COMPARISON OF MEASURES OF CHILDBEARING: PATTERNS BY AGE AND PARITY IN MATLAB, BANGLADESH

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PREFACE

The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) is an autonomous, international, philanthropic and non-profit centre for research, education and training as well as clinical service. The Centre is derived from the Cholera Research Laboratory (CRL). The activities of the institution are to undertake and promote study, research and dissemination of knowledge in diarrhoeal diseases and directly related subjects of nutrition and fertility with a view to develop improved methods of health care and for the prevention and control of diarrhoeal diseases and improvement of public health programmes with special relevance to developing countries. ICDDR,B issues two types of papers: scientific reports and working papers which demonstrate the type of research activity currently in progress at ICDDR,B. The views expressed in these papers are those of authors and do not necessarily represent views of International Centre for Diarrhoeal Disease Research, Bangladesh. They should not be quoted without the permission of the authors.

INTRODUCTION

With data from cross sectional surveys there are many possible measures of the quantity and tempo of childbearing in a population (1). One can measure the frequency of birth events to women in time before the survey and (and obtain fertility rates or birth probabilities) or intervals between events for women (open and closed birth intervals) or the cumulative number of birth events to women (parity distribution measures) or the prevalence of pregnancy. Each measure has a particular time reference and gives one perspective on childbearing in the population. That the level of most such measures depends on age is obvious. In addition, for interval measures in particular, parity has been shown to be a crucial control variable (2). This is because the range of interval lengths for women of high parity is much more constrained than the range for women of lower parity. This paper documents the levels of seven measures of childbearing by age and parity for married women in the Demographic Surveillance System in Matlab, Bangladesh.

THE MEASURES

Seven period measures which appear often in the literature are included in this study. An additional age-parity distribution measure is also included. All of the measures are defined with reference to the married female population of reproductive age (15-44). Excluded are measures incorporating mortality (e.g. net reproduction rate) and those based on wider populations (e.g. crude birth rate, general fertility rate). Also non-parametric statistics of the distributions (e.g. median, quartiles) are not considered. The measures are defined below and abbreviations are given with arguments identifying age-specificity (a) parity-specificity (i) and age-parity specificity (i,a).

Age-parity Distribution Measures

1. Mean parity MP (a). This measure, more commonly known as mean number of children ever born, is basic to the Brass indirect estimation techniques of current fertility and mortality (3).
2. Proportion of women who are greater than or equal to a given parity PGEP (i), PGEP (i,a). This is one measure derived from age-parity data alone which is both age and parity specific. It is directly analygous to a measure which is easily derived from fertility models -- the probability of n or more birth events in a given time. Thus direct comparison of results from models and data are possible (5).

Rates, Probabilities and Pregnancy Prevalence

3. Fertility rate FR(i), FR(i,a). From survey data this is defined as the ratio of the number of births in the period immediately preceding the survey (usually one year) to married women who have been married since the beginning of the period. This is not the standard definition of the fertility rate used with vital registration data since the concept of the mid-year population is not applicable. Births in the period to women who died before the survey are obviously not included. The rates calculated from the survey are thus 'purged' rates (6).

   While FR(a) is defined as the ratio of births of women age a to the number of women age a, FR(i) is defined as the ratio of ith births in the period to the total number of women. Similarly, FR(i,a) has ith births to women age a in the numerator and all women of age a in the denominator. Thus FR(a) and FR(i) are not symmetric measures.

   Fertility rates are the conventional measure of the current pace of childbearing in a population and therefore are often used as a reference with which to compare the patterns and sensitivity of other measures.

4. Birth probability BP(i), BP(i,a). This is defined by the ratio of ith births in the period preceding the survey to the number of married women at the time of the survey who were parity i-1 at the beginning of the period (7). BP is calculated with the same data used for age-parity specific fertility rates. BP is a more refined measure of fertility than FR since it gives an estimate of the risk of childbearing.

5. Pregnancy prevalence PP(a), PP(i,a). This is the proportion of women who are pregnant at the time of the survey. Unless pregnancy testing is used, this measure is derived from responses to a question on pregnancy status. In contrast to the FR and BP measures, for PP the arguments a and i specify the universe of women in both the numerator and denominator. Thus PP(i,a) is the ratio of the number of women of parity i and age a who are pregnant at the time of survey to the number of women of parity i and age a. This measure has recently been shown to be an accurate predictor of fertility, especially if collected in a double round survey (8).

Interval Measures

6. Mean closed birth interval-women MCIW(i), MCIW(a), MCIW(i,a). This is defined as the mean interval between the last two birth events: It is derived from data for all married women who have at least one birth. (For women of parity one the interval since marriage can be used.)

Closed birth intervals were first of interest to demographers for the estimation of fecundability (9). Subsequently, they were analyzed in historical demographic studies and their mathematical relationships to fertility rates and parameters of the reproductive process were derived (10,11). They were first used as indicators of changes in current fertility with surveys in India (12). The last closed interval before the survey data is used in such analyses. However, Sheps and others demonstrated the effects of truncation of birth interval means and concluded that closed (and open) intervals may not be any more informative than parity distributions in describing child-bearing in a population (2).

7. Mean closed birth interval-birth MCIB(i), MCIB9a), MCIB(i,a). This is defined as the mean interval between the last two birth events for women who have a birth in the period immediately preceding the date of the survey. Wolfers made the important distinction between mean birth interval-birth and mean birth interval-woman according to whether the sampling frame was births or women (13). Intervals in the MCIB calculation are a subset of those used in the MCIW calculation.

8. Mean open birth interval MOI(i), MOI(a), MOI(i,a). This is defined as the mean time from the last live birth to the date of survey. In the case of nulliparious women the time from marriage to the date of the survey is used. The open interval was proposed by Srinivasan as an indicator of fertility (14). The theoretical distributions of the open interval have been derived under several models but the finding of the truncation effect of short marital duration or high parity challenges the measure's usefullness (2).

DATA

Since 1966 the Cholera Research Laboratory (now the International Centre for Diarrhoeal Disease Research, Bangladesh) has registered births, deaths and migrations in 132 villages in the Matlab area of Comilla district in Bangladesh. In addition censuses were conducted in the area in 1966, 1970 and 1974. Several studies of fertility dynamics in this population have been published previously (15,16,17).

