Steering Committee, the WFS then launched the present series of 'Illustrative Analyses' of selected topics. The main purpose of the series is to illustrate the application of certain demographic and statistical techniques in the analysis of WFS data, thereby encouraging other researchers and other countries to undertake similar work.

In view of the potentially large number of research topics which could be undertaken, some selection was necessary. After consultation with the participating countries, 12 subjects which are believed to be of top priority and of considerable interest to the countries themselves were selected. The topics chosen for the series span the areas of fertility estimation, levels, trends and determinants, marital formation and dissolution, breastfeeding, sterilization, contraceptive use, fertility preferences, family structure, and infant and child mortality.

It was envisaged that each study would include a brief literature review summarizing important developments in the subject studied, a clear statement of the substantive and methodological approach adopted in the analysis, and a detailed illustration of the application of such an approach to the data from one of the participating countries, but with emphasis on the general applicability of the analysis. These studies have been conducted in close collaboration with the country concerned, where possible with the active participation of national staff.

It should perhaps be emphasized that the studies in the 'Illustrative Analyses' series are meant to be didactic examples rather than prescriptive models of research, and should therefore not be viewed as cookbook recipes to be followed indiscriminately. In many cases the investigators have had to choose a particular course of action from several possible, sometimes equally sound, approaches. In some instances this choice has been made more difficult by the fact that demographers or statisticians disagree among themselves as to the approach most appropriate for a particular problem. In the present series we have, quite intentionally, resisted the temptation to enter the ongoing debates on all such issues. Instead, and in view of the urgency with which countries require guidelines for analysis, an attempt has been made to present what we believe to be a basically sound approach to each problem, spelling out clearly its drawbacks and limitations.

In this difficult task the WFS has been aided by an *ad hoc* advisory committee established in consultation with the International Union for the Scientific Study of Population (IUSSP) and consisting of Ansley Coale (Chairman), Mercedes Concepcion, Gwendolyn Johnson-Ascádi and Henri Leridon, to whom we express our gratitude. Thanks are also due to the referees who have generously donated their time to review the manuscripts and to the consultants who have contributed to the series.

Many members of the WFS staff made valuable contributions to this project, which was co-ordinated by V.C. Chidambaram and German Rodriguez.

Sir Maurice Kendall
WFS Project Director

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The Colombian National Fertility Survey was conducted in 1976 jointly by the *Corporación Centro Regional de Población* (CCRP), a non-profit private institution devoted to research in population, and the *Departmento Administrativo Nacional de Estadística* (DANE), the state agency responsible for the collection, processing and publication of statistical data, with the collaboration of the Division of Information Systems of the Ministry of Health in the design and implementation of the sample.

The author wishes to acknowledge the invaluable help received from WFS Central Staff, especially German Rodriguez and Mick Pearce. He would also like to thank the Corporacion Centro Regional de Poblacion and the Departamento Administrativo Nacional de Estadistica of Colombia, who both encouraged this project and gave speedy help with the difficult problems of matching the Household and Individual samples. In addition Carmen Eliza Florez and Noreen Goldman generously made available their tabulations of fertility rates and children ever born for periods comparable with previous estimates of fertility in Colombia, which are used in Section 3.4. John Cleland, Ken Hill, German Rodriguez and James Trussell all gave valuable comments on the first draft of this report.

1 Introduction

1.1 Purpose

The main aim of this illustrative analysis is to present a brief review of the available procedures for the estimation and evaluation of fertility levels and trends from World Fertility Survey data, with an application to the specific example of the Colombian Survey (Encuesta Nacional de Fecundidad, Colombia or ENFC for subsequent reference). The application of the procedures to the data from ENFC forms an essential part of the illustrative nature of this study: the aim is to demonstrate some of the real problems which occur in actual analysis, rather than discuss possible problems in abstract. A subsidiary purpose is to illustrate the general problems of analyzing differentials in both fertility levels and trends, with educational groups being used as the particular example. It is worth noting at this early stage that education has the advantage of being a relatively fixed characteristic, whereas many other variables such as those associated with place of residence or occupation are less fixed (after age 20 or so). Relative fixity of a characteristic is particular important in the study of trends, especially when information is only collected on present status, as in WFS surveys.

1.2 Data Used

The data used for the illustrative analysis come from the ENFC. Colombia is of particular interest for illustrative purposes because an expanded sample was used for the household survey, which permits various extra checks to be made on the quality of the data. Some of these extra checks proved very useful in this instance. We shall only outline the relevant aspects of the ENFC here, but more detail can be found in the First Country Report (CCRP and DANE, 1977). The household sample was not self-weighting and contained 12,928 women who were eligible for individual interview, who came from the 9793 households where successful interviews were carried out (9999 were in the sample, giving a 97.9 per cent completeness at this stage of the sampling). These eligible women were then used to select the sample for the individual interview. The probabilities of selection were inverse to those used at the first stage so as to make the individual sample self-weighting. Only women aged between 15 and 49 were eligible for interview in the individual survey, although it should be noted that Colombia was not typical of WFS surveys in that all women in this age range were so eligible, regardless of their marital status. From the selected population of 5685 women, 5378 were successfully interviewed, giving a response rate of 94.6 per cent. Unfortunately, no record appears to exist to identify the selected women on the household survey, which would have given some valuable information on the nature of any selection and/or response biasses affecting the individual survey. However, it did prove possible to match the individual and households records for women who were interviewed in the individual survey, which at least allows some simple checks of response consistency for these women. (In fact 12 of the women could not be so matched, despite great efforts to do so.)

For the household sample we have made use of the information on date of last live birth, number of children ever born, age, educational status and union status. For the individual sample we have made use of the detailed maternity histories, educational level, age and union status. A difficulty arises with the coding of the education questions between the two stages of the survey, as a supplementary question on literacy was asked in the individual questionnaire and the coding procedures adopted were not the same. In the household file the coding available is for the three separate questions on whether ever attended school, highest level attended and years completed at the level. Although the same questions were asked in the individual questionnaire only total number of years of schooling is available in the recoded individual file. In addition, the question on literacy was used as supplementary information in the first reort tabulations on educational status for the individual survey. This complicates some of our comparisons between the two samples by educational status. Of necessity, further minor, annoying discrepancies arise in these between sample comparisons due to differing response and other patterns. Most of the tabulations used for this study were generated specifically for this purpose, although a few were available in the First Country Report.

1.3 Techniques Used

Several of the analyses to be presented later in this study are straightforward uses of tabulations from either the individual or the household parts of the survey. Whilst such analyses are useful, it is a major aim of this study to present other approaches which do not necessarily treat the data used as being entirely correct. These approaches to the analysis of demographic data, which usually take some part of the data as being more likely to be correct than others and often make further simplifying assumptions or use models, are usually broadly referred to as indirect estimation techniques. Many of these techniques have appeared in recent years and several of them are due to Brass. We shall only be concerned with those approaches which have been devised for the analysis of data on fertility levels and trends. Perhaps the most widely used of these techniques is Brass' P/F ratio technique for relating current and retrospective information on fertility to improve the estimate of current fertility. More recently Coale, Hill and Trussell (1975) have produced a technique for examining fertility by marriage duration rather than age, and Brass has suggested procedures for estimating current total fertility from order specific rates. Brass has also begun to develop similar approaches for dealing with data from maternity histories to attempt better estimation of fertility trends. All of the techniques mentioned so far are of particular interest because they avoid taking the available data at face value and try to 'correct' for errors. Such 'corrective' procedures inevitably require rather strong assumptions, for example of constant fertility in the recent past. In many third world countries there is now

incontrovertible evidence of recent and sustained fertility declines, which renders these techniques unusable for corrective purposes. However, these techniques are still valuable as diagnostic tools, even when the basic assumptions required for their use as corrective procedures are violated. Another type of indirect estimation procedure, which is especially useful for data of fairly high quality, is the 'own-children' technique. This uses several pieces of information to obtain estimates of recent time trends in fertility, but involves no 'corrective' element as the data used are taken largely at face value, although some attempt at correction has been introduced in a few applications. Another approach which utilises data at their face value is to use reported proportions pregnant to obtain estimates of current fertility. Proportions pregnant could be used in an approach similar to Brass' original technique, although no procedure for this has yet been elaborated. It is often valuable to be able to assess the quality of data even when no corrective technique exists to adjust for the patterns of error so identified. An area where we are still at this purely diagnostic stage by and large is that of analysis of maternity history data. Examples of such diagnostic analyses will also be presented.

One great advantage of a data source such as the World Fertility Survey, especially when both household and individual samples are available, is the ability to compare and contrast the estimates from the various techniques and from the two sources. Contrasts of this type will constitute an important part of this study. It should be stressed at this point that it was not always the individual respondent who gave the information about herself at the household survey. Important differences appear between women who were self reporting in the household survey and those who were not.

1.4 Matched Data Files and Consistency Checks

Another kind of assessment of data quality has been mentioned earlier. The ability to match the women interviewed in the individual sample to the responses given by or about them on the household survey permits several checks to be made for bias in the second stage selection procedure. It is unfortunate that the non-responding women at the individual stage are not identifiable, as this would allow direct study of any biasses. Even so, it proved possible to get useful but incomplete evidence on at least some aspects of bias. The matched files are also extremely useful for checking the consistency of responses which gives clues about the quality of the data.

Before presenting any of the results from comparing the household and individual responses for those women who could be matched, it is essential to give some more background material on the field procedures, to establish the degree of independence of the two sets of responses. Colombia used an extended household sample, with the individual sample only forming a fraction of all eligible women. This sub-sample was selected in the field, with the selection taking place within each segment. Segments averaged ten households, with an average of about 13 eligible women. In most cases the selection was done by the supervisor, but in remote rural segments was occasionally entrusted to the interviewer. The selection procedure involved listing eligible women in ascending order of age and taking a systematic sample with random starting point. The sampling fraction was quite variable, ranging from 1 in 1 to 1 in 14.6, with the most common value being 1 in 2.6. Whilst the two interviews (with the household and the selected individuals) were nominally independent, there clearly is possibility of contamination of reports between the two sources, with the most likely possibility being revision of the household responses in the light of the more detailed responses given at the individual interviews. Some suggestion of the degree of such contamination can be gleaned from studies of the differences between the reports of those women who were administered the individual interviews and the rest, especially with regard to data quality. In sections 2.1 and 2.2 we present results making these contrasts for current fertility and reported women (those who were individually interviewed) having higher average fertility reported in both sources than the once reported group. It is impossible to tell whether this is due to upward revision of the household reports as a result of discovering missing births at the individual interview or a selection bias resulting from selective non-response among lower fertility women who were less likely to be available for individual interview. There is some evidence of such selection bias, although it does not appear to account for the whole discrepancy.

A further aspect of the field procedures is that the household response could be made by any person aged 18 or more who was not a domestic servant. Thus, for many eligible women, the household reports were made by proxies rather than by the women themselves. In general we would expect a higher response consistency between the two interviews for those who were self-reporters at the household interview. This does prove to be the case but only becomes apparent when results are disaggregated by age, owing to the extreme difference in age composition between self-reporters and women for whom proxies reported at the household survey. Table 1.1 shows the percentage of self-reporters by age and, by implication, evidence of a small selection or non-response bias involved in the women interviewed at the individual survey, in terms of the degree of self-reporting at the household survey. Table 1.2 shows the strong association between degree of self-reporting and fertility, with women with recent births and of higher parity being more likely to have self-responded at the household survey. Proxy reporting is also more likely for the young, unmarried and the employed.

We now proceed to a brief examination of the consistency of reporting for those women who were twice-reported, distinguishing between self and proxy reported women at the household interview. The first variable we shall examine is age (in five-year groups) which is used in most of our tabulations: Table 1.3 shows the degree of consistency for the self and proxy reported women. It is clear that the two reports differed more frequently for the proxy reported women and that the direction of change was toward the women reporting higher ages at the individual survey than did their proxies at the household survey. In other words the proxy reports of age were downwardly biassed relative to those reported by the women themselves. The degree of variability in these reports is somewhat surprising with between 5 and 17 per cent of the self-reporters changing their responses, although in an unbiassed fashion for five year groups (except at the two extreme

Table 1.1. Percentages Self-Reporting at Household Survey

Age at Household Survey	Percentage Self-Reporting in Entire Household Sample (Weighted)	Age at Individual Survey	Percentage Self-Reporting Among Individual Interviewees (Unweighted)	Individual Interviewees by Union Status		
				Single	In Union	Widowed, Divorced, Separated
15-19	32.3	15-19	31.5	25.3	69.1	51.5
20-24	55.5	20-24	57.0	32.9	77.5	61.7
25-29	66.4	25-29	69.4	37.1	80.2	65.1
30-34	75.8	30-34	78.4	45.6	84.6	66.1
35-39	74.7	35-39	79.2	53.5	84.4	74.1
40-44	71.0	40-44	73.7	40.5	78.7	69.2
45-49	71.0	45-49	71.9	48.6	72.2	80.2

Table 1.2. Percentages Self-Reporting at Household Survey Among Women Interviewed at Individual Survey

Children Ever Born	Percentage Self-Reporting	Birth in Previous Year	Percentage Self-Reporting
0	32.0	YES	78.1
1	68.2	NO	56.8
2/3	76.5		
4+	81.2		

Table 1.3. Consistency of Age Reporting (Percentage Distributions)

Difference in Five-Year Groups*	Age Reported at Individual Survey							
	ALL	15-19	20-24	25-29	30-34	35-39	40-44	45-49
Proxy Reported at Household								
-2 or more	1.0	—	—	0.0	3.1	2.5	6.4	6.3
-1	6.3	—	6.7	11.8	17.8	12.5	12.1	19.3
0	87.5	96.1	87.0	81.2	72.9	80.0	69.4	74.6
+1	4.8	3.5	5.8	5.9	5.4	5.0	12.1	—
+2 or more	0.5	0.4	0.4	1.2	0.8	0.0	—	—
Self-Reported at Household								
-2 or more	0.5	—	—	0.0	0.6	0.7	1.2	2.0
-1	5.1	—	4.4	5.4	5.4	5.0	10.1	7.5
0	89.7	94.6	91.7	89.3	86.7	89.9	83.6	90.4
+1	4.2	4.1	3.7	4.1	7.1	3.7	5.2	—
+2 or more	0.6	1.4	0.2	1.2	0.2	0.7	—	—

*Reported age-group in household survey minus reported age-group in individual survey.

Table 1.4. Consistency of Responses on Number of Children Ever Born (Percentage distributions).

Age at Individual Survey	Proxy Reported at Household			Self-Reported at Household		
	More on Household	Same on Both	More on Individual	More on Household	Same on Both	More on Individual
15-19	0.3	99.6	0.1	1.8	97.3	0.9
20-24	1.1	97.1	1.8	1.0	98.3	0.7
25-29	2.8	92.2	5.1	2.2	96.5	1.3
30-34	4.7	87.6	7.8	2.8	95.1	2.1
35-39	6.7	80.8	12.6	6.4	90.1	3.5
40-44	8.1	79.0	12.9	6.6	88.2	5.2
45-49	12.3	71.1	16.7	6.6	89.0	4.4

ends of the age-range), and between 4 and 31 per cent of the proxy reports being changed. Florez and Goldman (1980: Table 1) show for the entire sample that between 27 and 48 per cent reported different ages in terms of single years of age between the two sources.

We now turn to consistency of responses at the individual level in terms of the fertility variables used in this study. Table 1.4 shows this consistency for reported numbers of children ever born. With the exception of the 15-19 year olds, the proxy reported women exhibit lower consistency of response and a tendency to report slightly more children on the individual survey. Such a bias in reporting does not appear to exist when the women are self reporting on both occasions — if anything the older women reported slightly fewer births at the individual interview on average. Table 1.5 shows the degree of consistency of date of the most recent live-birth in terms of whether or not it was attributed to the period one to twelve months prior to the interview. The proxy reported woman again exhibit lower response consistency (actually quite substantial as births are relatively rare events) although there is no evidence of a relative bias in the responses in this instance. Slightly more dates were not stated for proxy reported women. Table 1.6 shows the degree of consistency of the reported date of the most recent live-birth between the two interviews. Yet again the responses of the self reporters are more consistent and there is a tendency for the date to be reported as *slightly* more recent on the

individual survey especially at the higher ages and among women for whom proxies reported at the household survey. The small differences in the category termed "rest" arise mainly from there being a slightly larger number of discrepant reports of zero parity on one source and 1 or more birth on the other among the proxy reported women (21 as opposed to 9). In addition it should be remembered that missing or non-reported dates were imputed for the individual sample (for 8.8 per cent of all live births; not available for most recent birth only, but probably about 4 per cent judging by experience in other WFS countries — see Table 17 of Chidambaram, Cleland, and Verma, 1980). In addition, both the month and year of birth of the respondent was imputed for 3 per cent of women in the individual survey.

