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DETERMINANTS OF INFANT AND CHILD MORTALITY IN THE WEST BANK AND GAZA STRIP

JON PEDERSEN

Fafo, Institute for Applied Social Science, Box 2947 Tøyen, N 0608 Oslo, Norway

Summary. Infant and child mortality in the West Bank and Gaza Strip has steadily reduced since 1967, even though fertility has remained extremely high. In this paper the determinants of infant and child mortality are discussed, with particular emphasis on the role of consanguineous marriages, short birth spacing and maternal education. It is shown that short birth spacings and type of marriage are more important determinants of infant mortality than maternal education. Moreover, the relative role of consanguineous marriages appears to increase with time.

Introduction

In general, Arab countries have seen a substantial decline in infant and child mortality during the past 30 years, and the West Bank and Gaza Strip are no exceptions. In 1967 Israel occupied the West Bank and Gaza Strip. The census of that year found infant mortality to be around 150 per 1000 and child mortality 200 per 1000 (SICBS, 1996). Until around 1987 mortality declined steadily, at which time it stabilized at a level of approximately 30 per 1000 in both the West Bank and the Gaza Strip (Pedersen, 1997). As in other Arab countries (Tabutin, 1994), there appears to have been a concomitant change from a slight surplus of female infant and child mortality to the slight surplus of male mortality commonly reported in economically developed countries.

However, little is known about the determinants of infant and child mortality in the West Bank and Gaza. While some studies were carried out prior to the Declaration of Principles of 1993, most had small sample sizes that could not detect differences in mortality patterns between the various groups, especially with the fairly low overall mortality. An overview of these studies can be found in PBS (1994). While Israel through its Civil Administration of the Occupied Territories and Ministry of Health conducted vital registration and monitoring of mortality, a substantial proportion of deaths were missed and little contextual information was recorded (SIMH, 1990; SICBS, 1996). The registration of deaths has been continued by the Palestinian administration, but under-registration remains a problem (PNAMH, 1996).

The present paper seeks to address some of the issues pertaining to the mortality patterns of children in the West Bank and Gaza Strip. Of particular interest are four sets of explanatory variables. The first is birth interval, i.e. the time elapsed between a birth and the immediately preceding delivery. In the West Bank and Gaza Strip, 33% of birth intervals are 17 months or less. While it is well established that short birth intervals are correlated with increased infant and child mortality (Palloni, 1989), it is of considerable importance to assess their overall effects in the context of this extremely high proportion of short intervals.

A second variable is maternal education. The fertility pattern in the West Bank and Gaza Strip is characterized by rather weak effects of maternal education on fertility, and the effect operates mainly through the fact that educated women tend to marry later than their less educated counterparts. Once married, however, the differentials in fertility are rather small, with a total marital fertility among women in the West Bank of 9·4 and a variation according to educational status of not more than 0·6. In the Gaza Strip the corresponding figures are 10·7 and 0·7. It therefore is of interest whether this apparent lack of effect of education on fertility also holds for mortality.

A third issue is that of consanguineous marriage. Marriage between close biological kin is common in many Arab countries (Bittles, 1995). According to the demographic survey of the West Bank and Gaza (see below), around 29% of marriages take place between first cousins, and a further 20% are contracted within the wider patrilineal clan, the *hamulah*. Several studies both from the Middle East and from other parts of the world have documented substantial effects on the mortality of the offspring of consanguineous marriages (e.g. Bittles, 1994; Boisvert & Mayer, 1994). The West Bank and Gaza are ideal locations to estimate the effects of consanguinity on childhood mortality. First, the high frequency of consanguineous marriage assures sufficient cases for analysis. Second, in studies in developed countries, it has been claimed that issues of racism and differential treatment at hospitals may arise (Ahmad, 1994), because the children of consanguineous marriages are often born to minority ethnic groups. These types of intervening variables do not come into play in the Middle East, as consanguineous marriages are widely socially accepted and representative of majority ethnic groups. A final consideration is whether the level of child mortality associated with consanguineous marriage changes in importance at varying overall levels of mortality.