Using the census, vital event and migration data, the married female population was reconstructed as of July 1, 1974. After matching birth events for the period 1966-1974, the reproductive variables needed for these analyses were calculated. Only women present in the 1966, 1970 and 1974 censuses were included since birth events for other women could be missing. However, this requirement led to a distorted age distribution in the study population as younger women were disproportionately excluded. The cause was a much higher migration rate among younger women. (Such migrations are frequently associated with marriage.) Though age-parity specific and age-specific measures are largely unaffected by this distortion, the parity specific and global measures are affected. Therefore, standardized parity specific measures were calculated using the age-parity distribution of currently married women from another survey in Matlab as the standard (18). The size of the study population was 13,128.

RESULTS

Age-parity Distribution Measures

The mean parity by age for this population and several nationwide samples from Bangladesh is shown in Table 1. The Matlab results were quite close to the other series. The mean increases by about one and a half children with each successive age group up to age 35-39.

PGEP is shown graphically in Figure 1. The proportion of women at or above parity eight is very high -- 43 percent of those 40-44 years of age, 36 percent of those 35-39 and even 15 percent of women 30-44 have had eight or more live births. The distance between any two curves gives an indication of the pace of childbearing between the respective ages. It can be seen that parity increases by about two for each age group up to age group 30-44. The area under a given curve yields mean parity for that age group.

The very low proportions of women of zero parity required explanation since they are below 3-5%, the expected rate of the proportion of women childless because of primary sterility in natural fertility populations (19). There are two possible explanations. First, divorces occur disproportionately to childless women in Bangladesh. This is true even after controlling for duration of marriage at divorce. For example, among divorcing women who had been married four to five years in Matlab only half had a live birth (Table 2). One would normally expect about 75% of the women to have had a birth within this period of time. Second, reports of parity are apparently biased upward in Bangladesh. For example, in the Bangladesh Fertility Survey of 1975, the percentages of currently married women who reported themselves childless were also very low. (The percentages were 38.4, 7.6, 1.8, 2.4, 1.2, 1.3 and 2.1 for age groups 15-19, 20-24, ... 40-44, 45 + respectively.) (20, page A65)

Rates, Birth Probabilities and Pregnancy Prevalence

Age-order specific fertility rates of this population are shown in Figure 2. The age-standardized order specific rates show the usual monotonic decline with parity from 140 per 1000 for first births to 40 per thousand for

TABLE 1

MEAN NUMBER OF CHILDREN EVER BORN FOR MARRIED WOMEN IN THE MATLAB STUDY POPULATION AND THREE NATIONAL SURVEYS OF BANGLADESH[a]

Age Group	Matlab Study Population 1973	BRFSM 1974[a]	BFS 1975	Impact 1969
All ages	4.4	-	4.0	4.0
15-19	.6	.6	.9	.9
20-24	2.3	1.9	2.5	2.5
25-29	3.9	3.5	4.3	4.3
30-34	5.4	4.9	5.9	5.6
35-39	6.6	5.9	6.9	6.4
40-44	7.0	6.2	7.6	6.6

Sources: Table 2.2.18 of Ministry of Health and Population Control, Government of Peoples' Republic of Bangladesh (1978), Bangladesh Fertility Survey 1975-76. Table 3.1 in Report on the 1974 Bangladesh Retrospective Survey of Fertility and Mortality. Table 4 of Sirageldin *et al.* "Fertility in Bangladesh: Facts and Fancies" *Pop Stud* 29(2):210.

[a]The data from BRSFM refer to ever married women. The remaining series are for currently married women.