In general, the reports made by proxies were more likely to differ from the results of the individual interviews for the reports examined here and there do appear to be systematic directions to the differences. In particular there is a suggestion that proxies were likely to underreport parity slightly on average and to report slightly more distant dates for the most recent live-birth, although this latter is complicated by a similar but less marked tendency among the older self-reporters.

Table 1.5. Consistency of Responses on Date of Last Live Birth with Respect to Period One to Twelve Completed Months Before Interview

(Percentage distributions)

Age at Individual Survey	Proxy Reported at Household				Self-Reporting at Household			
	Consistent Responses	Birth in Period: Household Only	Birth in Period: Individual Only	Not Stated on Household	Consistent Responses	Birth in Period: Household Only	Birth in Period: Individual Only	Not Stated on Household
15-19	99.4	0.4	0.2	0.0	98.2	0.7	0.9	0.2
20-24	96.7	1.1	1.6	0.7	97.6	1.0	1.2	0.2
25-29	96.5	1.2	1.6	0.8	97.0	1.2	1.7	0.0
30-34	91.5	2.3	2.3	3.9	96.6	1.1	1.5	0.9
35-39	92.5	1.7	0.8	5.0	96.1	1.3	1.1	1.5
40-44	96.7	0.0	1.6	1.6	97.7	0.6	1.1	0.6
45-49	93.9	0.9	0.9	4.4	97.6	0.3	0.0	2.1

Table 1.6. Consistency of Reports of Date of Most Recent Live Birth

(Percentage distribution)

Age at Individual Survey	Consistent Responses	<1 year H > I	Diff. I > H	Exact 1 H > I	Year Diff. I > H	>1 Year H > I	Diff. I > H	Rest	Total H > I	Discrepant I > H
Proxy Reported at Household										
15-19	98.3	0.3	0.5	0.3	0.1	0.0	0.1	0.3	0.6	0.7
20-24	89.5	3.6	1.3	0.7	1.3	0.4	1.1	2.0	4.7	3.7
25-29	78.8	7.1	4.0	2.7	2.0	1.2	2.4	2.0	11.0	8.4
30-34	68.2	5.5	3.9	3.9	5.4	3.9	3.9	5.5	13.3	13.2
35-39	60.8	5.0	10.8	6.7	4.2	2.5	4.2	5.8	14.2	19.2
40-44	53.3	6.4	9.6	1.6	7.3	6.4	10.4	4.8	14.4	27.3
45-49	59.6	6.1	12.2	3.5	4.4	4.4	3.6	6.2	14.0	20.2
All	85.6	3.0	3.0	1.5	1.8	1.2	1.8	2.0	5.7	6.6
Self-Reporting at Household										
15-19	95.7	0.4	0.7	0.7	0.5	0.0	0.5	1.5	1.1	1.7
20-24	88.2	2.6	4.7	1.3	1.7	0.6	0.5	0.4	4.5	6.9
25-29	83.6	4.0	4.5	1.4	3.6	0.7	2.1	0.2	6.1	10.2
30-34	79.2	5.3	6.6	1.9	2.8	1.3	1.9	0.9	8.5	11.3
35-39	74.4	5.3	6.1	2.9	4.4	2.0	3.3	1.7	10.2	13.8
40-44	69.0	6.3	6.9	5.2	5.2	1.7	5.2	0.6	13.2	17.3
45-49	64.4	3.1	7.9	3.1	7.2	5.8	6.5	2.1	11.9	21.6
All	80.8	3.8	5.2	2.1	3.3	1.4	2.4	0.9	7.3	10.9

2 Estimation of Current Fertility Levels

2.1 Direct Estimates

The various questions asked on the two surveys permit several estimates to be made which are approximate measures of current fertility. On the household questionnaire the date of the last live birth was asked for all women aged 15 and over. From this information, it is possible to obtain an estimate of the numbers of live births in the year prior to the interview and to relate these to the numbers of women in the various age-groups at the time of the interviews. It should be noted that fertility rates so calculated are for the year prior to interview, but that the ages of the women are those reported at the time of interview. Thus, the rates so calculated actually refer to age-groups approximately six months younger on average. A similar set of rates can be derived from the maternity history information obtained at the individual interviews.

In addition, the respondents were asked whether they were currrently pregnant at the individual survey and for the duration of such pregnancy where appropriate. Again these responses can be related to the numbers of women who are in the various age-groups to give estimates of fertility rates at a short time after the survey. As it is unlikely that women will always be aware that they are pregnant during the early stages of pregnancy and foetal loss rates are high in early pregnancy, it is sensible to restrict analyses of this type to using pregnancies with reported duration of 4 months or more. It is obvious that any rates so derived will refer to ages which are slightly above those recorded at the survey, the exact amount depending upon the particular range of pregnancy durations utilised.

Whilst every attempt was doubtless made to obtain the most accurate responses possible, under the time and resource constraints imposed, it is unreasonable to presume all responses were accurate. There is a substantial body of evidence to indicate that respondents have difficulty in dating events, including their own birth, especially in those societies where dates of events or ages are not very important. Thus it is certain that ages of the women were not always correctly reported and that the dates of their most recent live-births were inaccurately reported at least in some cases. The information presented in Section 1.4 strongly suggests that errors exist and also suggest bias in date reporting. Errors of dating can and often do lead to erroneous estimates of current fertility from direct estimation procedures such as those outlined above. This is especially true when the dating errors for the date of last live birth, or reports of whether a child was born in the year preceding a census or survey, are biassed towards a shorter or longer reference period on average. Whilst an average bias does not always exist, there is ample evidence that it quite often does. Errors of dating are also likely to be frequent in reporting durations of pregnancy and a bias in the average reported duration would again lead to erroneous estimates of current fertility. It is therefore clear that these estimates of current fertility should be treated with caution without further supporting evidence, which may come from internal consistency checks, but is likely to be more useful if from another source.

Table 2.1 shows several estimates of current fertility from the individual and household surveys of the ENFC, including an indirect estimate derived from the own-children approach, which is described in Section 3.2, as well as the estimates discussed above. This is an opportune moment to introduce some more comparisons permitted by the matching of the two surveys. For the women who were interviewed in the individual survey, we can obtain estimates based on the responses given on their behalf in the household survey. These estimates are based on unweighted tables as the individual sample was self-weighting, whereas those for the household are more correctly based on the weighted tables, as here. This presents a minor difficulty if we wish to examine the estimates of current fertility that would be obtained from the responses relating to the women who were not subsequently interviewed in the individual survey, or the once reported women. To obtain such estimates we used the following simple procedure. The numbers of once reported women involved in a sub-group were obtained by subtracting the unweighted number of individual interviewees (to reflect their probability of selection, subject to adjustment by the overall sampling fraction) from the weighted numbers from the entire household sample (again reflecting their probability of selection except for the overall sampling fraction). Similarly the number of events attributable to these once-reported women were obtained by subtraction. The ratios of the estimated events to the estimated numbers for a group of women then gave the estimate of the measure in question (whether current fertility as here, or average parity as used later). If there were no non-contact or non-response at the individual interview this procedure is theoretically correct. Insofar as this is not the case there may be minor biasses involved, as the individual realised sample may not be completely self-weighting. As we have no way of identifying the selected sample we cannot improve on this procedure here. As a result of this procedure the once-reported group of women are correctly given more extreme weights (in the sense of departures from unit weights) than the entire household sample, to allow for the removal of the self-weighting sample of twice-reported women (i.e. the individual respondents).

Table 2.1. Estimates of Current Fertility from ENFC 1976

Age at Survey	Household Survey: Births in Previous Year: All Women (Weighted)	Household Survey: Births in Previous Year: Individual Interviewees (Unweighted)	Household Survey: Births in Previous Year: Once-Reported* (Adjusted)	Household Survey: Own-Children (Weighted)	Individual Survey: Births in Previous Year from Maternity Histories	Individual Survey: Twice Proportion 4 to 9 + Months Pregnant	Individual Survey: Thrice Proportion 4-7 Months Pregnant
15-19	.072	.070	.074	.073	.063	.078	.090
20-24	.213	.208	.216	.205	.204	.178	.186
25-29	.203	.208	.199	.199	.209	.216	.225
30-34	.175	.186	.167	.183	.182	.154	.135
35-39	.134	.149	.123	.127	.136	.058	.054
40-44	.057	.075	.043	.039	.076	.040	.036
45-49	.020	.013	.025	—	.025	.000	.000
Total Fertility	4.370	4.545	4.235	4.130	4.475	3.620	3.630
Total Fertility 15-29	2.440	2.430	2.445	2.386	2.380	2.360	2.505
Total Fertility 30-49	1.930	2.115	1.790	1.744	2.095	1.260	1.125
Total Fertility from unweighted sample	(4.140)		(3.870)				

*See text for method of adjustment

The effect of using the weights in the estimates of fertility from the household survey for either all women or those not subsequently interviewed at the second stage is to raise fertility estimates compared with the unweighted figures, partly because of over-representation of urban areas and the educated in the household stage of the sample. An indication of the magnitude of the effects of weighting is given at Table 2.1, showing a rise in the total fertility estimates of 0.23 for all women and 0.36 for the once-reported group of women.

From Table 2.1 we notice several things about the various estimates of current fertility. The estimates are all in quite close agreement in terms of the contribution to total fertility of the age-range 15-29, although the differences in age at childbearing between the retrospective reports and the reports on pregnancy status should not be forgotten. The estimates based on proportions reporting current pregnancy are not consistent with other estimates, suggesting that women are under-reporting current pregnancies, especially at the higher ages (see Hanenberg, 1980 and Goldman and Westoff, 1980, for fuller discussions of results on proportions pregnant for a wide range of WFS surveys). The main differences between the various estimates arise in the age range 30-49, with the contributions of total fertility being quite disparate. The other interesting feature of Table 2.1 is the contrasts that can be made between the individual survey and the different groups of respondents on the household survey. There is some evidence that the women not subsequently interviewed in the individual survey were reporting lower current fertility than those who were subsequently interviewed. This difference is somewhat puzzling and seems to suggest a small bias in the selection procedure, or at least in the group who finally responded to the individual interview. An alternative possibility is that the interviewers adjusted the responses recorded in the household survey in the light of the responses given at the individual interview. The field procedures were designed to obviate either of the aforementioned biases occurring.

It has been argued that the intensive maternity history interview used in the individual survey should provide more accurate estimates of fertility than the simpler question on date of last live-birth used in the household survey (see Marckwardt, 1975). For current fertility in Colombia this is clearly not the case, with the same individuals giving very much the same average current fertility rates in either interview. This is perhaps surprising, because the individual woman was of necessity the respondent at the individual interview whereas a proxy may well have responded on her behalf at the household survey. There is some evidence from other sources that proxies tend to report lower fertility on average than do the women themselves (Marckwardt, 1973). Table 2.2 shows evidence on the effects of proxy reporting for ENFC. In this case there is some evidence that the proxies under-reported the women's fertility on average. The evidence presented in section 1.4 is a clearer demonstration of the levels of bias between the two sources. Again these analyses demonstrate the advantage of having both the household and the individual survey responses available and of being able to match the two sources for the women interviewed at the individual survey. On a superficial examination of the responses on births in the last year from the household survey alone, it would have been tempting to infer that the substantial differences in current fertility

Table 2.2. Effect of Proxy Reporting on Estimates of Current Fertility (Based on Birth in Last Year) — Proportions Reporting a Birth in the Year Prior to the Survey

Sub-group: Report at Household survey by: Information from	Women Interviewed in Individual Survey (Unweighted)				All Eligible Women (Weighted)	
	Proxy	Proxy	Self	Self	Proxy	Self
	Household Survey (Proxy)	Individual Survey (Self)	Household Survey (Self)	Individual Survey (Self)	Household Survey (Proxy)	Household Survey (Self)
Age of Woman at Survey						
15-19	.025	.025	.162	.144	.030	.158
20-24	.129	.128	.257	.265	.113	.284
25-29	.126	.129	.234	.244	.128	.230
30-34	.134	.147	.194	.199	.109	.189
35-39	.153	.133	.147	.143	.098	.145
40-44	.027	.057	.085	.089	.020	.069
45-49	.000	.001	.018	.021	.015	.022
Total Fertility	2.970	3.100	5.485	5.525	2.565	5.485

levels between the self-reporters and the proxy reports were due to the very fact of proxy reporting. However the availability of the individual interview with these same women makes such a conclusion untenable. A comparison of the first two columns of Table 2.2 suggests that the differences arise mainly through the women for whom the proxy reports were made being different in fertility related characteristics, such as urban/rural residence, work status. The women for whom proxy reports were made were also younger on average, but this should not unduly affect our comparisons on current fertility as we are controlling for age.

2.2 Current Parity

The other direct information on fertility comes in the form of the stock element, as opposed to the previous information on flows. In both the household and individual rounds of the survey questions were asked regarding the total numbers of children ever borne by women. Table 2.3 presents the average reported parities by age-group of mother, with similar adjustments to those described in the previous section being carried out to get the estimates for the remainder group, namely those who were not included in the individual interviews. Again there is quite strong evidence that such reports of numbers of children ever born are subject to reporting errors, especially at the higher ages, and that on occasion these reports can be subject to an average bias, which is usually thought to be a downward one. Once again there is little indication that the much more detailed maternity history used at the individual survey was more successful in obtaining achieved parity than the much simpler questions used on the household survey, with the estimates from the two sources being essentially the same, provided that proper weighting procedures are used. Table 2.4 presents the evidence about the effects of proxy reporting on average parity estimates by age of mother. Again there is no strong indication that the proxies were reporting fewer births on average than did the women themselves at the individual interview, although the individual level analyses presented in Section 1.4 gave an indication of such a bias. This is a somewhat surprising finding, which suggests that quite simple questions, even when answered by proxies, are quite effective at eliciting information on average parity, at least in Colombia with high quality field-work. The two-wave procedure used in many of the countries participating in the World Fertility Survey provides a unique opportunity to examine whether such a conclusion holds for a wide range of countries, which would have important implications for the procedures used to obtain estimates of fertility. It would be surprising if this result were replicated for all countries, especially those where data quality is generally poorer than for Colombia. In addition, it was clear from the information presented in Section 1.4 that the individual responses were not especially highly consistent, even for women who self-reported at the household survey and that there are some small average biasses in proxy reports.

Table 2.3. Average Reported Number of Children Ever Born, by Age of Mother, ENFC 1976

Age at Survey	Household Survey			Individual Survey (Unweighted)
	All Women (Weighted)	Individual Interviewees (Unweighted)	Once-Reported (Adjusted)	
15-19	0.17	0.17	0.17	0.17
20-24	1.11	1.12	1.10	1.10
25-29	2.46	2.43	2.48	2.44
30-34	3.92	3.97	3.88	4.05
35-39	5.27	5.16	5.35	5.04
40-44	6.33	6.24	6.40	6.08
45-49	6.60	6.75	6.50	6.74

*See text for method of adjustment.

Table 2.4. Effect of Proxy Reporting on Estimates of Current Average Parity

Sub-group: Report at Household Survey by:	Women Interviewed in Individual Survey (Unweighted)				All Eligible Women (Weighted)	
	Proxy	Proxy	Self	Self	Proxy	Self
Information from:	Household Survey (Proxy)	Individual Interview (Self)	Household Survey (Self)	Individual Interview (Self)	Household Survey (Proxy)	Household Survey (Self)
Age of Woman at Survey						
15-19	.07	.07	.40	.37	.08	.36
20-24	.61	.56	1.52	1.52	.57	1.56
25-29	1.44	1.44	2.90	2.89	1.53	2.93
30-34	2.95	2.88	4.27	4.36	2.67	4.33
35-39	4.00	4.09	5.46	5.29	3.97	5.73
40-44	5.68	5.23	6.42	6.40	5.87	6.53
45-49	6.37	6.58	6.89	6.79	5.85	6.92

2.3 Brass' Adjustment Procedure

Although the estimates of fertility, both in terms of the flows based on reports of births in the previous year and in terms of the stocks based on reports of achieved parity, are remarkably consistent between the two waves of the ENFC, this similarity may simply reflect similar reporting biasses at each wave. Brass (see Brass, 1975) devised a simple technique which attempts to test the mutual consistency of the stock and flow estimates. This technique is predicated upon an assumed constancy of fertility in the fairly recent past. This is clearly not the case in Colombia, where there has been a substantial fertility decline in recent years. Despite this obvious problem we shall proceed with this technique as an illustrative example and point out the resulting indications of recent fertility decline. In other words we shall use Brass' technique as a diagnostic rather than corrective procedure. The second crucial assumption of Brass' technique is that the age-pattern (but not necessarily the level) of current fertility is correct. This assumption cannot be tested within the technique, but is quite important, as the adjustment procedure (when used correctively) simply scales the current fertility flow estimates by a single adjustment factor based on the comparison of current and retrospective reports (or flows and stocks). Thus the assumed pattern of error is that women in each age-group are equally likely to estimate incorrectly the length of the year prior to the survey and the aim of the procedure is to obtain an estimate of the average bias if any. As will be shown later, when fertility differentials by education are examined, Colombia has experienced substantial changes in the proportions of each cohort which received education in recent years. Thus the older cohorts contain a much higher proportion of illiterate or minimally educated than do the younger ones. Such changes are likely to mean that any average error in the length of the reporting period for current fertility is likely to be greater for the older cohorts in Colombia. Whilst we shall bear this problem in mind during any attempt to interpret the results we obtain using Brass' procedure, there is little or nothing that can be done to correct for such effects if they exist, or even explicitly to demonstrate their existence. It is always worth examining evidence on changing educational composition for the relevant cohorts, as we do in Section 3.1.