The fourth issue to be addressed is the period in which the children were born. As indicated above, the mortality decline appears to have been arrested around 1987 which coincides with the start of the Palestinian uprising, the *intifada*. Of considerable relevance for the understanding of the mortality patterns is therefore whether the effects of the various determinants of infant and child mortality changed in relative importance coincidental with the arrest of the mortality decline.

Subjects

The data set on which these investigations are based is the Demographic Survey of the Occupied Palestinian Territories, carried out by the Palestinian Central Bureau of Statistics (PCBS) in co-operation with Fafo in 1995. In the survey, 15,683 households were interviewed, representing a total of 110,574 household members, 25,452 of whom

were women aged 14–54. A total of 16,204 ever-married women were interviewed about their birth history. In the birth history all children ever born alive to each woman were recorded, along with the sex and date of birth. Survival status was also recorded, together with the age at death or date of death of any children if known. The complete birth history file contains data on 78,490 children. The total survey comprised either a stratified two-stage (in Gaza) or three-stage (in parts of the West Bank) probability sample. The sample frame was derived from population estimates produced by PCBS for small areas of the West Bank and Gaza, and final-stage sampling was carried out from lists constructed during a mapping and listing of selected clusters.

Apart from the basic demographic data, the survey also inquired about a number of background variables, especially relating to the household and the woman. There were no direct measures of socioeconomic status, but the possession of specific household goods was listed and combined into an index to indicate the economic resources available to the household. Consanguinity status was determined from the actual kinship terms used to refer to relatives. Arabic kinship terminology is denotative, i.e. relatives are referred to using descriptions of the precise kinship link. The questions thus reveal whether or not the cousins are on the maternal or paternal side, and if they are cross or parallel cousins. They have, however, been recoded for purposes of analysis into cousins, relatives within the clan and more distant or non-relatives.

The data can generally be considered of high quality, although there are some problems with regard to infant and child mortality. The calendar year ratios given in Table 1 show that while overall birth reporting appears satisfactory, the mean sex ratio at birth is somewhat biased towards males, and the sex ratios at birth of children now-deceased show considerable bias in favour of males. This is consistent with other sources that consistently show some under-reporting of females, both living and dead. Another consideration is that while short birth intervals are characteristic of the Palestinian fertility pattern, there appears to be a tendency to record birth spacings which are impossibly short. There is little evidence of significant differences in the reporting of births between the West Bank and the Gaza Strip. Restriction of the sample to ever-married women probably leads to a downward bias in mortality estimates because unmarried mothers are extremely marginalized, but the effect is likely to be unimportant in overall terms as extremely few children are born out of wedlock in either area.

Methods

The analysis follows a three-stage approach. First, to place the importance of the various explanatory factors into perspective, some of the characteristics of the population will be presented. Second, a number of the bivariate associations between infant and child mortality and the explanatory variables will be examined. The mortality measures have been directly calculated from the birth history data by the synthetic cohort method that is commonly used in, for instance, Demographic and Health Surveys (Curtis, 1995).

Third, it seems probable that the different explanatory variables operate in combination to create the overall mortality pattern, so proportional hazards

Table 1. Calendar year ratios for the birth history data of the Demographic Survey

Year of birth	Total births	Total births still alive	Total births now dead	Complete birth date %	Still alive with complete birth date	Dead with complete birth date	Sex ratio at birth	Sex ratio at birth, still living
95	1483	1456	27	100	100	100	106·3	105·1
94	4291	4176	115	99·9	100	97·4	107·3	107·1
93	4381	4252	129	99·7	99·9	93·8	112·6	111·8
92	4230	4090	140	99·6	99·8	94·3	109	107·8
91	4217	4073	144	99·7	99·9	93·1	107·6	106·2
90	4029	3878	151	99·4	99·8	88·7	108	107·5
89	3736	3609	127	99·4	99·8	87·4	106·8	105·2
88	3409	3291	118	99·3	99·8	86·4	112·7	112·7
87	3181	3036	145	99	99·7	82·8	103·1	102·8
86	3111	2975	136	98·8	99·9	76·5	104	105·2
85	3082	2914	168	98·6	99·7	79·8	105·5	106·1
84	3048	2868	180	98·5	99·8	78·9	110·6	111
83	2969	2793	176	98·5	99·9	76·7	103·5	103·9
82	2832	2661	171	98·4	99·8	76	100·6	101
81	2576	2424	152	98·1	99·7	73·7	102·4	103·2
80	2627	2425	202	97·1	99·3	70·8	108·5	110