Fig. 1. Proportion of women at or above parity i in Matlab, by age group

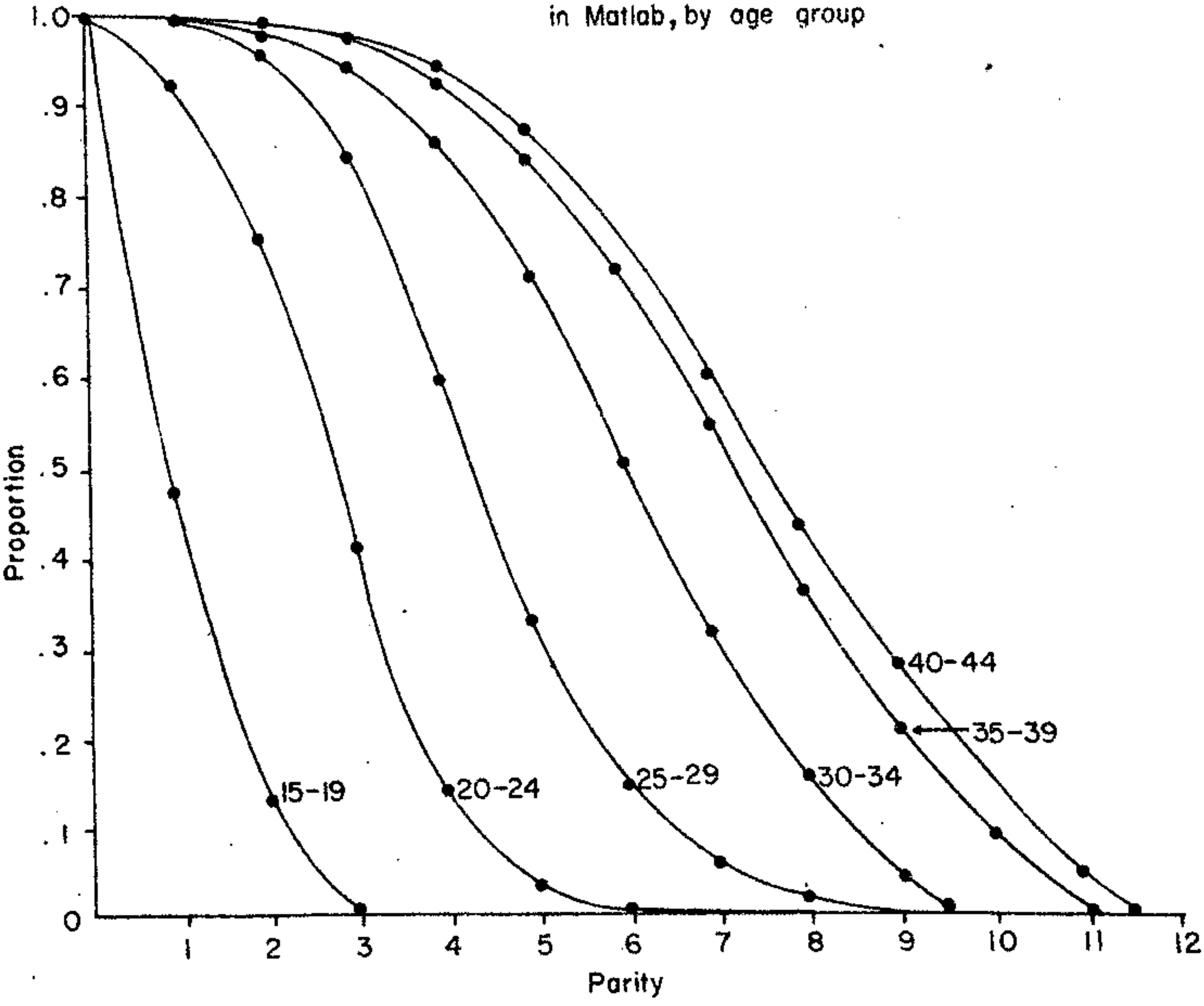
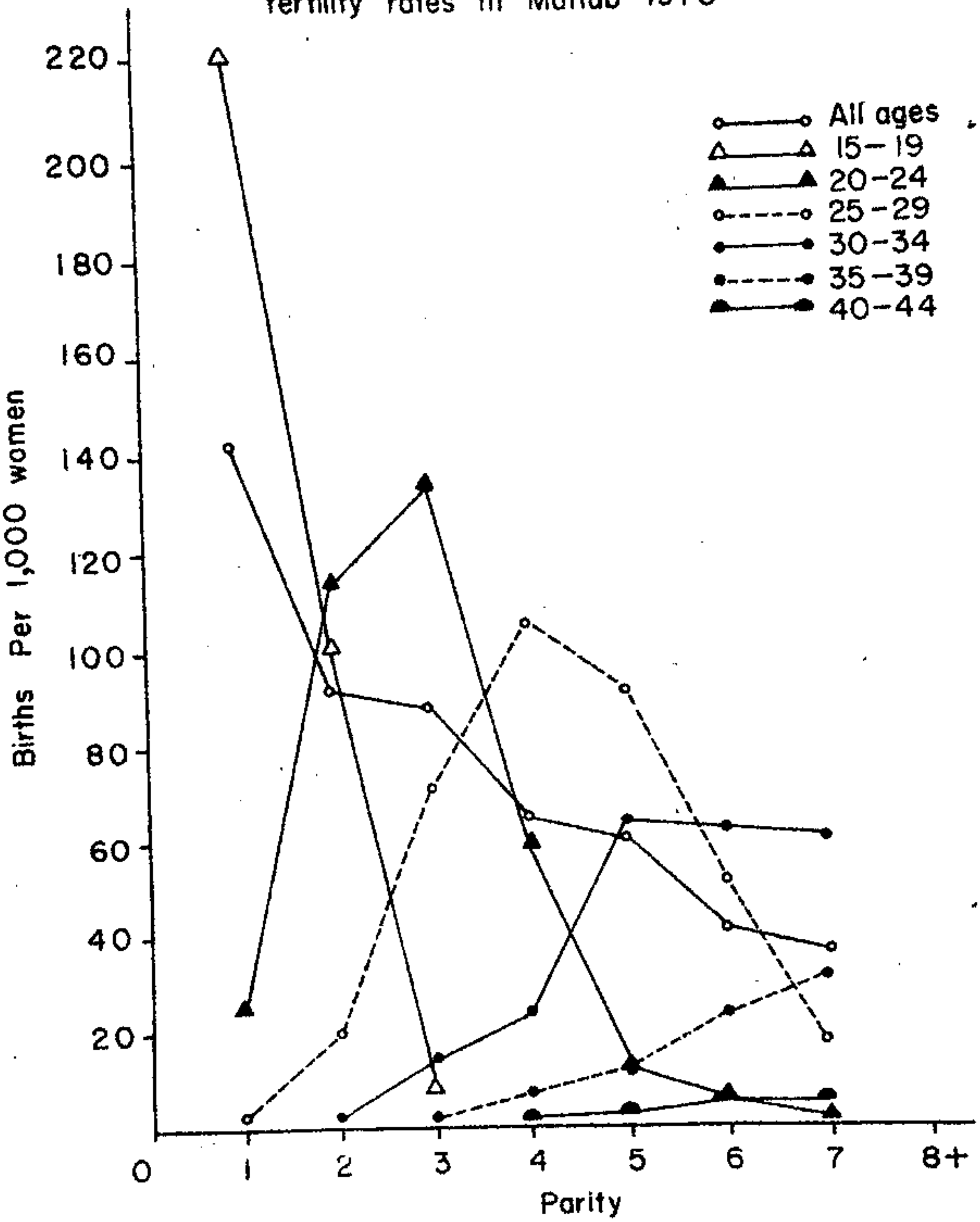


TABLE 2

PROPORTION OF DIVORCING WOMEN WHO ARE CHILDLESS IN MATLAB, 1975 BY AGE, AND DURATION OF MARRIAGE

Age	Duration of marriage (in years)				
	< 2	2 - 3	3 - 4	4 - 5	5 +
All ages	.82	.67	.65	.49	.23
	(242)	(90)	(94)	(59)	(197)
15-19	.97	.73	.77	.76	.44
	(203)	(71)	(66)	(25)	(32)
20-24	.68	.62	.41	.36	.21
	(25)	(13)	(22)	(28)	(70)

Fig.2. Age-parity specific marital fertility rates in Matlab 1973



births of order eight and above. The first order fertility rate for women 15-19 is a very high 220 per thousand. The modal parity-specific rate is at parity three for women 20-24 and at parity four for women 25-29. For women 30-34 years of age the rates for parities 5,6,7 and 8 are constant at approximately 60 per 1000. For women above 35 the rates were maximum after parity seven, though at a low level.

The birth probability gives the risk that a woman of parity i-1 at the beginning of the year will have an ith birth during the year. The parity specific probabilities (all ages) show only a small decline from parity one (.340) to parity seven (2.75).

The overall patterns by age are similar to those of the fertility rates (Figure 3). However, an important difference emerges. For the age groups 20-24 and 25-29 the modal value of BP is one parity earlier than the FR mode. The FR mode indicates that the number of women having births is maximum at that parity but the BP mode indicates that the risk of childbirth is at a maximum one parity lower. In the age group 30-34 birth probabilities are high for parities 5, 6 and 7. The highest probabilities of giving birth in the year are for nulliparious women 15-19, women 20-24 of parity 1, and women 25-29 of parity 2. These probabilities approach .5. The low probabilities at low parities in each age group after the first probably indicate that women in these groups have below average fecundability.

The proportion pregnant (PP) indicates what fertility will be in the year after the survey. The patients by age and parity are therefore expected to be similar to fertility rate patterns. The parity specific prevalence rate in Matlab increases from 18 per 1000 for nulliparous women to a maximum (265) for women of parity two and declines to (.155) for women of parity eight and above (Figure 4). For older women the proportion pregnant increases monotonically with parity. This may be another indication of the heterogeneity of fecundability i.e., at ages above 35, women of high parity are more likely to be pregnant than women of lower parities.