The main aim of Brass' procedure is to provide a means of comparing the estimates based on fertility in the year prior to the survey (often referred to as current fertility) and the estimates based on average reported numbers of children ever born (often retrospective fertility). Under the two crucial assumptions of constant fertility and equal reference period error for all ages, it is possible to convert the current fertility estimates into average parities that would be achieved by a group of women experiencing these rates throughout their reproductive lives. Thus, for example, women who were aged 25-29 at the time of the survey would have experienced five years of fertility at the rate recorded for the 15-19 group (who were on average 14½-19½ exact years at the time of childbearing given that the current fertility rates are based on reported births in the previous year: of course the 14½-19½ becomes an approximation if women are reporting events for a period longer or shorter than a year); five years at the fertility rate of the group who were 20-24 at the time of the survey and thus approximately 19½-24½ when the children were born (on average); and an appropriate fraction of five years at the fertility rate of the group who were on average 24½-29½ at the time of childbearing (25-29 at the survey). (Note that we are treating ages as being accurately recorded in this discussion, whereas it is highly probable that there will have been some misstatement of ages in the survey. Again we can only draw attention to this problem without being in a position to correct for any effects of age-misstatement: for a discussion of the possible biasses introduced by errors in age-reporting see the Appendix to Chapter 3 of The Demography of Tropical Africa by Van de Walle, Brass et al., 1968.) Brass' contribution to this problem was to provide a means for estimating the relevant fraction of five years, for each of the five-year age-groups, which would lead to the estimates of average parity derived from the current fertility distribution being directly comparable with the reported parities. The exact proportion clearly depends upon the shape of the fertility distribution. To simplify the procedure Brass used an approximate function for the fertility schedule, taking fertility as a cubic curve with age, namely

$$f(x) = c(S+x)(33+S-x)^2 \text{ for } S \leq x \leq S+33$$

where $f(x)$ denotes fertility at age x and S is the starting age of fertility, with c being an arbitrary constant (see Feeney, 1978 for further details). Table 2.5 shows the estimates of the appropriate fractions for each of the five-year groups for a variety of values of S, the only free parameter in the model, at least as far as determining the shape of the fertility curve. Brass suggests that the value of S be determined for the first three five-year age-groups by use of the ratio of the fertility rate at 15-19 to that at 20-24 (f_1/f_2), as the early shape is better determined by this ratio, and by the mean age-groups on the value of f_1/f_2 as the fitting index, ($m = S + 13.2$). This is equivalent to assuming that the cubic function can be fitted separately for the first three age-groups on the value of f_1/f_2 as the fitting index, and for the remaining age-groups using $\overline{m}$ as the fitting index. Because the fertility curve is usually approximately horizontal aroung age 30 the two fits splice together reasonably, at least in terms of the allocation for, say, the 30-34 group.

Table 2.6 shows the application of Brass' technique for ENFC, 1976. The values w_i are the fractions along the relevant age-group to give equivalent average parities derived from current fertility on the basis of Brass' cubic curve, using the value of f_1/f_2 to interpolate linearly in Table 2.5 for the first three groups and m (calculated remembering that the women were on average about half a year younger at the time of the births included in the current fertility values which are based on reported births in the previous year) for the remaining four groups, again interpolating linearly. Thus we can obtain the estimates, F_i, of cumulative fertility if current (or last year) rates were to apply over time. For example, for the 25-29 age-group, women would have spent five years childbearing in the 15-19 and 20-24 groups, giving the 1.425 average fertility and are then estimated to have spent an average of 3.012 further years childbearing at the 25-29 age-group rate by the time of the survey.

Table 2.5. Table for Estimating Cumulative Fertility from Age Specific Fertility Rates
When $f_0 = 0$,
f_1 = Age-Specific Fertility Rate for Ages 14.5-19.5,
f_2 = For Ages 19.5-24.5, etc.

Multiplying Factors k_i for Estimating the Average Value over 5-Year Age Groups of Cumulative Fertility, F_i, According to the Formula

$$F_i = 5\sum_{j=0}^{i-1} f_j + k_i f_i$$

Age Interval (i)	Exact Limits of Age Interval	Multiplying factors k_i for Values of f_1/f_2 and $\bar{m}$ As Indicated in Lower Part of Table							
1	15-20	1.120	1.310	1.615	1.950	2.305	2.640	2.925	3.170
2	20-25	2.555	2.690	2.780	2.840	2.890	2.925	2.960	2.985
3	25-30	2.925	2.960	2.985	3.010	3.035	3.055	3.075	3.095
4	30-35	3.055	3.075	3.095	3.120	3.140	3.165	3.190	3.215
5	35-40	3.165	3.190	3.215	3.245	3.285	3.325	3.375	3.435
6	40-45	3.325	3.375	3.435	3.510	3.610	3.740	3.915	4.150
7	45-50	3.640	3.895	4.150	4.395	4.630	4.840	4.985	5.000
	f_1/f_2	.036	.113	.213	.330	.460	.605	.764	.939
	$\bar{m}$	31.7	30.7	29.7	28.7	27.7	26.7	25.7	24.7
	s	18.5	17.5	16.5	15.5	14.5	13.5	12.5	11.5

Source: Adapted from United Nations, Department of Economic and Social Affairs, 1967, p. 124.

Table 2.6. Application of Brass' P/F Ratio Technique to ENFC, 1976.
Household Survey, All Women, Weighted.

Age at Survey	Group i	Current Fertility f_i	Cumulated to Lower End of Age Group $\sum_{j=1}^{i-1} f_j$	Estimated Fraction of i^{th} Group W_i	Contribution of i^{th} Group $W_i f_i$	Parity Estimated from Current Fertility F_i	Recorded Average Parity P_i	Ratio P_i/F_i
15-19	1	.072	—	1.972	0.142	0.142	0.17	1.20
20-24	2	.213	.360	2.843	0.606	0.966	1.11	1.15
25-29	3	.203	1.425	3.012	0.611	2.036	2.46	1.21
30-34	4	.175	2.440	3.114	0.545	2.985	3.92	1.31
35-39	5	.134	3.315	3.238	0.434	3.749	5.27	1.41
40-44	6	.057	3.985	3.493	0.199	4.184	6.33	1.51
45-49	7	.020	4.270	4.339	0.087	4.357	6.60	1.51
			4.370					

$f_1/f_2 = 0.388$; $\bar{m} = 28.93$.

Thus $F_3(25\text{-}29) = 5(f_1+f_2) + 3.012f_3$
$= 1.425 + 0.611 = 2.036$

The first thing that even the most casual glance at the last three columns of Table 2.6 reveals is the substantial differences between the average recorded parities, which are based on actual past childbearing experience and the estimated current equivalent parities based on the reported births in the previous year. The pattern of the P/F ratios is quite different from that which would be observed if the basic assumptions of the technique held. The assumptions are of constant past fertility, a constant reference period error for reported births in the previous year and that parities of younger women are likely to be reported more completely than those of older women due to omissions of some births by these older women, perhaps of children who died very young or of those who have left home. These assumptions should lead to the P/F ratios being approximately constant for the first three age groups, at a value equal to the reciprocal of the average reference period error, and then declining steadily with age. The value for the first age-group is often out of line with the older groups for several possible reasons including: sensitivity to early shape of the fertility distribution which is not always adequately captured by the cubic used by Brass; sampling errors because of small numbers of births; and effects of age-misstatement leading to the average reported parity being especially high and thus the ratio being too high. Adoption may also affect this age group. The effects of changing educational standards over time would tend to produce average reference period errors which departed more from being one year with increasing age and thus would lead to a relative increase in the P/F ratios with age where the average reference period was less than a year and vice-versa. Finally, declining fertility would lead to P/F ratios over unity and increasing steadily with age, as the older cohorts would have experienced progressively more of their childbearing during earlier times of higher fertility.

The pattern of P/F ratios exhibited for Colombia is clearly consistent with the possibility of a substantial recent decline in fertility, although there is also some possibility that some of the increases with age are due to the effects of improving educational standards for recent cohorts, with the reference period being progressively taken as a smaller fraction of a year with increasing age. As we shall show later, there is strong evidence for a substantial fertility decline in recent years in Colombia, but there is also strong evidence of improving educational standards over time. What is clear, though, is that the basic assumptions required for a corrective technique cannot apply here and that the Brass technique gives no further information on whether or not the reported current fertility and average parities are accurate or not, and certainly provides no possibility of correcting either in this case.

2.4 Educational Differentials

Table 2.7 presents information on current fertility, based on reported births in the year prior to the survey, average reported parity and the results of applying the Brass P/F ratio technique for each of five educational groups for the household survey. Table 2.8 gives the proportions with a live birth in the previous year and average reported parity by educational level for the two major sub-groups of respondents to the household survey, namely those subsequently interviewed in the individual survey and the remainder, again with approximate adjustments to give population estimates (see Section 2.1 for more details of the adjustment procedure used), and also for the responses given at the individual survey. There is no point in repeating the P/F ratio calculations for each of these three further cases here, as the results are generally quite similar to those using all household responses, given at Table 2.7, although we would find such comparisons of interest if there were grounds for believing that the assumptions of Brass' technique were approximately satisfied, so that comparisons of the estimated reference period errors and the adjusted fertility estimates could throw some light on relative errors.

The first observation to be made about Table 2.7 is to stress the huge differentials in recorded fertility, both in proportions with births in the year prior to the survey, or current fertility, and in average parity. Once more we should be cautious about taking these reported levels at face value, owing to the possibility of errors in the data, especially the quite likely event of greater errors for the less educated groups. Nevertheless it is extraordinarily unlikely that differences of the magnitude observed here arose solely or mainly through errors in measurement or through sampling errors. The availability of estimates by educational level can also throw more light on the data quality: there is clear evidence that current fertility levels reduce with increasing educational level, with total fertility falling by about one birth for each rise in category. Examination of the measured rates across the educational categories suggests one or two sub-groups for whom the recorded rates must be suspect. The 15-19 category with 1/2 years of primary education seem to have surprisingly low levels of current fertility and the P/F ratio for this group also strongly suggests the current rate and average achieved parity are seriously out of line: in this case the lack of consistency in current estimates across educational groups suggests that it is the current fertility level which is suspect. In addition the 40-44 group in the same educational category also seems to have low current fertility, perhaps due to a transfer of some women with births to the 35-39 age-group. Similarly the current rate for the 25-29 age-group in the completed primary education group is also probably low, both from comparison across age-groups and across educational groups, although the P/F ratios do not confirm this case. For the 35-39 age-group the current rates for the two least educated groups are out of line, perhaps due to the possible transfer already mentioned above. Inspection of the average parity figures also suggests some minor peculiarities. For example the uneducated group seem to show possible under-reporting of children ever born above age 35, as a comparison with the next educational group suggests; this suggestion is also based on the belief that over-reporting of average parity is very unlikely to occur. The other obvious example is that of the average reported parities for ages 40 and over in the completed primary education group, especially that for 45-49, which are relatively high. These high values may indicate a decline in fertility some time before for this educational group or, perhaps, a changing composition over time with completion of primary education some years ago only being equivalent to 3/4 years primary education for more recent cohorts, or even an overestimation of average parity at these ages. Thus from a careful scrutiny of a tabulation of this type, we can get some indications of inaccuracies in the data, some of which may arise through sampling errors, but a few of which may arise through reporting errors. We must stress that

Table 2.7. Current Fertility: Average Number of Children Ever Born and P/F Ratios, by Educational Group, ENFC, 1976 (Household Survey, All Women, Weighted)

Age	Educational Level					
	None	1/2 Years Primary	3/4 Years Primary	Completed Primary	Secondary or Above	All
			Proportions with Birth in Previous Year			
15-19	.195	.092	.098	.072	.033	.072
20-24	.329	.306	.223	.225	.138	.213
25-29	.286	.274	.230	.135	.135	.203
30-34	.242	.222	.176	.150	.108	.175
35-39	.172	.208	.144	.089	.036	.134
40-44	.078	.036	.073	.047	.028	.057
45-49	.025	.018	.007	.035	.013	.020
Total Fertility	6.635	5.780	4.755	3.765	2.455	4.370
			Average Children Ever Born			
15-19	.45	.29	.23	.13	.07	.17
20-24	1.84	1.80	1.37	1.03	.55	1.11
25-29	3.54	3.41	2.82	2.09	1.35	2.46
30-34	5.34	4.72	4.12	3.30	2.58	3.92
35-39	5.94	6.15	5.62	4.57	3.68	5.27
40-44	6.90	7.35	6.53	5.78	4.10	6.33
45-49	7.22	7.36	6.59	6.50	4.21	6.60
			P/F Ratios			
15-19	.88	1.69	1.04	.94	1.26	1.20
20-24	.95	1.36	1.21	1.03	1.00	1.15
25-29	1.01	1.21	1.22	1.11	1.07	1.21
30-34	1.11	1.16	1.25	1.26	1.38	1.31
35-39	1.02	1.19	1.37	1.43	1.68	1.41
40-44	1.08	1.30	1.42	1.64	1.74	1.51
45-49	1.09	1.28	1.39	1.74	1.72	1.51
f_1/f_2	.593	.301	.439	.320	.239	0.338
m	27.76	28.42	28.54	28.59	28.14	28.93

Note: The value of $\overline{m}$ actually is higher when based on the entire sample than is the value of $\overline{m}$ for any of the education groups. This arises from strong differences in age composition between the groups.

such detailed comparisons and comments are risky, as they involve assumptions about continuity and consistency in the underlying rates which may not hold. We must also stress that these comments and comparisons rely on the data used being of fairly high quality, and that such insights are unlikely to prove possible for poorer quality data sets, although different indications of the poorer quality are likely to be found.

We now turn to a consideration of the P/F ratios given at Table 2.7. By considering each educational level separately we remove, or at least considerably reduce, the effects of changing educational composition over time, which may well have affected the average reference period for the population as a whole. Thus explanations for a pattern of P/F ratios which are increasingly above or below unity with increasing age are extremely unlikely to be due to changing educational composition, although some residual effects could perhaps remain. For all educational groups we still observe a tendency for the P/F ratios to increase with age (ignoring age-group 15-19, which is inaccurate), although this is more so for the higher educational groups. For the least educated there is at most only slight evidence of such a rise with age and the 1/2 years primary education group is complicated by the effects of the remarkably low current fertility recorded for the 15-19 group, which affects the P/F ratios for at least the first three age-groups. Even so there does appear to be some evidence of a fall in fertility (as the most plausible explanation of steadily rising P/F ratios once educational level is controlled). There is, then, evidence of fertility decline for most educational groups, with the magnitude and duration of the decline increasing with increasing educational level.

We have used Brass' P/F ratio technique mainly as a diagnostic tool, but its original purpose was to provide a check on data quality and a means of adjusting for any errors found. We have fairly convincing evidence that the required assumptions for adjustment are not met in Colombia and thus can obtain little information about data quality or average reference period error (if any). The group nearest to satisfying the underlying assumptions is the no education group, although some of the small relative rise in the P/F ratios is probably due to the effects of under-reported average parity, which are apparent in comparisons with the remaining groups. For the no education group the P/F ratios are reasonably close to unity, perhaps suggesting little or no average reference period error for this group. If the no education group has little or no average reference period error, it is likely that this will also be the case for the more educated groups. We must stress though, that there is really very little evidence on this, owing to the failure to comply with the basic assumptions of the Brass technique.