Note: the calendar year ratio is calculated as $CR = 2B/(B_{i-1} + B_{i+1})$, where B_i is number of births in year i.

regression will be used to explore some of the multivariate dependencies. In proportional hazards regression (or Cox regression), the time-dependent hazard function $\lambda(t)$ is seen as the product of a non-parametric baseline hazard function $\lambda_0(t)$ and a vector of coefficients (for a vector of variables x, as given in the equation below; Parmar & Machin, 1995);

$$\lambda(t) = \lambda_0(t) \exp(\beta^T x).$$

The method thus estimates a baseline hazard function which is modified by the coefficient estimates for the various independent variables. From the equation emerges the implicit assumption of the proportional hazards regression, namely the proportionality of the hazards. This entails that for every value of t, i.e. on every point of the survival curve, there is a fixed factor with which to multiply the baseline hazard in order to obtain the hazard given a particular value of an explanatory variable.

For the mortality patterns found in subgroups represented in the data set, it is clear that the assumption of proportionality does not always hold. In particular, since mortality has been changing it is likely that the hazards depend substantially on the period when the child was born, as will be apparent from the data. Therefore separate baseline hazards are estimated for four groups of children, sub-divided by year of birth so that they split the data set roughly into four time periods.

Although 78,490 children were listed in the birth history file, only 74,570 were actually analysed in the regression models because of missing values for some variables. Of particular importance here is that the date of birth could not always be established with precision. Children who were born after the start of the survey also were excluded.

Since the sample design of the survey is complex, i.e. involving stratification, clustering and sample weights, the assumption that the observations are independently and identically distributed cannot be sustained. This is potentially problematic for some of the variables used, such as the type of marriage, which is fairly heavily clustered. For this reason the SURVIVAL procedure of SUDAAN 7·5 (Shah, Barnwell & Bieler, 1997) has been used for estimation, as this software corrects for the sampling design by Taylor series linearization of the variance estimators. The method has the added benefit that it also takes account of the clustering of characteristics within each birth history (see Curtis, Diamond & McDonald, 1993).

Results

The Palestinian population of the West Bank and Gaza is in some ways unique in its demographic dynamics. Its main feature is that fertility is very high while mortality is quite low. As Table 3 shows, this exists in a situation where a progressively increasing share of the births are to women who are well educated. While 61% of the births between 1980 and 1985 were to women with no education or incomplete primary education, the comparable figure for births in 1990–1994 was just 19%. During the same time period the share of births to women with secondary education increased from 8% to 27%. Differentials in mortality that are related to low education

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Table 2. Consanguineous (first) marriages by education and age of woman. Percentage of ever-married women

Education of woman	Age group (years)	Type of first marriage			
		Cousin	*Hamulah*	More distant or no relation	Unweighted count
None or incomplete elementary	10–19	40	18	42	85
	20–29	34	21	46	796
	30–39	32	24	44	1170
	40–49	30	24	46	1418
	50+	29	25	46	780
Elementary	10–19	27	24	49	444
	20–29	31	22	48	1355
	30–39	29	23	48	1167
	40–49	27	25	48	570
	50+	33	20	47	98
Preparatory	10–19	31	20	49	613
	20–29	28	21	51	1570
	30–39	33	18	50	864
	40–49	28	21	51	330
	50+	28	9	63	57
Secondary and more	10–19	31	19	50	150
	20–29	29	19	53	1812
	30–39	25	16	59	1173
	40–49	27	15	58	543
	50+	20	12	68	74
Total		29	21	50	15,069

of the mother must therefore be seen in perspective, as all the women now entering marriage have at least primary and preparatory education, and a large percentage are educated at secondary level.