Intervals

The mean open intervals by age and parity (Fig. 5) show three usual characteristics. First, for any given parity the mean is longer for older women. For example, among primapara women those age 15-19 had a mean interval of 14 months while the mean for women age 30-34 was over 50 months. Second, the mean declines progressively within a given age group. Third, for all ages MOI increases only slightly with parity. The strong positive relation of MOI with age and strong negative relation of MOI with parity counterbalance to produce this affect.

The mean closed interval woman has patterns similar to those of MOI: for a given age group the mean decreases with increasing parity and for a fixed parity the mean increases with increasing age (Fig. 6). The shortest mean

Fig. 3. Birth probabilities (BP) by age and parity for married women in Matlab, 1973

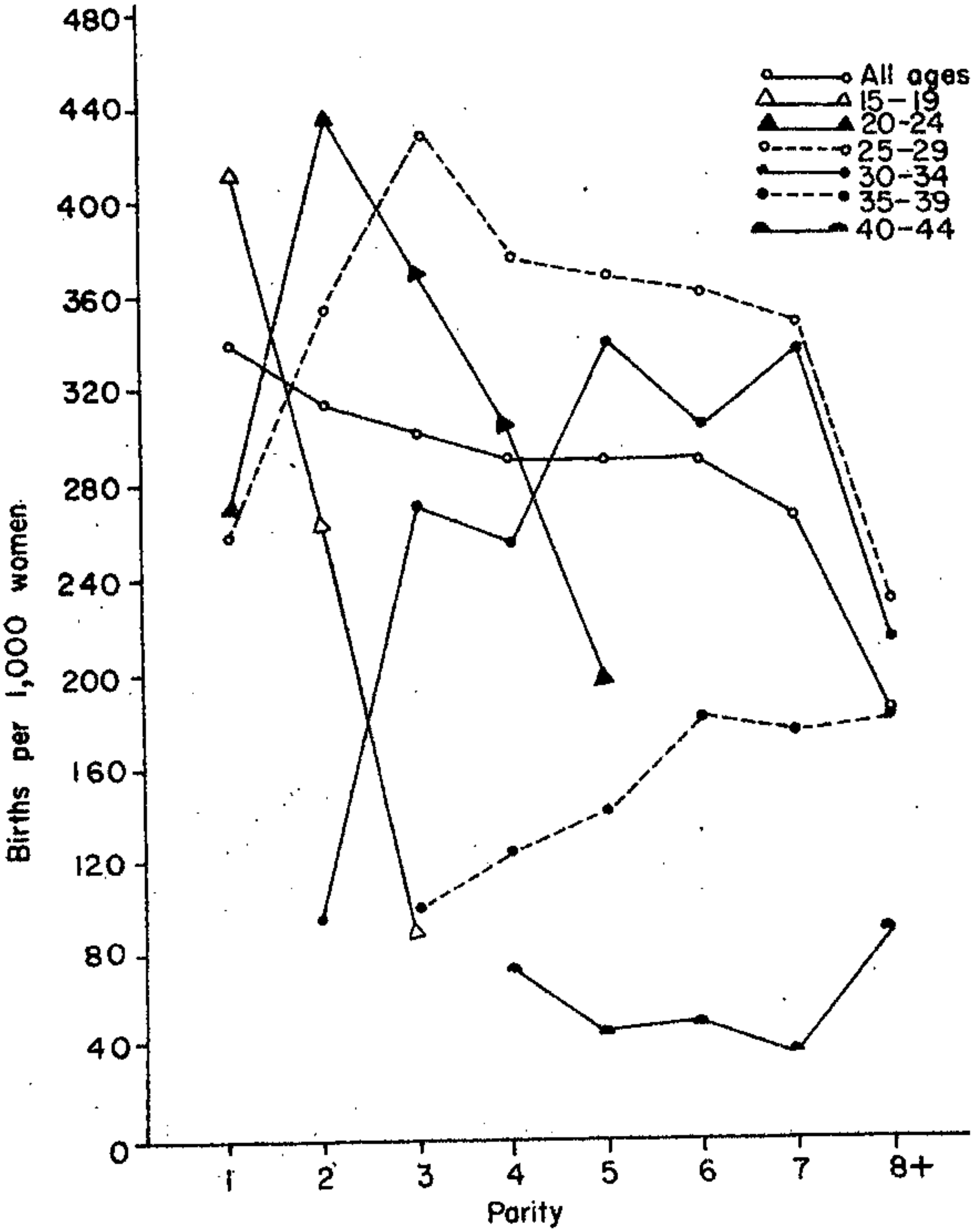


Fig. 4. Proportion of married women pregnant (pp) by age and parity in Matlab, 1973