Table 2.8 permits comparison to be made between those who were subsequently interviewed and the remainder, which allows for a partial check on any bias in the response or selection at this second stage of the sampling procedure. From Section 2.1 we already know that some differences exist, with the individual interviewers reporting higher current fertility on average than the remainder, even when appropriately adjusted to allow for the different selection probabilities. In addition the main discrepancies arose in the 30-49 age-group. For measures of current fertility, it is clear that much of the discrepancy must arise from the group with no education, where, for some reason or another, those women interviewed in the individual survey reported substantially higher current fertility than did the remainder. Table 2.9 shows the contributions to total fertility by broad age-group for each of the educational levels and for various responses and groups of respondents. (For the sake of completeness Table 2.9 also shows the estimates based on reported pregnancy status from the individual survey, although these estimates are clearly more variable and less trustworthy and are not shown at Table 2.8). It is clear that much of the difference in total fertility for the no education group is due to the differences above age 30, but there are also quite substantial differences below age 30. The one other really large difference to emerge from Tables 2.8 and 2.9, in terms of potential selection or response errors at the second stage is associated with the current fertility of the most educated group at ages above 30, where there again seems to be a positive selection towards higher current fertility in the group who were subsequently interviewed in the individual sample. It is indeed curious that these two groups, at opposite ends of the educational spectrum, should have quite substantial differences in terms of current fertility, especially above age 30, whilst the other education groups have no such apparent selection or response bias in terms of current fertility. We have been unable to find an adequate explanation for these biasses at the second sampling stage, although some may have arisen through selective non-response, perhaps especially among those for whom proxy reports were made in the household survey.

Table 2.8. Average Reported Proportions with Births in Previous Year and Average Reported Parities, ENFC, 1976, by Educational Group

Age and Educational Level	Current Fertility				Average Parity			
	Household Survey				Household Survey			
	All Women (weighted)	Remainder (adjusted)*	Individual Interviewees (unweighted)	Individual Survey (unweighted)	All Women (weighted)	Remainder (adjusted)*	Individual Interviewees (unweighted)	Individual Survey (unweighted)
None**								
15-19	.195	.189	.208	.204	.45	.46	.42	.53
20-24	.329	.301	.368	.336	1.84	1.78	1.93	1.74
25-29	.286	.287	.286	.346	3.54	3.55	3.52	3.75
30-34	.242	.204	.308	.248	5.34	5.21	5.58	5.07
35-39	.172	.141	.221	.177	5.94	5.82	6.12	6.11
40-44	.078	.050	.126	.103	6.90	7.19	6.43	6.57
45-49	.025	.038	.009	.015	7.22	7.34	7.12	7.32
Total	6.635	6.050	7.630	7.145				
1/2 Years Primary								
15-19	.092	.063	.127	.112	.29	.24	.36	.30
20-24	.306	.346	.252	.243	1.80	1.78	1.83	1.69
25-29	.274	.280	.268	.255	3.41	3.46	3.34	3.23
30-34	.222	.225	.219	.197	4.72	4.58	4.89	4.79
35-39	.208	.181	.239	.246	6.15	6.52	5.71	5.36
40-44	.036	.022	.049	.051	7.35	7.53	7.19	6.59
45-49	.018	.028	.000	.028	7.36	7.20	7.65	7.44
Total	5.780	5.725	5.770	5.660				
3/4 Years Primary								
15-19	.098	.116	.076	.070	.23	.24	.22	.19
20-24	.223	.220	.228	.219	1.37	1.37	1.37	1.49
25-29	.230	.201	.270	.227	2.82	2.78	2.88	2.62
30-34	.176	.183	.167	.186	4.12	4.24	3.97	4.33
35-39	.144	.156	.129	.101	5.62	5.78	5.10	4.80
40-44	.073	.075	.069	.077	6.53	6.55	6.50	6.35
45-49	.007	.004	.011	.032	6.59	6.60	6.57	6.49
Total	4.755	4.775	4.750	4.560				
Completed Primary								
15-19	.072	.089	.051	.049	.13	.15	.10	.13
20-24	.225	.230	.219	.213	1.03	1.04	1.01	.94
25-29	.135	.135	.133	.149	2.09	2.18	1.99	2.08
30-34	.150	.165	.129	.133	3.30	3.38	3.18	3.52
35-39	.089	.098	.078	.088	4.57	4.66	4.45	4.47
40-44	.047	.017	.096	.081	5.78	5.68	5.94	5.42
45-49	.035	.049	.016	.019	6.50	6.39	6.66	6.31
Total	3.765	3.915	3.610	3.660				
Secondary and Higher								
15-19	.033	.030	.037	.027	.07	.05	.09	.07
20-24	.138	.144	.130	.137	.55	.58	.50	.54
25-29	.135	.135	.134	.133	1.35	1.37	1.32	1.36
30-34	.108	.074	.152	.150	2.58	2.46	2.75	2.56
35-39	.036	.020	.061	.032	3.68	3.36	4.16	3.94
40-44	.028	.037	.016	.046	4.10	4.16	4.02	4.40
45-49	.013	.000	.046	.040	4.21	3.97	4.70	5.08
Total	2.455	2.200	2.880	2.825				

*See text for method of adjustment.
**Including all illiterates for Individual Survey.

Table 2.9. Contributions to Total Fertility, by Broad Age Groups and by Education Group

Age and Educational Level	Household Survey Births in Previous Year			Individual Survey		
	All Women (Weighted)	Once Interviewed (Adjusted)*	Individual Interviewees (Unweighted)	Births in Previous Year Maternity History	Twice Proportion 4 to 9+ months Pregnant	Thrice Proportion 4-7 Months Pregnant
None						
15-19	4.050	3.885	4.310	4.430	3.105	3.220
30-49	2.585	2.165	3.320	2.715	1.620	1.730
All	6.635	6.050	7.630	7.145	4.725	4.950
1/2 Years Primary						
15-29	3.360	3.445	3.235	3.050	3.775	3.460
30-49	2.420	2.280	2.535	2.610	2.220	2.220
All	5.780	5.725	5.770	5.660	5.995	5.680
3/4 Years Primary						
15-29	2.755	2.685	2.870	2.580	2.970	2.720
30-49	2.000	2.090	1.880	1.980	0.645	0.860
All	4.755	4.775	4.750	4.560	3.615	3.580
Completed Primary						
15-29	2.160	2.270	2.015	2.055	2.610	2.480
30-49	1.605	1.645	1.595	1.605	0.840	0.820
All	3.765	3.915	3.610	3.660	3.450	3.300
Secondary and Above						
15-29	1.530	1.545	1.505	1.485	1.545	1.390
30-49	0.925	0.655	1.375	1.340	0.495	0.990
All	2.455	2.200	2.880	2.825	2.040	2.540
All						
15-29	2.440	2.445	2.430	2.380	2.360	2.505
30-49	1.930	1.790	2.115	2.095	1.260	1.125
All	4.370	4.235	4.545	4.475	3.620	3.630

We can be less precise about the possible selection and response biasses associated with the reported children ever born, but there are clearly some substantial differences between the two sub-groups of the household sample, especially in the 35-39 age-group and also for other isolated instances. Again we do not have an explanation.

We now turn to the contrasts which can be made between the rates based on the two sets of responses from the individual interviewees. Unfortunately these are not completely comparable, as the classification used in the first country report for the individual survey included all illiterate women in the no education group. Thus some of the differences shown at Tables 2.8 and 2.9 arise from these different classifications. In addition there are inconsistencies of reporting between the two sets of responses. Table 2.10 summarises the various differences in reported educational status regardless of age. Tables 2.8 and 2.9 were based on the marginal distributions shown in the first two rows of Table 2.10. The extra information on literacy was only collected in the individual survey and was used as part of the educational classification in the First Country Report, which is the reason for retaining this classification here, despite the problems thus caused in comparability with the household survey. The other category which caused problems of definition is that of completed primary. For the individual tabulations in the First Country Report, the detailed responses were apparently used to include those whose highest level was primary with 5 years completed, plus those reporting any higher level of education but with 0 years completed. In order to make the household tabulations agree as closely as possible

with the individual tabulations of the FCR, this classification scheme was also adopted for the household tabulations used in this illustrative guide.

In retrospect it may have been wiser to adopt a consistent classification omitting both the literacy information and this last difficult element of the completed primary group for this report and to lose comparability with the First Country Report. The remaining classifications in Table 2.10 come from the files which are now available, noting in particular that the Standard Recode Tape for Colombia only retains an overall categorisation of years of schooling, without information on highest level reached. Of the 5,244 women who reported educational levels which were categorisable in both surveys, 84.67 per cent gave consistent reports (note that primary 6 years for the household should be an extremely small category), a further 7.03 per cent gave higher levels on the individual survey (mostly 1 higher — 5.85 per cent) and 8.30 per cent gave higher levels on the household survey (mostly 1 higher — 7.02 per cent).

These differences in categorisation by educational level clearly complicate the comparisons between the estimates of current fertility and average parity for the individual interviewees shown at Tables 2.8 and 2.9. In particular the shifting of the illiterate category into the no education group is likely to have brought about much of the apparent difference between the household and individual reports, although there is some doubt about this because the average reported parities are more consistent than the current fertility estimates. The estimates of current fertility based on proportions pregnant do not seem reliable.

Table 2.10. Variations in Educational Distribution for Women Included in Individual Interviews

Item	No Schooling	1/2 Years Primary	3/4 Years Primary	Completed Primary	Secondary and Above	Not Stated	Total
Distribution for household tabulations*	683	1003	1199	931	1550	0	5366
Individual tabulations as in First Country Report and here**	879	864	1155	893	1587	0	5378
Individual responses, taking 5 years as completed primary	635	1068	1180	893	1583	7	5366
Household responses, defining 5/6 years of primary as completed primary	566	1003	1199	864	1619	115	5366
Subset with actual responses on both							
Household (as 4 above)	566	1002	1199	864	1615	0	5244
Individual (as 3 above)	561	1039	1172	890	1582	0	5244
Agree on both	487	833	963	679	1478	0	4440

*All not stated were taken as no schooling (115 of whom 74 reported no schooling at individual interview, and 29 reported 1/2 years and rest higher).
**No schooling includes all reported illiterates.

2.5 Estimated Using Marriage Duration

Coale, Hill and Trussell (1975) proposed a technique which attempts to estimate the current age-specific fertility schedule from reported average parities by duration of marriage. The technique utilises a model of 'natural' fertility and thus presumes that there is no volitional parity-specific fertility control. Their approach then simply estimates an average level of natural fertility which is used to scale a standard schedule. We have already presented some evidence of substantial fertility declines for Colombia (and will present more in Section 3), and thus would not have any expectations of the Coale, Hill and Trussell technique working. In addition, as Table 2.1.1 of ENFC (p.11) shows, there is substantial evidence of childbearing before reported date of first union with negative first birth intervals being most frequent among those women reporting higher ages at first union. The Coale, Hill and Trussell technique supposes the great majority of childbearing to take place within marriage which also presents problems.

In view of the aforementioned difficulties we do not present results of the application of this technique here, but feel it necessary to draw attention to the technique

for those countries where its application would be more appropriate, although their number is small, given the widespread problems of defining age at entry into unions and effective union status for much of Africa, Latin America and the Caribbean. For large parts of Asia arranged marriages can also complicate the procedure and although a means of adjustment is proposed, we have doubts about the number of parameters required. Even more crucially many countries have experienced recent fertility declines, which rule out use of this approach.

2.6 Estimates Using Birth Order

Brass (1975) has suggested several methods which utilise information on fertility by birth order, although some of these are inappropriate for Colombia. The first of these approached (developed by Hill and Blacker, 1971) utilises a comparison of current first birth rates with retrospective information on proportions achieving a first birth by age at time of a survey. In essence this is similar to Brass' technique for relating current and retrospective fertility, but utilises a different approximate distribution function for first births by age (a Beta function with parameters (½, 2) rather than the (1, 2) of the all births function).

The principle of this technique is similar to that elaborated for the all birth technique, except that only first births are considered. Thus it is only necessary for first birth rates to have remained constant, which is possible even with substantial declines in marital fertility provided the age pattern at marriage is not changing. Florez and Goldman (1980) present some evidence of rising age at marriage for the more educated which would undermine the basic assumption. In addition we do not feel the model used for ages at first birth is well validated and the parameters used to estimate the multiplying factors are not accurately estimated with data for five-year age-groups owing to the very concentrated age-pattern of first births. The technique does not appear to add any especially useful insights to the Colombian data except to point out difficulties with the first birth ratio for the 15-19 group, especially for the two least educated groups. We shall return to these features shortly. The results of the application are shown in Table 2.11.

Brass (1975) also suggests two approximate formulae for estimating the average number of children who would be born to each *mother* by the end of the reproductive age-range, which he denotes by F_m. These again presume constant fertility and are thus not applicable in Colombia. These formulae were developed for use with registration data rather then survey data. As a final approach to using information on parity or birth order, Brass suggests graphical comparison of the estimated registered births by order with some reference standard, which may well be the proportions of women of completed fertility who achieved at least a given parity. Such a comparison again would presume constant fertility and is not likely to be useful when the same information on parity distribution is used for both sources as in a single survey. Table 2.12 presents the relevant information by educational level and, despite the inapplicability of Brass' approach, these figures do require comment and interpretation.

Firstly we should note that the contributions to current fertility by parity for the uneducated group are highly suspect, with extraordinarily high proportions reporting first and, to a lesser extent, second births in the year preceding the survey. Indeed such figures would be impossible for an individual cohort, but can occasionally occur for time-period measures of fertility, usually due to sudden changes in the timing of first births, as happened in the United States in 1942 (see Whelpton, 1946). It is unlikely that such timing changes occurred in recent times for Colombia, especially for the uneducated alone and we are strongly of the opinion that these very high values reflect errors in the data for the uneducated group. At this point we also have to draw attention to two points of disagreement with Brass' treatment of these and related issues. Firstly Brass (1975, p.25) clearly inclines toward the view that information on first births is more reliable as a guide to errors in the data and, in particular, that values of the current contribution to fertility of birth order 1 in excess of unity are likely to indicate exaggerated reference periods. As it is clearly the case that the contributions measured for some of the later parities are underestimates this does not seem a foregone conclusion. In addition, Brass (1975, p.28) seems to think it most likely that values for the contribution of first births to current fertility exceeding unity occur because older women claim first births in the previous year when they have not had them (it is not really clear whether Brass is suggesting omission of higher order births or invention of first births by childless women). In the case of Colombia there is little evidence of this, but on the contrary, for women with no education there is strong evidence of the rate for the 15-19 age-group being extraordinarily high at .1365 and for the 20-24 rate for second order births being very high at .1208. These excessively high rates at the younger ages suggest a tendency for the women who are least certain of their ages to be assessed by their reproductive performance, with childless women being pushed below age 15 and, perhaps, women with one child being assessed as 15-19 and those with two children as 20-24, although some of these are also taken as 15-19. This loss of childless women would inflate the rates at earlier ages and could lead to values in excess of unity. The results quoted in Section 1.4 on the tendency for proxies to report ages which were on average too young may possibly have led to erroneous non-interview of some such women. We note that Brass was aware of this possibility (1975, p.27/8). We should also note that the rates for five year age-groups by parity and educational level are subject to large sampling errors and thus exhibit some random fluctuations. Nevertheless it is clear that the variations for the uneducated group are more severe than for the remaining groups, which is not due to larger sampling errors but, presumably, greater response errors. It should also be noted that the two panels of Table 2.12 are essentially partitioning the estimated current total fertility and the reported average parity (except births of order 11 and above) for women aged 45-49, respectively. Thus, unless there are grounds for assuming near constant fertility, we should expect the two sets of estimates to be discrepant, as one refers to current or time-period fertility and the other to cohort completed fertility, reflecting childbearing over some thirty years prior to the survey. In particular the current figures are lower at higher parities, reflecting recent fertility declines.

Table 2.11. Application of P/F Technique to First Births

Age and Educational Group	First Birth Rate in Previous Year (f_i)	Cohort Cumulative Proportions with First Births (P_i)	Multiplying Factors (K_i)	Estimated Period Cumulative Proportions (F_i)	P_i/F_i
None					
15-19	.1365	.294	3.143	.429	.69
20-24	.0733	.752	3.370	.929	.81
25-29	.0065	.855	3.417	1.071	.80
30-34	.0047	.962	4.048	1.100	.87
	f_1/f_2 = 1.862	$\bar{m}$ = 21.32			
1/2 Years Primary					
15-19	.0517	.160	2.165	.112	1.43
20-24	.0754	.734	3.123	.493	1.49
25-29	.0173	.852	3.349	.693	1.23
30-34	.0072	.884	3.858	.750	1.18
	f_1/f_2 = .686	$\bar{m}$ = 22.42			
3/4 Years Primary					
15-19	.0753	.161	2.902	.219	.74
20-24	.0609	.631	3.217	.572	1.10
25-29	.0226	.806	3.429	.758	1.06
30-34	.0187	.910	4.060	.870	1.05
	f_1/f_2 = 1.236	$\bar{m}$ = 21.14			
Completed Primary					
15-19	.0456	.092	1.717	.078	1.18
20-24	.1063	.548	3.068	.554	.99
25-29	.0142	.730	3.338	.806	.91
30-34	.0217	.849	3.821	.913	.93
	fs_1/f_2 = .429	$\bar{m}$ = 22.61			
Secondary and Above					
15-19	.0268	.054	1.556	.042	1.29
20-24	.0797	.321	3.047	.377	.85
25-29	.0626	.622	3.267	.737	.84
30-34	.0105	.796	3.605	.883	.90
	f_1/f_2 = .336	$\bar{m}$ = 24.01			

Table 2.12. Contributions of Births by Order to Current Total Fertility and Proportions of Women 45-49 Achieving at Least a Given Parity, by Educational Group.