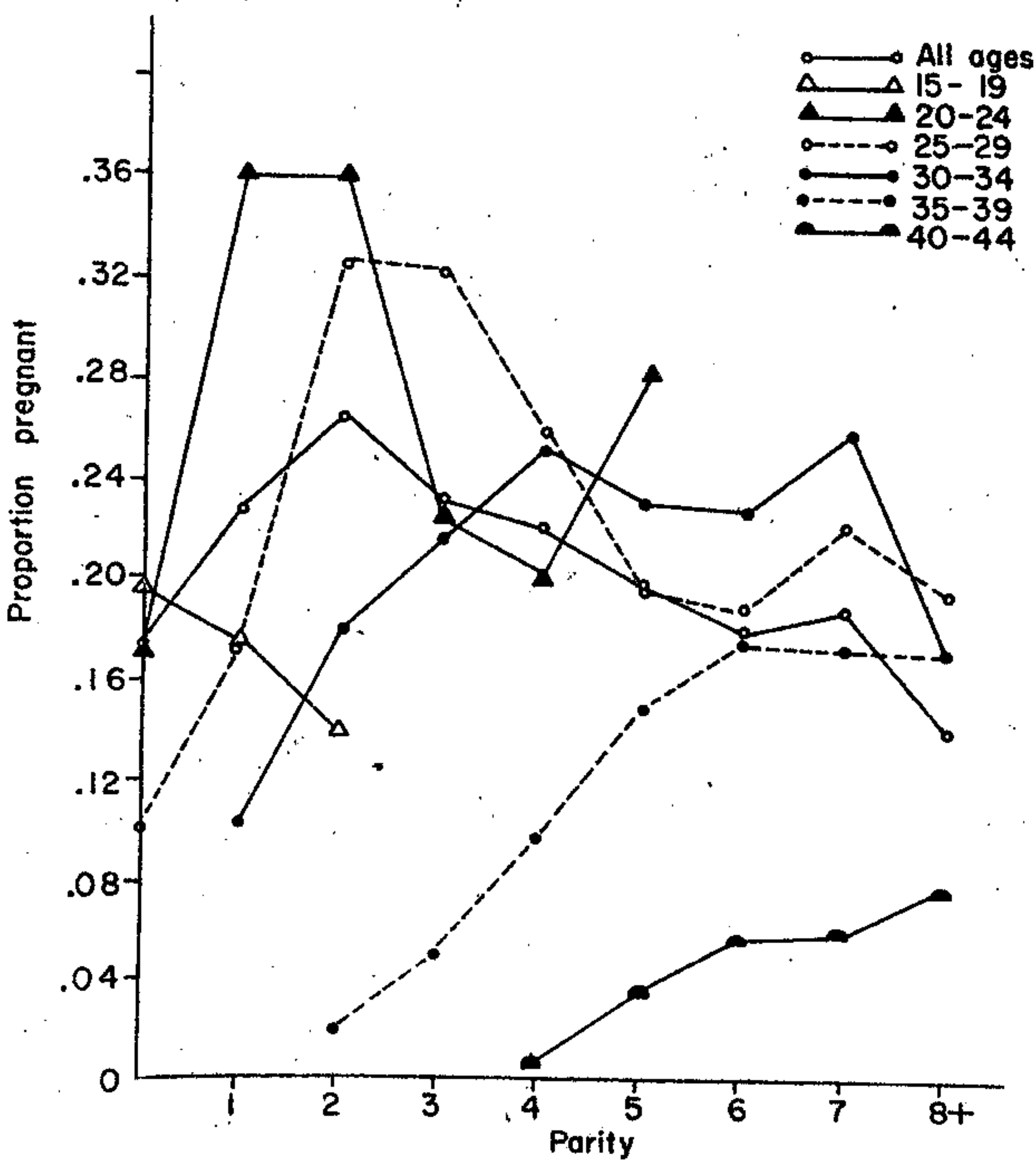


Fig. 5. Mean open birth interval in Matlab, by age and parity

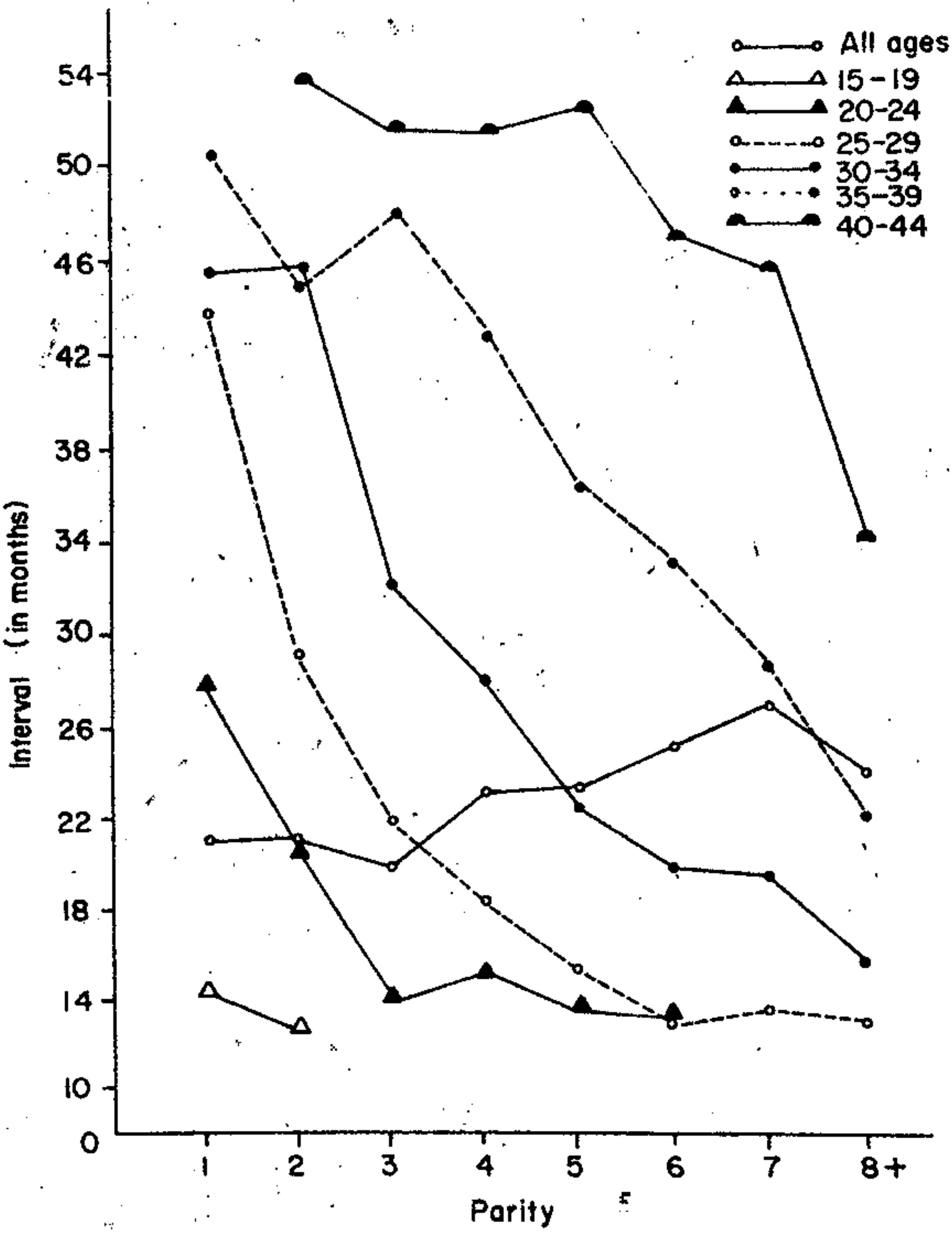
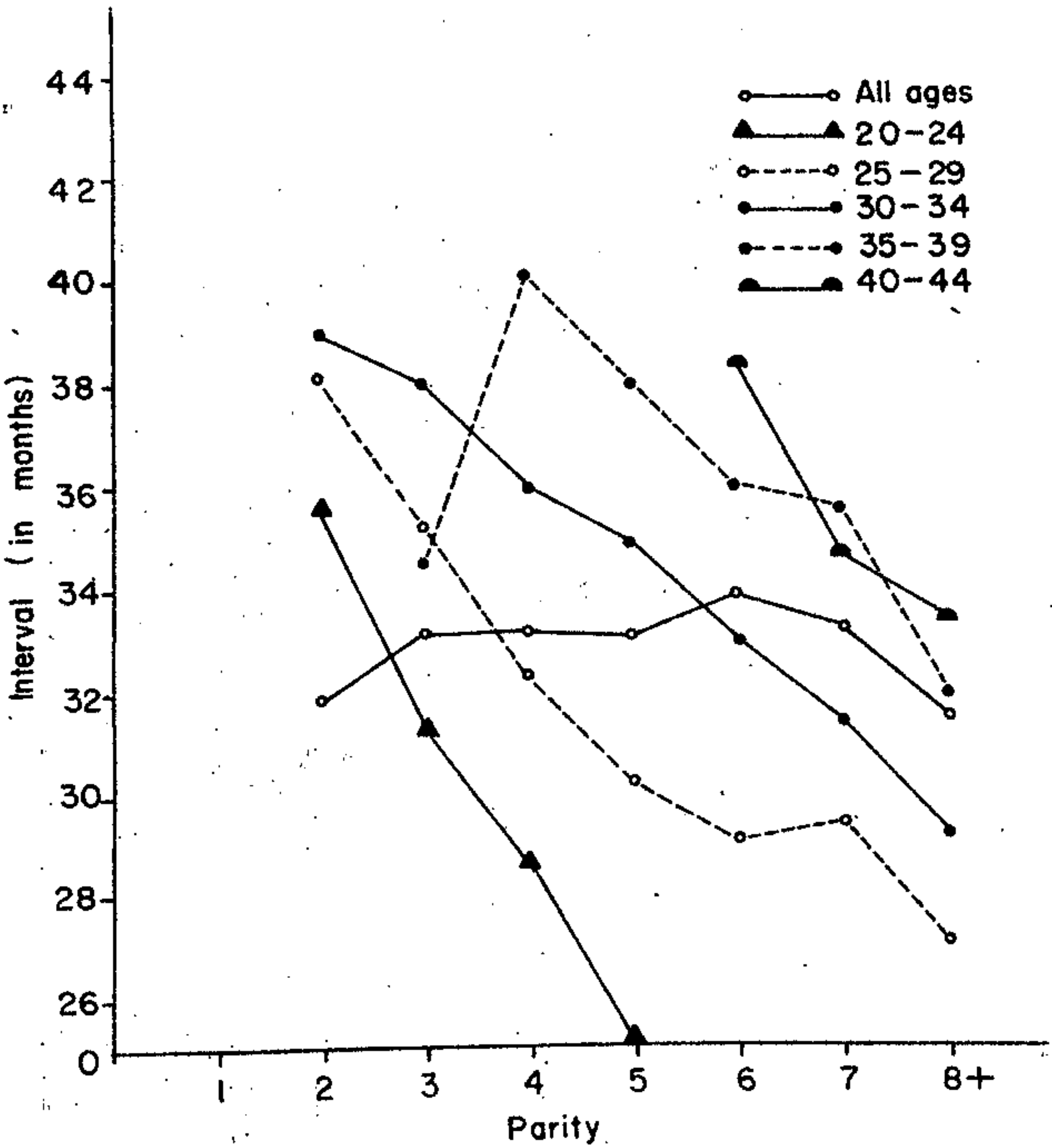


Fig. 6 Mean closed birth interval—woman (MCIW) for married women in Matlab, by age and parity



interval (25 months) is for women 20-24 of parity five while the longest (40 months) is for women 35-39 of parity four. For women of all ages the mean is fairly constant across parity. (32 to 34 months.) These values agree with other estimates of birth intervals in this population (15).

The mean closed interval-birth (Fig. 7) is based on a much smaller number of intervals than the mean closed interval-woman. In addition, while the combination of high age and low parity is possible with the MCIW measure -- these women stopped childbearing at a low parity, very few older women have a low order birth in the current period so MCIB does not exist for such combinations.

For a given age and parity MCIB is virtually always greater than MCIW. This is the reverse of what is expected from mathematical models. Wolfers and others assume that MCIB will be less than MCIW since, in the presence of heterogeneous fecundability, women with short intervals are over-represented when the sampling frame is births instead of women (13). However, in these Bangladesh data MCIB intervals are actually longer since, for a given age and parity, women who just had a birth had (ceteris paribus) a longer time in which to have the birth than women of the same age and parity who had the birth earlier in life. (For a proof see Becker, 1977.) The same inequality also holds for parity groups and age groups, though the empirical difference is less.

Relative Levels of the Measures with Age and Parity

One means of comparing the measures is to consider the relative levels by age and parity. Such comparison can also reveal relationships between the measures. The arithmetic mean of each series was used as reference in calculating the relative levels (Fig. 8). For the age-specific measures, the similarity of the patterns of PP and FR is apparent and MCIB and MCIW are both very close and relatively constant. The inverse relationship between MOI and FR is clear -- MOI was 60 percent above the mean for older women and FR had declined by 60 percent in this age group.

Compared to the age specific measure, the parity specific measures change very little with parity (Table 3). Only order specific fertility has a noticeable monotonic pattern. MOI rises slightly with increasing parity. PP after an initial rise, declines with increasing parity. The MCIB and MCIW are virtually constant across parity groups.

COMPARISON TO FERTILITY LEVELS OF THE HUTTERITES

The Hutterites, a North American anabaptist sect, have one of the highest recorded fertility schedules (21, 22). Since the study population in Matlab is also a natural fertility population, it is of interest to compare the levels and patterns of fertility measures of the two groups. Comparisons for FR(a) and

Fig.7-Mean closed birth interval-birth (MCIB) for married women in Matlab, by age and parity