(Household Survey, All Women, Weighted)

	Educational Level					
	None	1/2 Years Primary	3/4 Years Primary	Completed Primary	Secondary and above	All
	Contributions to current total fertility by birth order*					
Birth Order						
1	1.222	.814	.902	.958	.926	.908
2	1.048	.851	.778	.932	.574	.738
3	.696	.652	.598	.405	.358	.486
4	.486	.588	.584	.392	.169	.396
5	.640	.484	.240	.284	.152	.314
6	.333	.541	.407	.266	.092	.310
7	.362	.424	.370	.120	.062	.252
8	.771	.557	.214	.032	.024	.298
9	.569	.348	.118	.086	.012	.220
10+	.524	.539	.544	.286	.103	.425
All	6.635	5.780	4.755	3.765	2.455	4.370
Parity	Proportions of Women 45-49 Achieving Given Parities or Above					
1	.937	.940	.885	.873	.824	.900
2	.873	.889	.846	.813	.779	.847
3	.851	.849	.808	.773	.634	.797
4	.780	.774	.736	.747	.542	.728
5	.690	.709	.649	.653	.412	.638
6	.642	.628	.534	.580	.321	.560
7	.534	.568	.500	.467	.244	.482
8	.474	.487	.409	.393	.168	.408
9	.384	.402	.365	.320	.115	.335
10	.343	.342	.284	.240	.053	273
Average Parity	7.22	7.36	6.59	6.50	4.21	6.60

*These values are based on parity at time of survey and whether date of last live birth was less than one year before interview by five year age-groups. As a result all births are treated as singleton births, leading to underestimates of total fertility.

Although it is difficult to draw firm conclusions from the data by parity or birth order and Brass' suggestions for evaluating such data are inapplicable due to recent sustained fertility declines, we have gained extremely useful insights into data quality, especially for those with no education. Here there may even be evidence of parity misstatement as well as the effects of apparently assigning ages on the basis of achieved fertility. Clearly the data for this no education group require treating with caution.

2.7 An Appraisal of Current Fertility Estimates

On the whole, the data from the Encuesta Nacional de Fecundidad for Colombia in 1976 seem to show a high degree of consistency and, despite some reservations about the quality of the data for the no education group, we believe good estimates can be made of current fertility. In particular, these estimates rely heavily on date of last live birth being reported accurately and the small amount of evidence we have suggests no substantial tendency to under- or over-state the length of the year prior to the survey.

A check of the reported most recent births by single months before date of interview in the household survey reveals no obvious tendency towards heaping of events on either side of 12 months before interview. There do, however, appear to be some preferred lengths of time since the most recent birth, for example at 4, 19 and 23 months before. Table 2.13 presents this information in detail.

Equally there is little evidence of deficient reporting of average numbers of children ever born, with the probable exception of the no education group. We have carried out fairly extensive checks on the sex-ratios of reported children ever born, not only for the totals, but also for the sub-groups reported as still living at home, living away from home and dead. Little evidence emerged of systematic biasses in reporting by sex of offspring, although there is slight evidence of a tendency to under-report dead female offspring. Table 2.14 gives the detailed figures.

Table 2.13. Numbers of Women Reporting at Each Month of Length of Open Interval

(Household, Weighted)

	Months Before											
Years Before	0	1	2	3	4	5	6	7	8	9	10	11
0	147	141	149	121	179	141	139	131	127	114	132	137
1	115	116	119	113	95	99	97	125	78	78	80	100
2	68	76	55	85	73	56	77	58	58	65	61	46
3	52	45	69	49	36	51	66	47	52	47	38	43
4	60	46	45	57	55	42	34	27	41	34	27	41

Such reporting errors as exist in terms of current fertility status do not seem likely to bias seriously any estimates we have made. Even so care should be taken not to be too categorical about fertility levels. On the whole, we incline towards believing that the weighted household figures for all-women are the most trustworthy for Colombia, giving a level of recent total fertility of about 4.37. Our reasons for the choice of this estimate are that such evidence as we have suggests reporting of fertility on the individual survey to be no more accurate than on the household survey, despite the more detailed questions used: that it is likely that either through selection or non-response biasses the individual sample was biassed upwards in terms of current fertility; and that the sample size for the household survey was over twice that for the individual survey, giving some gain in sampling precision. The only problem with using the estimates based on date of last live birth from the household survey is that twins or multiple births and the rare occurrence of two confinements in one year are not included. The individual survey permits study of the errors produced by these omissions, but the estimates presented earlier were based on data forced to be comparable with the household survey definitions. The effect of such omission of multiple births is to lower the estimated total fertility by about 2½ per cent from its true value, so that the best estimate we can make of total fertility in Colombia for the year prior to the survey is about 4.5. Similarly the estimates presented for educational groups would also be slightly low due to omission of multiple births and the best set of estimates of total fertility allowing for this would be 6.8, 5.9, 4.9, 3.9 and 2.5 for the educational groups used throughout this report, in ascending order of education. (We should note here that births in the previous year were actually defined as births in the twelve complete months prior to interview, thus excluding those in the month of interview as dates of interviews and events were only recorded by month, rather than for exact dates.)

Table 2.14. Reported Children Ever Born and Sex Ratios, by Education, by Age and by Whether Dead, at Home or Away

	Educational Level																	
	All			None			1/2 Years Primary			3/4 Years Primary			Completed Primary			Secondary and Above		
Age	Male	Female	Sex Ratio	Male	Female	Sex Ratio	Male	Female	Sex Ratio	Male	Female	Sex Ratio	Male	Female	Sex Ratio	Male	Female	Sex Ratio
All																		
15-19	.08	.09	.89	.16	.28	.57	.15	.14	1.07	.12	.11	1.09	.05	.08	.63	.04	.04	1.00
20-24	.57	.54	1.06	.91	.93	.98	.90	.90	1.00	.69	.68	1.01	.55	.48	1.15	.30	.25	1.20
25-29	1.31	1.15	1.14	1.80	1.74	1.03	1.80	1.61	1.12	1.54	1.28	1.20	1.09	1.00	1.09	.74	.61	1.21
30-34	2.01	1.91	1.05	2.81	2.52	1.12	2.35	2.37	.99	2.09	2.03	1.03	1.69	1.61	1.05	1.36	1.21	1.12
35-39	2.68	2.59	1.03	2.96	2.98	.99	3.12	3.03	1.03	2.91	2.70	1.08	2.40	2.17	1.11	1.81	1.87	.97
40-44	3.27	3.06	1.07	3.60	3.30	1.09	3.74	3.61	1.04	3.37	3.16	1.07	3.15	2.63	1.20	1.99	2.11	.94
45-49	3.41	3.19	1.07	3.62	3.61	1.00	3.92	3.44	1.14	3.49	3.10	1.13	3.22	3.28	.98	2.25	1.96	1.15
Dead																		
15-19	.01	.01	1.00	.00	.02	—	.01	.01	—	.01	.02	—	.00	.00	—	.00	.00	—
20-24	.06	.04	1.50	.13	.09	1.44	.08	.12	.67	.10	.04	2.50	.04	.04	—	.01	.01	—
25-29	.15	.11	1.36	.22	.18	1.22	.35	.22	1.59	.16	.11	1.45	.09	.05	1.80	.04	.03	1.33
30-34	.21	.20	1.05	.41	.42	.98	.28	.30	.93	.22	.17	1.29	.12	.13	.92	.08	.05	1.60
35-39	.40	.34	1.18	.49	.54	.91	.61	.51	1.20	.46	.29	1.59	.22	.22	1.00	.11	.09	1.22
40-44	.51	.44	1.16	.62	.54	1.15	.63	.65	.97	.55	.44	1.25	.42	.27	1.56	.16	.14	1.14
45-49	.64	.47	1.36	.83	.58	1.43	.75	.56	1.34	.66	.48	1.38	.49	.40	1.23	.22	.19	1.16
At Home																		
15-19	.07	.08	—	.12	.26	—	.13	.12	—	.10	08	—	.05	.08	—	.03	.03	—
20-24	.48	.46	1.04	.71	.71	1.00	.75	.72	1.04	.55	.61	.90	.47	.42	1.12	.28	.24	1.17
25-29	1.07	.98	1.09	1.43	1.42	1.01	1.28	1.29	.99	1.28	1.11	1.15	.97	.91	1.07	.67	.54	1.24
30-34	1.66	1.59	1.04	2.00	1.75	1.14	1.93	1.96	.98	1.78	1.74	1.02	1.50	1.44	1.04	1.21	1.12	1.08
35-39	2.04	1.93	1.06	2.08	1.92	1.08	2.26	2.15	1.05	2.16	2.12	1.02	2.03	1.73	1.17	1.54	1.64	.94
40-44	2.19	1.99	1.10	2.19	2.01	1.09	2.43	2.12	1.15	2.30	2.06	1.12	2.32	1.95	1.19	1.51	1.69	.89
45-49	1.92	1.75	1.10	1.81	1.77	1.02	2.17	1.79	1.21	2.02	1.72	1.17	2.00	2.14	.93	1.49	1.27	1.17
Away																		
15-19	.00	.00	—	.04	.00	—	.01	.01	—	.00	.01	—	.00	.00	—	.00	.00	—
20-24	.04	.04	1.00	.07	.13	.54	.07	.06	1.17	.04	.03	1.33	.03	.03	1.00	.01	.01	1.00
25-29	.09	.07	1.29	.16	.14	1.14	.17	.10	1.70	.11	.06	1.83	.03	.04	.75	.03	.04	.75
30-34	.13	.12	1.08	.40	.36	1.11	.14	.10	1.40	.09	.12	.75	.07	.05	1.40	.07	.05	1.40
35-39	.25	.32	.78	.38	.52	.73	.25	.37	.68	.30	.30	1.00	.16	.22	.73	.16	.14	1.14
40-44	.57	.63	.90	.79	.75	1.05	.68	.84	.81	.51	.66	.77	.41	.41	1.00	.32	.28	1.14
45-49	.85	.96	.89	.98	1.26	.78	1.00	1.08	.93	.81	.90	.90	.73	.74	.99	.55	.50	1.10

We must stress that it is by no means necessarily the case that estimates of recent fertility based on simple questions from household surveys are always preferable to those based on individual interviews giving complete maternity or birth histories. Colombia is unlike many other WFS surveys in two or three important respects. Firstly an expanded household sample was used, meaning that only a sub-sample was subjected to a detailed individual interview: as a result, if all other factors are equal, estimates based on the household sample have lower sampling variability. Secondly, there is little evidence of differences in quality between the two surveys, although the individual survey is probably slightly more accurate. Thirdly, the sample of women actually interviewed at the individual survey has been shown to be selective of women with higher fertility, perhaps partly as a result of differential non-response for those who were reported on by proxies at the household survey. Whatever the reason, there is a bias present for Colombia which may be avoided by using the household survey. Such a bias can arise even when there is not an extended household survey, although no possibility then arises of any part of the bias being due to the actual process of selection. For Colombia, we cannot assess whether there are biasses in the household survey, although non-contact rates were probably extremely low.

It is important to carry out the detailed comparisons we have made here wherever possible, but no prescription can be given for the outcome. Careful analysis and evaluation of the results is essential before coming to any conclusions.

3 Estimation of Past Trends in Fertility

3.1 The Effects of Changing Educational Composition Over Time

As has been mentioned before, the educational composition of the female population of Colombia has changed substantially in recent years, with 28.7 per cent of the 45-49 age-group and only 6.2 per cent of the 15-19 year olds reporting no education and, at the other extreme, 13.5 per cent of the 45-49 group and 41.0 per cent of the 15-19 group reporting secondary education or higher. In view of the changing nature of these groups and of the social status attached to more education, it seems that all the results by educational group should be treated with caution, except as indicators of the situation for the actual women, as the retrospective reports for older women reflect an era of different educational composition and the current or time-period reports reflect the varying compositions by age group. Table 3.1 shows these changes in composition in more detail. Insofar as the value of each of the educational levels has changed over time, so may have the ascribed social status of the women of each educational level. In turn this may have affected attitudes towards reproduction within educational groups, even without other change in society.

Table 3.1. Number of Women, by Age Group and by Educational Group, ENFC, 1976

(Household Survey, Weighted, All Women)

	Educational Level					
Age	None	1/2 Years Primary	3/4 Years Primary	Completed Primary	Secondary and Above	All
15-19	201	458	690	561	1326	3,235
20-24	247	386	536	414	974	2,557
25-29	267	353	443	367	579	2,009
30-34	192	305	341	242	325	1,404
35-39	284	329	329	271	252	1,464
40-44	256	233	255	163	154	1,060
45-49	283	210	209	151	133	986
50-54	269	146	185	125	94	819
55-59	215	116	141	88	58	617
15-49	1730	2274	2803	2169	3743	12,715
20-54	1798	1962	2298	1733	2511	10,299
25-59	1766	1692	1903	1407	1595	8,359

Table 3.2. Results of Assuming Unchanged Fertility, by Educational Group for Studying Possible Effects of Changing Education Composition on Total Fertility, ENFC, 1976

(Household Survey, All Women, Weighted)

		Educational Composition (Per Cent)					
Age Group	Time to Which Estimate Would Apply	None	1/2 Years Primary	3/4 Years Primary	Completed Primary	Secondary and Above	Resulting Total Fertility
55-59	Distant Past	34.8	18.8	22.8	14.2	9.4	(5.4)
25-59	10 Years Before Survey	21.1	20.2	22.8	16.8	19.1	(4.9)
20-54	5 Years Before Survey	17.5	19.0	22.3	16.8	24.4	(4.7)
15-49	At Survey	13.6	17.9	20.0	17.1	29.4	(4.5)
15-19	Future	6.2	14.2	21.3	17.3	41.0	(4.0)
Total Fertility		6.8	5.9	4.9	3.9	2.5	(4.5)

Even if total fertility levels by educational groups had remained constant in the past, Colombia would have experienced substantial fertility declines as a result of this changing educational composition. Table 3.2 gives an indication of the effects this changing educational composition would have on the evaluation of total fertility over time, by taking a series of weighted averages of the estimates of total fertility by educational group obtained from reported maternities in the year prior to the survey, inflated to allow for multiple births as outlined in Section 2.7. (By applying the weights to total fertility we are neglecting the possible impact of differential age patterns of fertility for the broad age-groups, which have varying composition by age but this will not make a large difference, and the more elaborate calculations using all the age-specific fertility rates are not warranted for this purely illustrative purpose. It should also be noted that any differential mortality by education has also been ignored.) From Table 3.2 it is clear that even had fertility levels within each educational group remained constant, there would have been a decline in total fertility from around 5.4 or more in the moderately distant past to the current value of 4.5, with prospects for a further decline to at the most 4.0 in the not too distant future. It may be expected that educational standards in Colombia will continue to rise and thus the cohorts born after those who were 15-19 at the time of the survey would be expected to have lower total fertility on average, even if there was no decline within educational groups. However, we have already seen some evidence that fertility has declined within each educational group from an examination of the P/F ratios in Table 2.7, although the uneducated present less compelling evidence than the rest. It is, of course possible that some of the decline within educational groups reflects changing internal composition and other changes in the society, such as those in educational status of husbands, the occupation structure, urban/rural residence, and costs of raising children (both economic and psychic). It is also likely that some of these changes are due to changes in volitional behaviour, particularly through changes in contraceptive usage even within educational groups. These issues, whilst crucial to an understanding of fertility change in Colombia, are beyond the scope of this illustrative analysis.

3.2 Trends from Own-Children Analysis of Household Survey Data

From the household survey it is possible to identify most children aged under 15 with their mothers. This can be done for those households where both the mother and her biological children were recorded at the household interview. Thus some children who were present in the households could not be attributed to their mothers, especially if the mother was no longer alive. Similarly some children may have already left home, especially at the older ages and may thus not be attributable to their mothers. The biological children who can be attributed to their mothers are usually referred to as 'own children'.