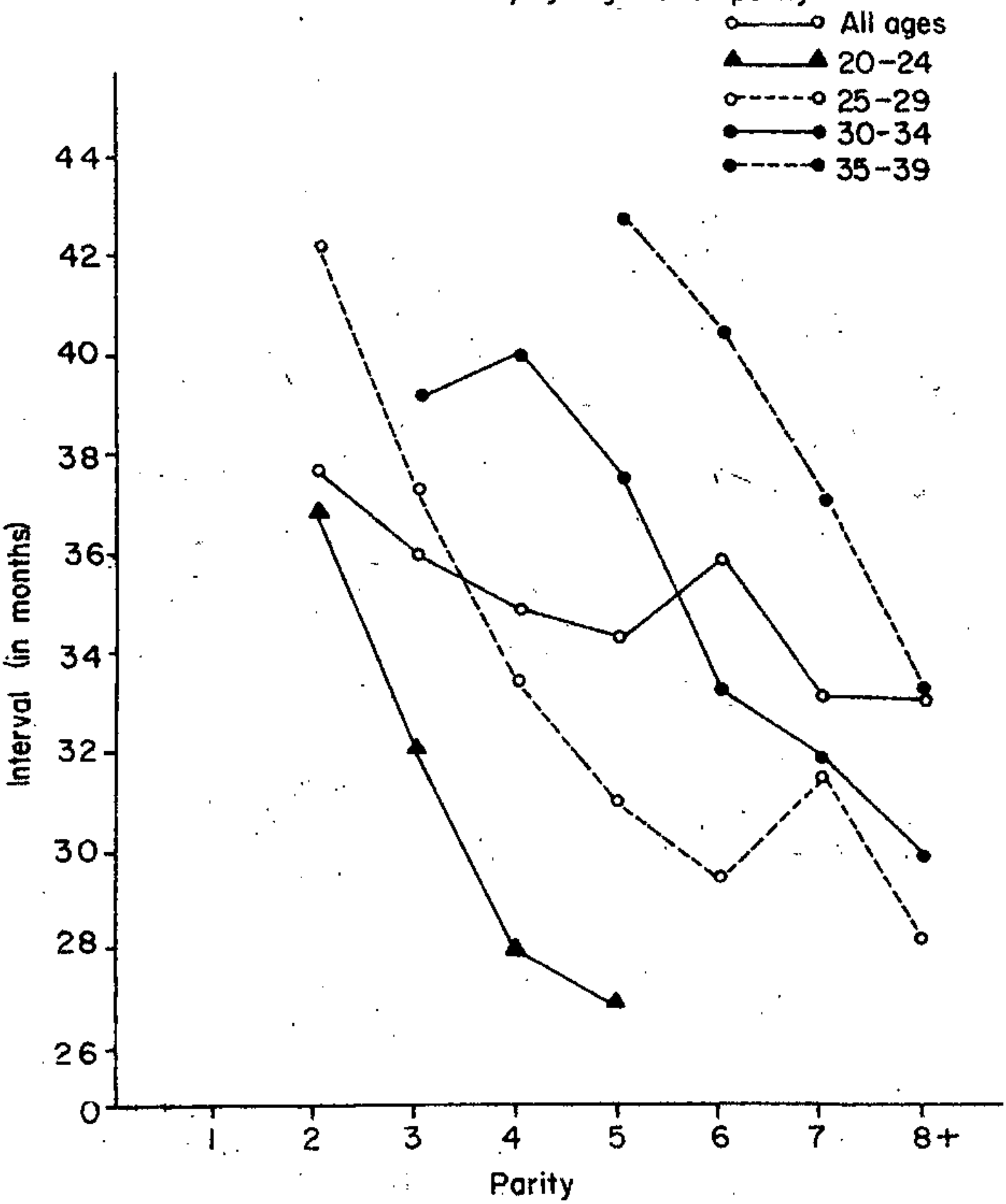
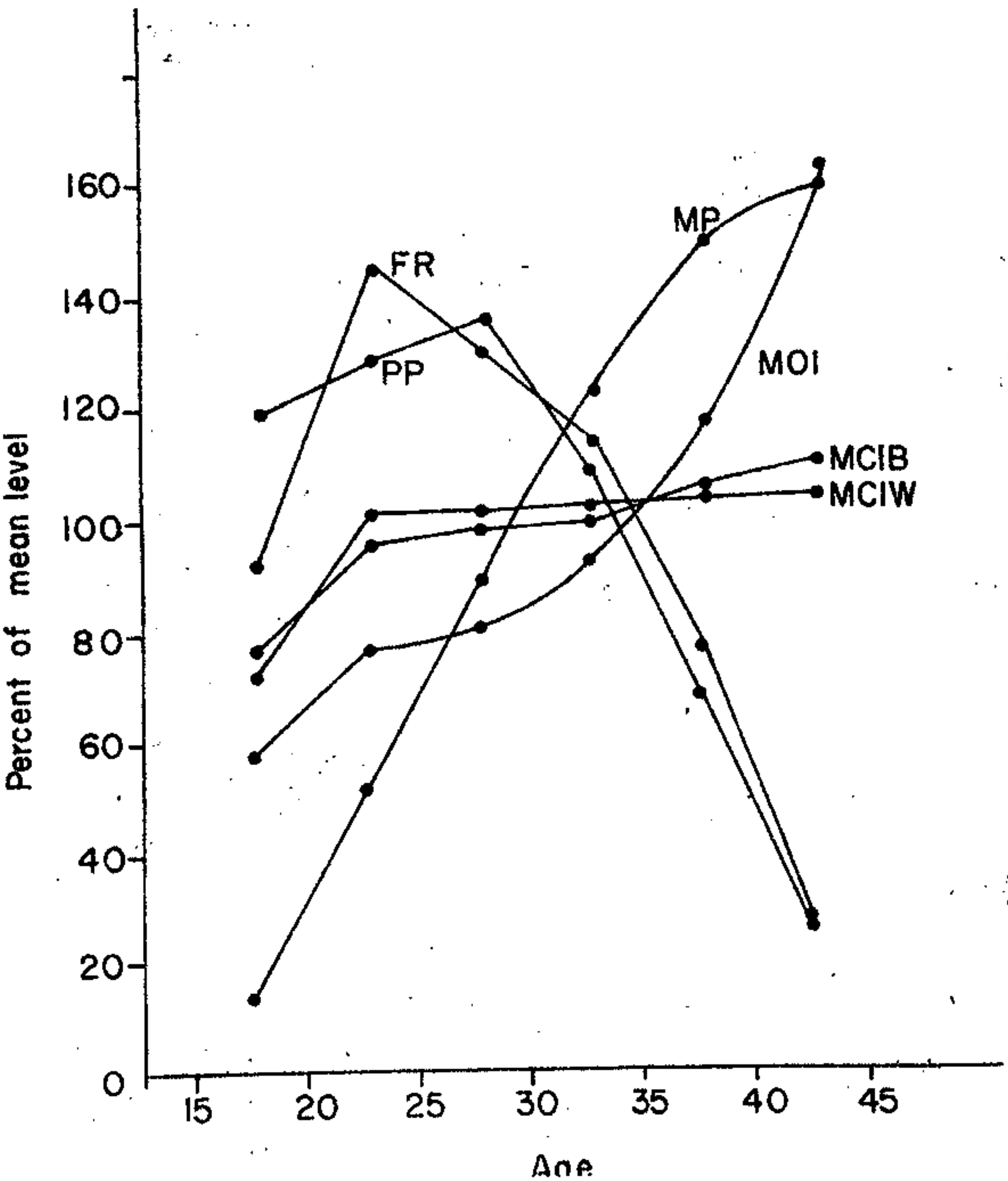


Fig. 8 Relative levels of six measures of fertility by age in Matlab, 1973



MICB(i) (the Hutterite series available in the published literature.) are shown in Table 4. Marital fertility is higher in Matlab in the 15-19 groups, is about the same as the Hutterite level in the 20-24 group, but declines to half of the Hutterite level beyond age 35.

The MCIB comparisons show that birth intervals for Matlab women are consistently longer than intervals for Hutterite women, but the difference decreases with birth order. In fact, while the mean intervals increase with birth order in the Hutterite population there is a slight decrease in the Matlab series. The longer mean interval at all orders can be attributed to the prolonged breastfeeding and the accompanying postparutm sterile period in the Matlab population. The mean postpartum amenorrhea interval for women with a surviving infant in Matlab has been estimated as 18 months (23).

CONCLUSIONS AND DISCUSSION

The patterns by age and parity of seve n measures of childbearing in the married female population of Matlab, Bangladesh have been presented. All the measures reflect the high level of fertility in this population.

The patterns of the fertility rates and pregnancy prevalence were very similar. This was expected because of the functional relationship between incidence and prevalence. The usual increase with age and decrease with parity were evident for the three birth interval measures studied. However, contrary to expectations from theoretical work, the MICB was found to be greater than MCIW in nearly all age and parity groups.

Except for FR, all of the measures showed greater variability with age than parity. This agrees with results from other studies. For the interval measures the constancy with parity was due to the counterbalancing of a positive effect of age and negative effect of parity.

Fertility was considerably lower in the Matlab population than in the Hutterite population of North America and birth intervals are consistently longer. An explanation is the very long interval of postpartum amenorrhea in the Matlab population.

TABLE 4

LEVELS OF FR(a) AND MCIB(i) IN THE MATLAB STUDY POPULATION AND THE HUTTERITE POPULATION OF NORTH AMERICA

Age Group	FR (per 1000) Hutterite[a] (1)	Matlab (2)	(2)/(1) x 100
15-19	92	328	355
20-24	336	355	106
25-29	498	376	76
30-34	443	302	68
35-39	370	197	53
40-44	215	82	38

Parity	MCIB (in months) Hutterite[a] (1)	Matlab (2)	(2)/(1) x 100
1	13.0	n a	-
2	19.0	37.0	199
3	20.3	36.1	178
4	20.6	35.0	170
5	21.7	34.5	159
6	22.1	36.1	163
7	23.0	33.4	145
8 +	23.6	37.4	142

a Hutterite birth intervals are calculated using records of all births in the population.

Source: Table 7 in Eaton and Mayer 1953, and Table 5 in Sheps, 1965.

Appendix Table 1

Pregnancy, Prevalence, Fertility rate and Birth probability
(per 1000 women) in Matlab, 1973 by Age and Parity

Age	Measures	All Parities	Parity								
			0	1	2	3	4	5	6	7	8+
	PP	201	176	230	267	234	223	200	184	194	147
All ages	FR	288	-	143	91	89	66	61	43	38	83
	BP	-	-	340	317	272	293	294	295	271	186
	PP	184	198	176	141	-	-	-	-	-	-
15-19	FR	328	-	221	99	8	-	-	-	-	-
	BP	-	-	411	264	91					
	PP	290	169	361	360	228	206	282	-	-	-
20-24	FR	355	-	25	144	134	59	13	6	3	1
	BP	-	-	268	437	370	301	204	-	-	-
	PP	260	100	174	327	325	262	199	193	227	200
25-29	PR	376	-	2	20	72	106	93	53	18	12
	BP	-	-	259	356	431	378	370	364	352	236
	PP	228	231	104	184	220	256	234	232	264	177
30-34	FR	302	-	-	2	14	25	65	63	62	71
	BP	-	-	-	96	273	257	342	207	340	219
	PP	158	-	-	21	51	100	153	180	178	178
35-39	FR	197	-	-	1	2	7	13	25	23	166
	BP	-	-	-	-	2	127	145	185	180	185
	PP	61	-	-	-	20	8	39	61	64	82
40-44	FR	82	-	1	1	1	2	3	6	6	62
	BP	-	-	-	-	-	75	46	51	39	95

Appendix Table 2

Mean of three birth interval measures by age and parity in Matlab, 1973

Age Group	Measures	All Parities*	Parity 1	2	3	4	5	6	7	8 +
All Ages	MOI	23.4	21.1	21.2	20.0	23.5	23.7	25.7	27.4	24.5
	MCIB	33.0	-	37.8	36.1	35.0	34.5	36.1	33.4	33.0
	MCIW	31.7	-	31.9	33.2	33.3	33.2	34.0	33.4	31.7
15-19	MOI	14.1	14.5	12.9	-	-	-	-	-	-
	MCIB	25.8	-	25.1	-	-	-	-	-	-
	MCIW	32.2	-	23.4	-	-	-	-	-	-
20-24	MOI	19.1	28.0	20.7	14.3	15.6	13.9	13.5	-	-
	MCIB	32.4	-	36.0	32.2	28.1	27.1	-	-	-
	MCIW	32.3	-	35.6	31.4	28.8	25.3	27.2	-	-
25-29	MOI	20.0	43.9	29.3	22.2	18.7	15.8	33.3	14.2	13.7
	MCIB	33.2	-	42.3	37.4	33.6	31.2	29.7	31.8	38.6
	MCIW	32.7	-	38.8	35.3	32.4	30.4	29.3	29.7	27.2
30-34	MOI	23.1	45.7	45.9	32.5	28.2	22.8	20.2	20.0	16.2
	MCIB	34.1	-	-	39.3	40.2	37.7	33.5	32.2	30.4
	MCIW	33.3	-	39.0	38.2	36.1	35.1	33.2	31.6	29.4
35-39	MOI	29.6	50.7	45.1	48.3	43.1	36.6	33.7	29.0	22.5
	MCIB	36.3	-	-	-	46.1	43.0	40.7	37.3	33.6
	MCIW	34.3	-	-	34.6	40.4	38.0	36.2	35.8	32.0
40-44	MOI	40.7		54.0	51.9	52.0	52.8	47.4	46.0	34.4
	MCIB	38.0	-	-	-	-	-	49.6	30.6	37.9
	MCIW	34.3	-	-	-	39.2	35.3	38.4	34.8	33.6

*Parities one and above for MOI and parities two and above for MCIB and MCIW.

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