There are some potential problems in societies where adoption is widespread because women may identify adopted children as their own, but such biasses would be partially overcome by the usual adjustment procedures, which we shall use. From these household records it is then possible to produce a tabulation of numbers of own children at each age by the ages of their mothers, which contains substantial information about past fertility trends and patterns. For example, division of the number of children aged 8 at the survey who had mothers aged 23 to 27 at the time of the survey by the number of these mothers gives a measure (albeit biassed and incomplete) of the age-specific fertility rate eight to nine years before the survey to women aged approximately 14½-19½ at the time of birth. Figure 3.1 shows how the various quasi-fertility measures so derived relate to the ages of children and of the women at the time of the survey. All of the rates so derived refer to age-groups on average on half year younger than conventional five-year age-groups in the same way as the retrospective information on births in the year prior to the survey, discussed earlier in relation to current fertility measures. Measures derived in this way will be referred to as quasi-fertility rates to remind us that they are not true fertility rates for the period and age-group in question and are deficient in several respects. Firstly, only surviving children are enumerated at the household survey so that the quasi-fertility rates are biassed downwards by the effects of childhood mortality. Secondly, not all living offspring of the women will be still living with their mothers, which would again bias the measures downward. Thirdly, there may be adoption of children as 'own children', which would bias the estimates upwards. In addition, once adjustments are adopted to try to overcome the last two of these potential births, some account needs to be taken of the effects of mortality of mothers. There are other reasons for bias in the estimates, particularly through errors in age-statement of both the women and more particularly, the children.

From the quasi-fertility rates derived from the own-children data of the survey it is possible to obtain quasi-total fertility estimates as five times the sum of the quasi-fertility rates for the period in question. As all adjustment procedures we shall use make the same adjustments regardless of the age of women we can carry out all our adjustments on the quasi-total fertility rates so derived and retain the implied age-pattern of fertility. To maintain comparability throughout our calculations and to avoid problems of truncation and absurdly low ages of reproduction, we have chosen to work with quasi-total fertility rates which are only derived from the age-range 14½ to 44½ years, although our adjustment procedures would partially correct for any errors of incompleteness this might cause. Table 3.3 shows the values of these quasi-total fertility rates for the various periods in the past. It will be noted that the values shown are quite variable, especially as a result of misstatement of ages for the children, which brings about the apparent peak corresponding to age twelve, for example. If there were no adoption effects and all own children were enumerated with their mothers, which is sometimes approximately true, especially for the youngest ages of children, we could obtain estimates of fertility simply by making allowance for childhood mortality. Table 3.4 shows some of the information on childhood mortality from ENFC (for a much more thorough analysis of mortality levels in Colombia reference should be made to the illustrative analysis on mortality by Somoza, 1980). Brass has devised a procedure for converting proportions of children dead by age of mother into life table probabilities of survival, which has been modified and improved by Sullivan and by Trussell (1975). We have somewhat arbitrarily

Figure 3.1 Diagram Showing the Relation of Own-Children Age Groups to Fertility Rates at Various Times Before the Survey

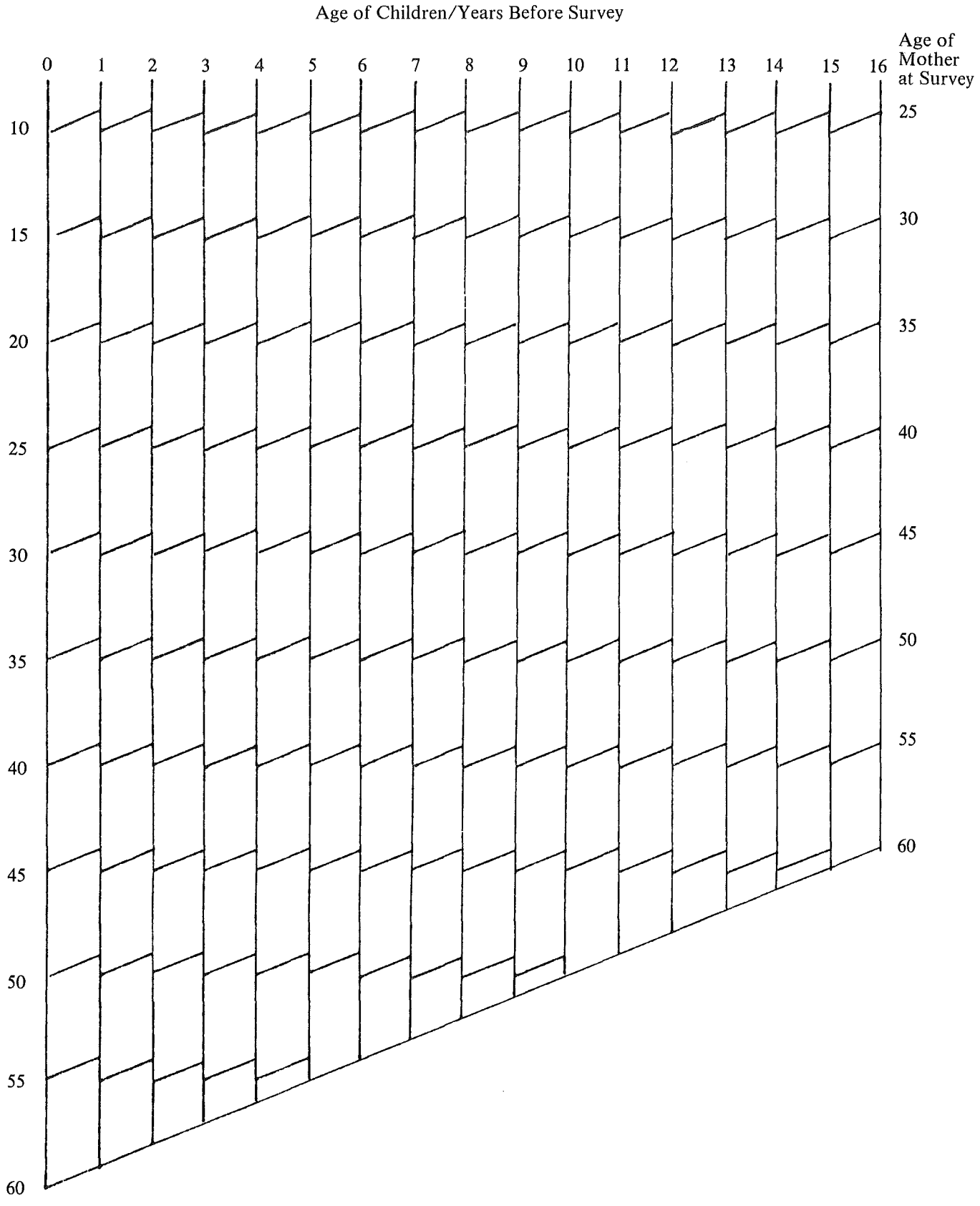

Table 3.3. Results of Own Children Analysis from Household Survey, ENFC, 1976 (Weighted)

Age (x)	Date	Quasi-Total Fertility[1]	Inflation Factor — Childhood Mortality[2]	First Own Children Estimate	Adjustment Factors		Second Own Children Estimate
					Mortality of Mothers[3]	Non-Own Children[4]	
0	75/6	3.826	1.0456	4.00	0.9942	1.0379	4.13
1	74/5	3.706	1.0817	4.01	0.9886	1.0638	4.22
2	73/4	3.445	1.1058	3.81	0.9830	1.0698	4.01
3	72/3	4.018	1.1194	4.50	0.9767	1.1002	4.83
4	71/2	4.253	1.1287	4.80	0.9705	1.0979	5.11
5	70/1	4.830	1.1362	5.49	0.9641	1.1230	5.94
6	69/70	5.110	1.1431	5.84	0.9575	1.1053	6.18
7	68/9	5.040	1.1494	5.79	0.9510	1.1241	6.19
8	67/8	5.447	1.1551	6.29	0.9437	1.1233	6.67
9	66/7	4.897	1.1601	5.68	0.9365	1.1470	6.10
10	65/6	5.569	1.1640	6.48	0.9290	1.1669	7.03
11	64/5	4.915	1.1667	5.73	0.9213	1.1452	6.05
12	63/4	6.016	1.1692	7.03	0.9135	1.2014	7.72
13	62/3	5.780	1.1714	6.77	0.9049	1.2012	7.36
14	61/2	5.468	1.1736	6.42	0.8961	1.2595	7.24
15	60/1	5.144	1.1766	6.05	0.8870	1.2565	6.75

[1] Quasi-total fertility is estimated by summing the ratios of numbers of enumerated own children of the relevant age to the relevant enumerated number of mothers for ages of mother ranging from 15 to 44 years at the end of the children's year of birth.
[2] Childhood mortality was estimated from recorded proportions of children surviving (see Table 2.8). As the estimates were in very close agreement with a Brass one-parameter model life-table at level 70 (e_0 = 55.0 years), the values from the model life table were substituted (see Carrier and Hobcraft, 1971). The inflation factors were then derived as $l_0/{}_1L_x$.
[3] For mortality of the mothers the same Brass one-parameter model life table was used and the factors were derived as ${}_{30}L_{15+x}/{}_{30}L_{14½}$, where x is the relevant age of child. In a growing population this will slightly overestimate mortality and thus lead to a slight underestimate of total fertility.
[4] The adjustment for non-own children is the ratio of the *de facto* number of children enumerated at the survey to the number of own children of mothers aged 15-44 at the end of their year of birth.

chosen to use the regression equations derived by Trussell based on the Coale-Demeny West model life tables (p.105). We have then matched the resulting survival probabilities to a Brass one-parameter model life table based on his African standard from the extensive tabulations of Carrier and Hobcraft (1971). As can be seen from Table 3.4, the values for Level 70 correspond remarkably closely to the pattern of estimates from the adjustment of the proportions of children dead by age. At the time of carrying out this analysis we only had information on childhood mortality to hand and took Level 70 as the applicable life table for all our own-children calculations, including mortality of the mothers. This may be somewhat suspect, as it is very likely that mortality had actually been declining in Colombia over the fifteen years prior to the survey, but such trends ought to be reflected in the childhood mortality based on retrospective reports, which is remarkably closely fitted by the single life table of Level 70 from the Carrier and Hobcraft tables. Then childhood mortality estimates (in the form ${}_1L_x/l_0$ as the proportion surviving) can be used to adjust the quasi-total fertilities to give the first set of own children estimates shown at Table 3.3.

As can be seen from Table 3.5, the proportion of children enumerated with their mothers decreased fairly steadily with age, and more steeply than would be explained by the effects of mortality of mothers. Thus the first own-children estimates are almost certainly too low and we proceed to modify these to allow for effects of non-own-children and mortality of mothers. The procedure adopted is the usual one of inflating the estimates by the inverse of the proportion non-own-children form of the *de jure* population which effectively includes all births, regardless of whether the mother survived or adoption and leaving home effects, but then to reduce the estimates by the proportion of mothers who would still be alive, so as to allow for the underestimation of the denominator of the rates after the adjustments. The proportion of mothers still alive at the survey for children aged n last birthday is estimated using the ratio ${}_{30}L_{15+n}/{}_{30}L_{14½}$, as the survivors of the women aged 14½ to 44½ on average at the time of birth of their n-year old children would be aged $15+n$ to $45+n$ at the time of the survey. The results of these further adjustments are shown as the 'second own-children' estimates at Table 3.3 and are to be preferred to the first own-children estimates. As several authors

Table 3.4. Estimates of Childhood Mortality from Household Survey, ENFC, 1976 (Unweighted)

Age of Mother	Average Parity	Average Dead	Proportion Dead	Factor[1]	Age x	Estimated $_xp_o$	Brass Model[2] Life Table Level 70 $_xp_o$
15-19	0.91	0.07	.0769	.819	1	.9370	.9377
20-24	1.90	0.16	.0842	.923	2	.9222	.9112
25-29	3.17	0.34	.1073	.948	3	.9025	.8974
30-34	4.47	0.46	.1029	.972	5	.8999	.8829
35-39	5.93	0.82	.1383	.992	10	.8628	.8602
40-44	6.97	1.04	.1492	.984	15	.8532	.8512
45-49	7.40	1.25	.1689	.981	20	.8343	.8358

[1] The factors are derived from the regression equations given on p. 105 of Trussell (1975) for the Coale-Demeny West Model Life Tables.
[2] The Brass model life table is from Carrier and Hobcraft (1971).

Table 3.5. Numbers of Children Attributed to Mothers Aged 14½-44½ at Time of Birth of the Child and Enumerated *de jure* in the Household Survey, by Age of Child

Age	Own Children	*de jure*	Proportion Own Children	Age	Own Children	*de jure*	Proportion Own Children
0	1557	1616	.9635	8	1492	1676	.8902
1	1443	1535	.9401	9	1320	1514	.8719
2	1289	1379	.9347	10	1426	1664	.8570
3	1407	1548	.9089	11	1212	1388	.8732
4	1400	1537	.9109	12	1460	1754	.8324
5	1561	1753	.8905	13	1327	1594	.8325
6	1519	1679	.9047	14	1233	1553	.7939
7	1466	1648	.8896	15	1111	1396	.7958

have previously pointed out these adjusted own-children estimates of total fertility are essentially the same as would be derived from a less elaborate reverse survival analysis on the *de jure* population, although the own-children approach does have some advantages, giving estimates of total fertility rather than crude birth rates and more importantly giving information on the age-pattern of fertility as well.

Provided that the wilder fluctuations in total fertility estimates so derived are ignored and treated as effects of age-misstatement for children, the time trend in fertility is clearly one of a substantial decline over the ten or fifteen years prior to the survey, with falls from around 7.0 or 7.1 to about 4.1 for total fertility. We recall that our best estimate of current total fertility in Section 2 was 4.5 and thus the own-children analysis may be overstating fertility decline by a small amount. Nevertheless the apparent decline is both real and substantial and considerably greater than could be accounted for by the changes in educational structure.

3.3 Trends from Individual Maternity Histories

The presentation and analysis of data from maternity histories is a complex matter. As yet, we are of the opinion that no satisfactory corrective technique for handling such data exists, although Brass (1975) and Booth (1979) have made some attempts in this direction. Brass' technique requires strong assumptions about unchanging age distributions of first births and that first births are subject to similar reporting biasses as later ones. He provides no way of checking the validity of these strong assumptions. Nevertheless his approach may be useful in contexts where there is less evidence of fertility change than is the case for Colombia. Booth's work is still at an early stage of development and requires strong assumptions about all fertility change taking place for cohorts rather than for time-periods, as well as applying a fertility model which has not been well validated, even against the data used to generate it. We do not wish to appear too critical of such work, as

development of corrective techniques is a difficult thing and will inevitably involve strong assumptions. We merely wish to point out that these techniques are still at an early stage of their development and require considerable further testing and improvement before being trustworthy for use in an illustrative analysis of this kind.

In addition to the partial attempts to correct maternity history data mentioned above, there is a whole series of approaches for trying to exhibit and illuminate the biasses often present in such data. We shall present a few such displays, but will not attempt to be exhaustive. The subject of analysis of maternity history data from WFS data is of sufficient importance and complexity that a separate study in this illustrative analysis series deals solely with the subject (Alam 1980). Also a seminar with some fifteen papers, arranged jointly by the IUSSP, WFS and the Centre for Population Studies at the London School of Hygiene, took place in April, 1980. It is to be expected that considerably more experience and several detailed analyses will be gained from this seminar. As a result, our treatment here will be far from complete.

One major problem which arises in any attempt to use maternity history data for estimating past trends is the progressive truncation of the age-range for which estimates can be derived. Thus for the Colombia round of WFS, the oldest women included in the individual survey were aged 49 at the survey. As a result, estimates can only be made for the age range 15-44 for five years before the survey and 15-39 and 15-34 for ten and fifteen years before. This makes for substantial difficulties in estimating levels of total fertility, unless some model is used to infer the fertility of the missing age-groups (or cohorts) in the past. Such modelling would be applied to period fertility rates and could take the form of using the pattern for more recent periods or fitting a mathematical model to the incomplete period data and using the resulting estimates. Either procedure would work tolerably well during a period of fairly constant fertility, but both would be highly suspect during a period of substantial fertility change, such as we observe for Colombia and would require explicit assumptions about whether fertility change took place mainly between time-periods or between cohorts and the appropriateness of the models used for either of these situations. Tables 3.6a and 3.7 present the available estimates from the maternity histories collected at the ENFC, and Tables 3.6b and 3.7 present the corresponding estimates from the own-children analysis given earlier to permit comparisons of the two sets of estimates. In addition Figures 3.2 and 3.3 present the estimates from these two sources in graphical form. It is clear from these comparisons that the own-children and maternity history analysis are in broad agreement as to levels and trends of fertility for Colombia although there are differences in detail. The own-children estimates are slightly more susceptible to age-misstatement effects, probably in part because the maternity history based estimates are for calendar years and thus spread any effects of age (or date) heaping between two years. In addition the own-children estimates for the younger age-groups are consistently lower for the more recent periods. There is clear evidence of a moderate to substantial decline for all age-groups, although perhaps least for women aged 15-19.

Figure 3.2 Cumulative Fertility Up to Various Ages from Own Children and Maternity History Analysis, ENFC, 1976.

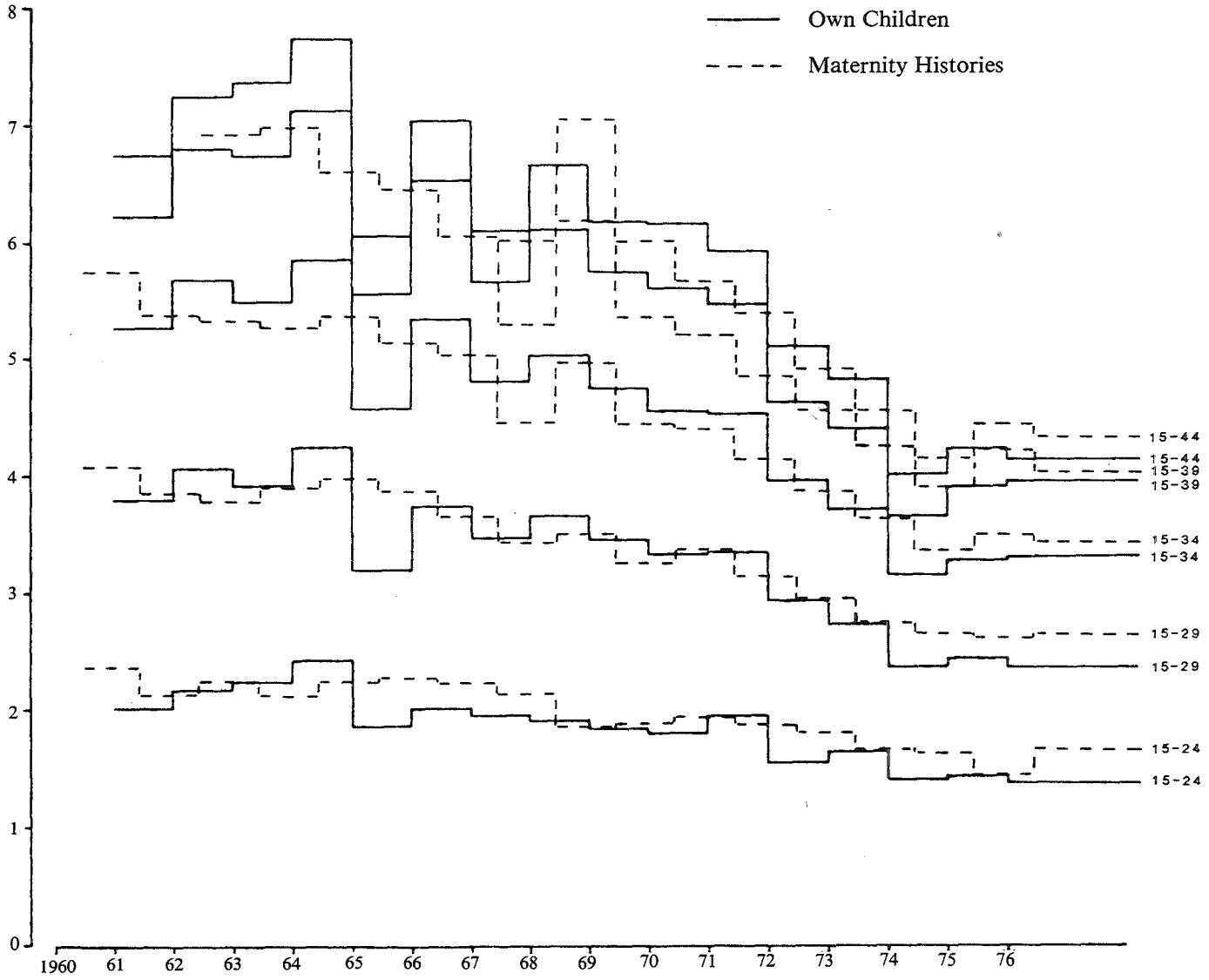

Figure 3.3 Age Specific Fertility Rates from Maternity Histories and Own Children Approaches.

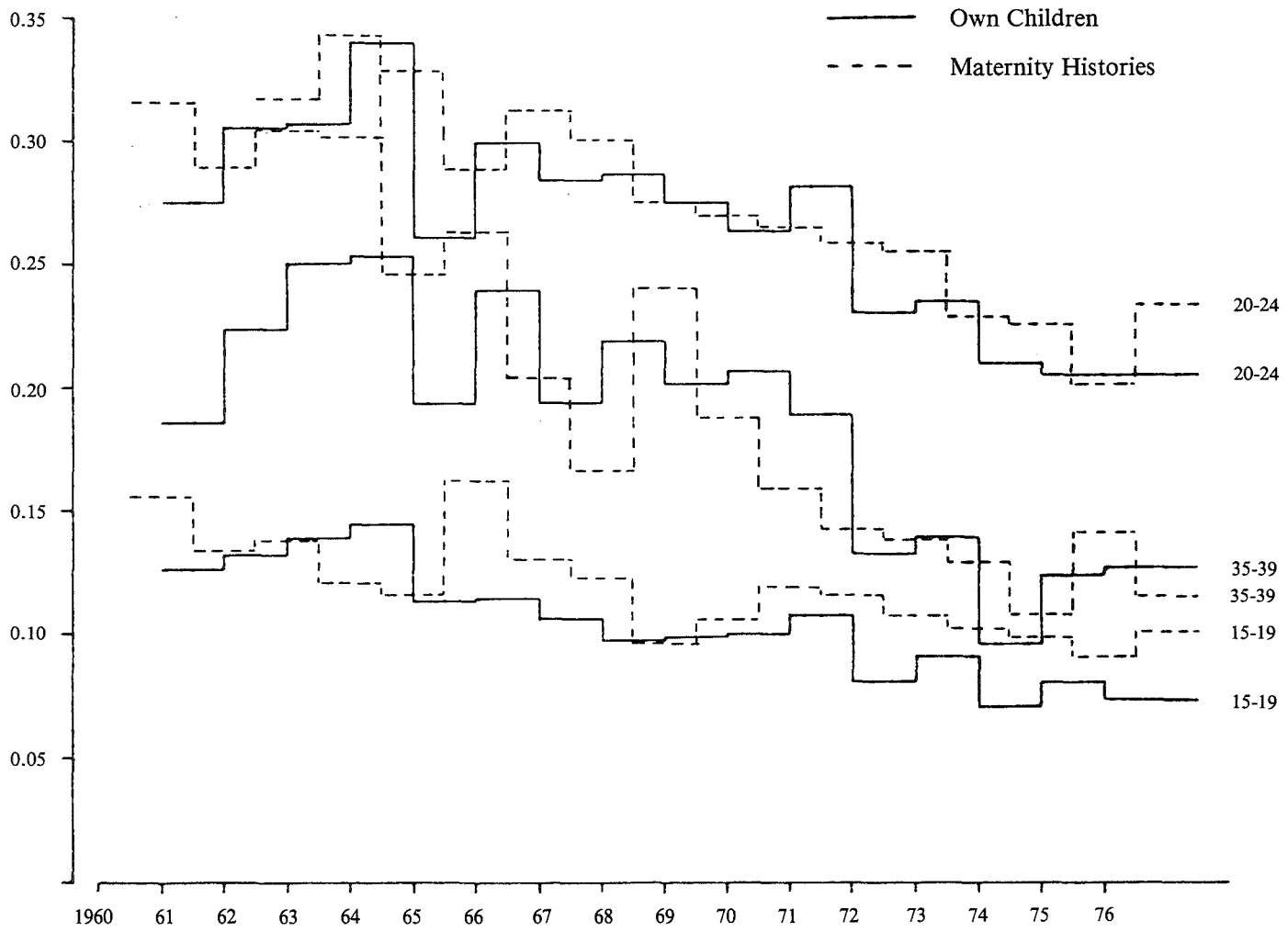

Figure 3.3 (continued) Age Specific Fertility Rates from Maternity Histories and Own Children Approaches.

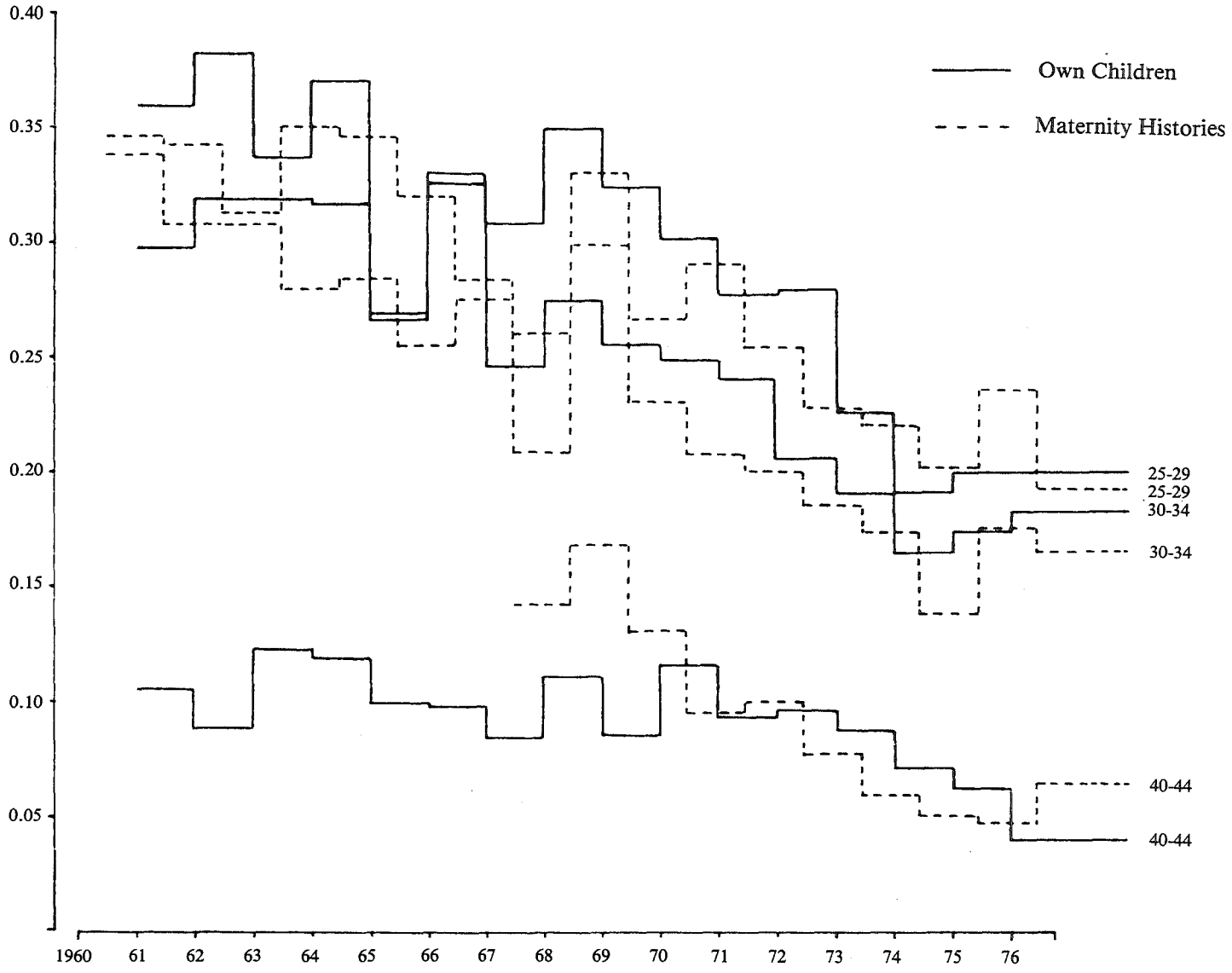

Table 3.6a. Estimates of Age Specific Fertility Rates from Individual Maternity Histories, ENFC, 1976

Calendar Year	Age Group 15-19	20-24	25-29	30-34	35-39	40-44	45-49
1976	.1015	.2335	.1929	.1657	.1151	.0640	(.0218)
1975	.0904	.2013	.2351	.1751	.1401	.0471	(.0362)
1974	.0997	.2265	.2024	.1485	.1073	.0505	(.0090)
1973	.1034	.2288	.2210	.1734	.1293	.0601	(.0146)
1972	.1067	.2564	.2282	.1842	.1376	.0728	(.0317)
1971	.1157	.2586	.2544	.2014	.1438	(.1084)	
1970	.1197	.2649	.2908	.2075	.1591	(.0955)	
1969	.1075	.2698	.2771	.2314	.1881	(.1301)	
1968	.0966	.2741	.3303	.2958	.2406	(.1678)	
1967	.1235	.3006	.2603	.2084	.1668	(.1426)	
1966	.1305	.3138	.2840	.2748	(.2043)		
1965	.1629	.2874	.3200	.2555	(.2633)		
1964	.1160	.3283	.3461	.2821	(.2467)		
1963	.1206	.3022	.3507	.2799	(.3428)		
1962	.1385	.3059	.3136	.3077	(.3170)		
1961	.1338	.2892	.3425	(.3077)			
1960	.1547	.3148	.3451	(.3357)			
1959	.1287	.3109	.2982	(.3096)			
1958	.1437	.3292	.3609	(.3574)			
1957	.1318	.2610	.2960	(.4437)			
1956	.1429	.3214	(.3657)				
1955	.1401	.3115	(.3061)				
1954	.1351	.3005	(.3320)				
1953	.1156	.3238	(.2918)				
1952	.1173	.2960	(.3170)				
1951	.1078	(.2295)					
1950	.1524	(.2798)					

Source: ENFC, 1976, Table 7.2.3, P.368.

Table 3.6b. Estimates of Age Specific Fertility Rates from Own-Children Analysis of Household Data, ENFC, 1976 (Weighted).

Years Before Survey	Date	Age Group					
		15-19	20-24	25-29	30-34	35-39	40-44
0	1975/6	.073	.205	.199	.183	.127	.039
1	1974/5	.080	.205	.199	.173	.123	.063
2	1973/4	.070	.210	.190	.164	.096	.071
3	1972/3	.091	.235	.225	.191	.139	.087
4	1971/2	.080	.230	.279	.205	.133	.095
5	1970/1	.107	.281	.278	.241	.188	.093
6	1969/70	.099	.263	.303	.249	.207	.115
7	1968/9	.098	.275	.323	.255	.202	.085
8	1967/8	.096	.286	.349	.274	.218	.111
9	1966/7	.106	.284	.308	.246	.193	.084
10	1965/6	.114	.299	.331	.326	.239	.097
11	1964/5	.113	.261	.266	.278	.193	.099
12	1963/4	.144	.340	.370	.317	.253	.119
13	1962/3	.138	.307	.337	.319	.250	.122
14	1961/2	.132	.306	.382	.319	.223	.088
15	1960/1	.126	.276	.359	.298	.186	.106

Table 3.7. Partial Total Fertility Rates (Cumulated Rates to Various Ages), Own Children and Maternity History Estimates, ENFC, 1976

Years Before Survey	Date	Age					
		15-34		15-39		15-44	
		Maternity History	Own Children	Maternity History	Own Children	Maternity History	Own Children
	1976	3.47		4.04		4.36	
0			3.30		3.94		4.13
	1975	3.51		4.21		4.45	
1			3.29		3.90		4.22
	1974	3.39		3.92		4.17	
2			3.17		3.65		4.01
	1973	3.63		4.28		4.58	
3			3.71		4.40		4.84
	1972	3.88		4.57		4.93	
4			3.97		4.63		5.11
	1971	4.15		4.87		(5.41)	
5			4.54		5.48		5.94
	1970	4.41		5.21		(5.69)	
6			4.57		5.61		6.18
	1969	4.43		5.37		(6.02)	
7			4.76		5.76		6.19
	1968	4.98		6.19		(7.03)	
8			5.02		6.11		6.67
	1967	4.46		5.30		(6.01)	
9			4.71		5.68		6.10
	1966	5.02		(6.04)		—	
10			5.35		6.54		7.03
	1965	5.13		(6.45)		—	
11			4.59		5.56		6.05
	1964	5.36		(6.60)		—	
12			5.86		7.12		7.72
	1963	5.27		(6.98)		—	
13			5.50		6.75		7.36
	1962	5.33		(6.91)		—	
14			5.69		6.80		7.24
	1961	5.37		—		—	
15			5.29		6.22		6.75
	1960	(5.75)		—		—	

Table 3.8. Displays of Data from Maternity Histories, ENFC, 1976, All Births

A. Average Number of Births Per Woman in Five-Year Segments Ending at Age

Cohort Aged	15-19	20-24	25-29	30-34	35-39	40-44	45-49
15-19	.164						
20-24	.206	.891					
25-29	.272	1.034	1.119				
30-34	.280	1.197	1.558	1.010			
35-39	.282	1.185	1.554	1.238	.765		
40-44	.256	1.069	1.639	1.565	1.050	.489	
45-49	.233	.993	1.554	1.632	1.358	.772	.194

B. Average Number of Births Per Woman by Age Group — Cumulative Fertility

Cohort Aged	15-19	20-24	25-29	30-34	35-39	40-44	45-49
15-19	.167						
20-24	.210	1.101					
25-29	.284	1.318	2.437				
30-34	.284	1.481	3.039	4.049			
35-39	.294	1.479	3.033	4.271	5.036		
40-44	.267	1.336	2.975	4.540	5.590	6.079	
45-49	.240	1.233	2.787	4.419	5.777	6.549	6.743

C. Cumulated Fertility Rates within Period — Cumulative Fertility by Age Group

Years Before Survey	15-19	20-24	25-29	30-34	35-39	40-44	45-49
0-4	.164	1.055	2.174	3.184	3.949	4.438	4. 632
5-9	.209	1.243	2.801	4.039	5.089	5.861	
10-14	.276	1.473	3.027	4.592	5.950		
15-19	.292	1.477	3.116	4.748			
20-24	.285	1.354	2.908				
25-29	.268	1.261					
30-34	.244						

At this point we should draw attention to the literature on biasses in maternity history data and methods of screening for such bias (e.g. Potter 1977 and Brass 1977). One fruitful approach involves tabulating various measures for successive five-year periods before the survey for five-year age-groups of women, such as average number of children born within each segment or total average number of children born by the end of each such segment. Such screening processes can also involve cumulating segments within a time-period and disaggregation by parity, as well as introduction of various background variables. To illustrate these points we present Table 3.8, which is selected from a large number of such tabulations we have examined. Panel A presents the raw information from maternity histories which can be manipulated in several ways (it should be noted that some contribution to fertility at ages below 10-14 to 15-19 was recorded for the earlier time-periods and this is included in Panels B and C, although reflecting erroneous reports). The first point to notice from Panel A is the tendency for rates for the older cohorts to be below those for the immediately younger cohorts especially at the younger ages. This may be explained in two possible ways. Firstly, it is well-known that the older women seem to omit reporting some of their births, usually those born in the more distant past who have subsequently died. In examining the data on average reported parity in Section 2 we concluded that there was some evidence of omission especially for the uneducated older women. Secondly, there may be problems in dating events for the older cohorts (see, for example, Potter, 1977), with the usual suggestion being that events are 'squashed' towards the middle of the reproductive age-range, which produces spurious recent declines and can be detected by examining the histories for a sufficiently long period in the past. Either of these alternatives is plausible as an explanation for the discrepancies observed for the older age-groups here and we have little evidence for deciding between the two. We reject the third possible explanation that fertility did indeed go through the changes in pattern (and level) implied by the rates for the oldest cohorts. Panel B of Table 3.8 gives a further illustration of these effects. Given that the rates are reduced for the oldest cohorts even at the youngest ages we mildly prefer the explanation of missing births but recognize that misdating of the first birth forward in time, followed by squeezing of the remaining births into a shorter period would also be consistent with the observed pattern. From an examination of similar tabulations by educational level, shown at Table 3.9 we can conclude several interesting things. Firstly, the very low values for reproduction during the five years prior to 15-19 and the five years prior to 20-24 for the cohort aged 45-49 at the survey persist for all levels of education, which is somewhat surprising. In general we would expect better educated women to do better both at recalling all the births they had and at dating these births. One factor to be borne in mind here is that some of the sample sizes for the later ages are small, and sampling errors may be affecting these average values. A further possibility may even be a genuine rise in fertility for the more educated groups as their composition and relative social status changed through increasing proportions being educated further. We think, however, that there are clear errors even for the most educated group in the older cohorts, which may have arisen through either dating problems or differential omissions.

Table 3.9. Average Number of Births Per Five-Year Segment, by Age Group and Educational Level, ENFC, 1976 — Contribution to Total Fertility

Educational Level	Age							Number of Cases
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
None								
15-19	.509							108
20-24	.405	1.328						116
25-29	.631	1.454	1.608					130
30-34	.416	1.396	1.822	1.426				101
35-39	.397	1.248	1.766	1.496	1.170			141
40-44	.390	1.185	1.568	1.514	1.226	.671		146
45-49	.336	1.153	1.620	1.788	1.409	.788	.204	137
1/2 Years Primary								
15-19	.304							161
20-24	.324	1.358						148
25-29	.338	1.366	1.517					145
30-34	.359	1.393	1.769	1.256				117
35-39	.246	1.254	1.516	1.443	.902			122
40-44	.263	1.172	1.879	1.606	1.141	.505		99
45-49	.264	1.042	1.639	1.639	1.556	1.028	.278	72
3/4 Years Primary								
15-19	.182							285
20-24	.339	1.147						224
25-29	.163	1.186	1.256					172
30-34	.244	1.288	1.756	1.045				156
35-39	.235	1.168	1.571	1.143	.681			119
40-44	.135	1.067	1.769	1.808	1.125	.442		104
45-49	.200	.874	1.432	1.495	1.474	.832	.189	95
Completed Primary								
15-19	.126							247
20-24	.148	.781						169
25-29	.214	.961	.903					154
30-34	.305	1.133	1.343	.743				105
35-39	.304	1.137	1.539	.980	.490			102
40-44	.274	.919	1.532	1.419	.855	.419		62
45-49	.111	.944	1.741	1.685	1.204	.537	.093	54
Secondary and Above								
15-19	.074							622
20-24	.053	.487						394
25-29	.154	.548	.656					241
30-34	.117	.775	1.058	.608				120
35-39	.189	1.074	1.284	.989	.389			95
40-44	.123	.800	1.323	1.369	.585	.200		65
45-49	.100	.760	1.280	1.400	.880	.500	.160	50
All								
15-19	.164							1423
20-24	.206	.891						1051
25-29	.272	1.034	1.119					842
30-34	.280	1.197	1.558	1.010				599
35-39	.282	1.185	1.554	1.238	.765			579
40-44	.256	1.069	1.639	1.565	1.050	.489		476
45-49	.233	.993	1.554	1.632	1.358	.772	.194	408

Once sub-groups of the population are being examined, as with educational groups, the problems of presenting maternity history data in summary form become quite acute and are not easily solved, especially if births are considered by order as well. Hobcraft and Trussell (1980) have suggested one approach to this problem using the Coale-McNeil marriage model to fit data from incomplete cohorts on proportions ever achieving various parities by age. As their work is exploratory we do not present it here. Instead, we choose to present total numbers of births by age-group 30-34 by five-year time segments before the survey, as in Table 3.10. We recognize that such measures are susceptible to the effects of dating errors, but feel they are not too seriously biassed for Colombia. There is not much evidence of fertility decline for the uneducated women, with the rates for 15-19 years before the survey appearing similar to those 0-4 years before the survey, which at least suggests for this group that the apparent decline in the ten years or so preceding the survey may be spurious and perhaps due to dating errors (or even omissions). For the higher educational groups the evidence of decline is overwhelming. (Although it is possible that a rising age at marriage could produce a spurious apparent decline this is clearly not a likely explanation here — Florez and Goldman (1980) present information on trends in nuptiality from ENFC which suggests little or no change in mean age at marriage.) What is perhaps surprising is that the proportions having first and second births have declined substantially over time for the higher educational groups. One problem is that we are examining synthetic measures and the younger cohorts may have first births at later ages to compensate. Another point to bear in mind is that it seems likely that older women are omitting births, especially at the younger ages. As a result they would be omitting early order births and reporting later order births which occur at higher ages as though they were the early order births. Florez and Goldman (1980) do find slight evidence of rising age at marriage for those women with completed primary or higher education (despite the non-existence of overall trends) which is probably a partial explanation for the rather extreme apparent trends in proportions having first and second (and thus subsequent) births by age 30-34 for the more educated groups. An examination of first birth rates by marriage duration does not show any decline over time, which strongly suggests that age at marriage is the important factor here. In addition there is some evidence of declining proportions having third and subsequent births by age-group 30-34 among those women with some primary education, which almost certainly reflects a real decline in fertility for these groups.

We also refer the reader at this point to a further illustrative analysis on Colombian fertility using life tables by birth order (Rodriguez and Hobcraft, 1980) which presents far more detailed analyses of many of these problems.

Although there are difficulties with maternity history analysis, and especially dangers of inferring recent declines where none exist, we are completely confident that the declines in Colombia are real, although they may be overstated as a result of dating errors and omissions of distant events for older women.

Table 3.10. Cumulated Period Contributions to Total Fertility, by Age Group 30-34, and by Educational Level, ENFC, 1976

Educational Level	Time before Survey			
	0-4	5-9	10-14	15-19
All Births				
None	4.871	5.196	5.316	5.074
1/2 Years Primary	4.435	4.902	4.860	5.138
3/4 Years Primary	3.630	4.431	4.830	4.688
Completed Primary	2.553	3.432	4.317	4.659
Secondary and Above	1.825	2.648	3.582	3.914
All	3.184	4.039	4.592	4.748
First Births				
None	.979	.919	.965	.997
1/2 Years Primary	.883	.970	.828	.987
3/4 Years Primary	.832	1.006	.912	.942
Completed Primary	.759	.762	.903	.899
Secondary and Above	.698	.721	.806	.821
All	.766	.830	.864	.914
Second Births				
None	.956	.846	.971	.925
1/2 Years Primary	.870	.853	.760	.935
3/4 Years Primary	.817	.888	.866	.902
Completed Primary	.596	.750	.740	.867
Secondary and Above	.511	.554	.739	.927
All	.680	.747	.802	.905
Third Births				
None	.751	.725	.911	.772
1/2 Years Primary	.743	.711	.792	.846
3/4 Years Primary	.624	.734	.707	.827
Completed Primary	.452	.580	.794	.734
Secondary and Above	.313	.491	.595	.717
All	.518	.630	.746	.782
Fourth and Subsequent Births				
None	2.184	2.708	2.470	2.382
1/2 Years Primary	1.941	2.367	2.484	2.368
3/4 Years Primary	1.360	1.805	2.347	2.018
Completed Primary	0.745	1.341	1.880	2.160
Secondary and Above	0.305	0.883	1.438	1.440
All	1.218	1.836	2.181	2.146

3.4 Comparison of WFS Data With Other Sources

From the maternity history data collected by ENFC it is possible to reconstruct estimates of fertility rates and children ever born at various times in the past for comparison with other survey or census results. Table 3.11 shows comparisons in terms of reported children ever born from the Encuesta Nacional de Fecundidad of 1969 (Hernandez and Florez, 1978) and the census of 1973 (DANE, 1976). In general the results from ENFC are higher, although only slightly so for 1969, which could reflect both the small sampling bias discussed in Section Two and, perhaps, the effects of dating errors. The values recorded at the 1973 Census were probably too low by about ten per cent, a figure which corresponds quite closely with the estimates given by Potter and Ordonez (1976).

Table 3.12 shows similar reconstructions of fertility rates at various dates in the past from ENFC and a comparison of them with rates from the 1973 Census (DANE, 1978 and Potter and Ordonez, 1976) and from the 1969 Encuesta Nacional de Fecundidad (Elkins, 1973). Again the level of agreement is remarkably reassuring, although yet again the 1976 survey gives higher estimates on the whole, although only slightly so in comparison with the results from ENF of 1969. There are also minor differences in the age-pattern. None of these discrepancies is sufficient to invalidate the broad trends derived from the 1976 survey. On the contrary the degree of concordance with the earlier sources is better than could usually be expected and constitutes a powerful check on the quality of ENFC, although it is always possible that all surveys miss some events, it is less likely they will miss a constant proportion regardless of age.

Table 3.11. Reconstructed Numbers of Children Ever Born From WFS Maternity Histories at Dates of ENF and Census

	1969		1973	
Age	ENFC Maternity Histories	ENF Reports	ENFC Maternity Histories	Census
15-19	0.22	0.20	0.22	0.14
20-24	1.36	1.27	1.18	1.04
25-29	3.07	2.85	2.70	2.41
30-34	4.46	4.43	4.30	3.89
35-39	5.97	5.78	5.31	5.04
40-44			6.54	5.79

Table 3.12. Comparison of Age Specific Fertility Rates from ENFC With those from ENF and The Census, Colombia

	Year prior to 1973 Census								
		1973 Census		1967-68		1965-66		1960-64	
Age	ENFC Maternity Histories	Potter & Ordonez	DANE	ENFC MH	ENF MH	ENFC	ENF	ENFC	ENF
15-19	.104	.077	.077	.110	.110	.146	.125	.131	.129
20-24	.236	.207	.209	.287	.270	.301	.270	.308	.299
25-29	.223	.205	.216	.314	.278	.302	.321	.340	.337
30-34	.176	.172	.185	.253	.277	.265	.267	.300	.304
35-39	.131	.130	.147	.204	.176	.230	.214	—	.230
40-44	.063	.063	.073	—	.085	—	.095	—	.098
45-49	—	.019	.025	—	.010	—	—	—	—
Total Fertility	4.79+	4.37	4.66	—	6.030	—	6.46+	—	6.985+

4. CONCLUSIONS

After fairly extensive examination and cross-checking of the data from the Colombian round of the World Fertility Survey, we conclude that the data are generally of high quality, enabling fairly satisfactory estimation of levels and trends of fertility. Almost all of our estimates are direct estimates, although we have attempted indirect estimation where possible. Indirect procedures are mostly not useful when there has been substantial fertility decline, which usually invalidates crucial assumptions.

Although our general conclusions are that the data from the Colombian survey are quite usable for estimating current fertility, we have found some evidence of problems and errors. The first important area considered is the comparison between the household and individual samples. The availability of an extended household sample makes these comparisons more illuminating. The ability to contrast the women interviewed with other eligible women allowed some inferences to be drawn about possible selection and/or non-response biasses and about the degree of independence between the two surveys. Some evidence emerged of an overall selection and/or non-response bias, with the two being inseparable owing to the impossibility of identifying those women selected for interview. In addition there is some slight suggestion that household responses may have been revised as a result of the individual interviews in some instances.

The second major contrast we were able to make is available whether or not the household sample was extended. This involved matching responses given at both individual and household interviews and a distinction between those for whom proxies made the reports on the household schedule and those who were self-reporting. Although not really evident at the aggregate level, important differences in consistency of response between these two groups did emerge, with the reports being generally less consistent and often even showing a net bias for the proxy reported group. In particular there was evidence that proxies tended to understate age and numbers of children ever born and to overstate the length of the open interval too. All of these differences are relative to the reports at the individual interview, which may not be correct but at least represent self reports for all women.

The main emphasis of this illustrative analysis is one of trying to get good estimates of levels and trends in fertility. The high degree of attention to data quality is an essential aspect of any such attempt, but the ultimate aim of overcoming problems of quality and/or making those statements about levels and trends which are supportable from data of the given quality should not be forgotten. For Colombia we are able to make fairly good estimates of fertility levels in the year before the survey. Our best estimate of total fertility in this period was about 4.5 (with a subjective confidence interval of about 0.2 on either side). From an examination of information disaggregated by educational level we also obtained estimates of total fertility of approximately 6.8, 5.9, 4.9, 3.9 and 2.5 for those with no education or illiterate, 1/2 years primary, 3/4 years primary, completed primary and secondary and higher education respectively. These are extremely large differentials and represent a society during a substantial demographic transition. The comparison of current fertility and reported average parity using Brass' P/F ratio technique indicated substantial recent fertility decline for most educational groups, with some doubts about those with no education. The estimates by educational level were shown to be most suspect for those with least education, with particular problems of apparent omission of earlier births at the higher ages and overrepresentation of fertile women in the 15-19 age group, probably through selective age misstatement pushing childless women to 10-14. There is also a small possibility that fertile young women were being incorrectly allocated to the no education group, at the expense of the 1/2 years primary group.

The other major section in this illustrative analysis is an examination of the available evidence of fertility trends, both from the maternity histories collected at the individual survey and from an own-children analysis of the household data. At the level of accuracy we can work to it is very difficult to make a clear choice between these two approaches. Both have advantages. The maternity history data are a richer and more accurate data source, which permits more detailed analyses than are described here (see Rodriguez and Hobcraft, 1980 for an example of the kinds of additional analyses which can be derived from a full maternity history). The own children estimates do not suffer from the progressive truncation introduced by the cut-off at age 50 in the individual sample, but are more susceptible to age-misstatement errors, especially for the ages of the children.

Our overall conclusion is that total fertility has declined from around 6.5 to 7.0 in the early 1960's to about 4.5 in the year before the survey. This is a substantial decline. No attempt was made to examine these trends separately by educational group, although the work by Rodriguez and Hobcraft does examine this aspect and suggests that even the most highly educated had high fertility levels before 1960, and that declines spread down the educational groups, probably affecting the least educated by the early 1970's.

To finish we re-stress the importance of data evaluation *as an integral part* of analyses of this kind. No statements about levels and trends can be made without some implicit or explicit consideration of data quality. In our view the consideration should always be explicit. Despite this emphasis it is important to keep in view the target of estimating levels and trends and making the best use of the available data in the light of their limitations rather than just pointing out the problems. We hope this illustrative analysis has achieved such an aim.

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