Another noteworthy feature of the birth characteristics shown in Table 3 is that there has been little or no change in the proportion of births to couples in consanguineous unions during the four study periods. Thus the proportion of children born to parents who are cousins remained stable at around 29% to 30%, with a slight decline in the proportion of marriages contracted within the *hamulah* from 24% to 20%. The numbers are about the same as the proportion of women married consanguineously, and indicate that there is little difference in fertility between consanguineously married women and those who marry outside of the immediate family or clan. Moreover, as indicated in Table 2, there appears to have been little change in the socioeconomic profile of consanguineously married couples, as the proportion of kin marriage within different levels of education are essentially constant. Another stable factor is that of the birth intervals, which show very little change over the periods covered (Fig. 1).

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The bivariate associations presented in Table 4 have two features that are fairly constant across all associations. First, the overall mortality of the study group: the highest level of mortality was rarely greater than twice that of the lowest mortality group, and more often only about 30% higher. The glaring exception was in the difference in mortality between twins and non-twins, with a ${}_5Q_0$ (child mortality under 5 year) for twins approximately 4 times that of non-twins. However, as is clear from Table 3, twins make up only some 1·3% of all births, so their high mortality does not contribute significantly to the overall level.

A second feature is that both in relative and absolute terms, for many variables the differentials shown in Table 4 are reduced over time. In one case, that of sex, the direction of the differential actually altered. While boys had lower mortality than girls in 1980–1984, by 1990–1994 girls were slightly advantaged in terms of mortality (Table 4). Similarly, while refugees appeared to have higher mortality in the 1980s, their survival now approximates to that of the remainder of the population. It is true that the residents of refugee camps appear to have higher mortality, but they share that disadvantage with villagers in contrast to those resident in the towns and cities. The regional differences that previously existed appear to have more or less disappeared.

The variable indicating whether or not the household had a kitchen sink with piped water at the time of the survey appears to more efficiently detect differences in mortality for births before 1991 than after. This is surprising, since it can be assumed that the measurement error on the variable should increase the farther back in time one goes. It may indicate that those who presently do not have piped water are among the worst off, and that they have been so for some time. Similarly the index of household goods variable, a crude measure of socioeconomic rank, does not show any clear relation to mortality. This may primarily indicate the inefficiency of the measure rather than be a true reflection of the situation.

Consanguineous marriages show a clear bivariate association with mortality, with a difference in ${}_5Q_0$ of 27·9 per 1000 in 1980–1984, and 19·9 per 1000 in 1985–1989 and 17·3 per 1000 in 1990–1994. Thus the difference diminishes with time. Between the first and second periods (1980–1984 to 1985–1989), the reduction was approximately proportional to the overall reduction as ${}_5Q_0$ diminished from 57·8 to 40·3. However, between the second (1985–1989) and the last period (1990–1994) the reduction was slightly less than if it had been in proportion to the overall reduction in mortality.

Not surprisingly, birth intervals show up as a strong determinant in the bivariate associations, with children born after a short birth interval having higher mortality. Again, there is a gradual reduction of the difference with time.

The results of the proportional hazards models are given in Tables 5 and 6. In Table 5 the overall model and the contributions of each variable have been computed as Wald F statistics. Four models are given, and one for each of the time periods studied (1977 and before, 1978–1984, 1985–1990, 1991 and after). The only predictors that significantly influence the baseline hazard of child mortality for all time periods are preceding birth interval and consanguineous marriage. Twin status, sex and maternal education are significant predictors in three of the four time periods, but it is not easy to explain why they each fail as a predictor in one period.

Piped water is a surprisingly poor predictor of mortality, and refugee status appears not to influence mortality at all when controlled for other factors.

Table 3. Characteristics of births by year of birth. Percentages relative to the total number of births

Variable	Value	1977 and before	1978 to 1984	1985 to 1990	1991 and after
Preceding birth interval, twins included	First born	23·9	15·7	18·5	18·0
	≤17 mths	29·2	27·3	24·6	24·1
	18–23 mths	19·4	21·9	20·6	21·2
	24–35 mths	20·7	23·8	22·4	22·9
	36–47 mths	4·4	6·6	6·9	7·1
	48 mths and more	2·5	4·8	7·0	6·7
Twin status	Not twins	98·9	98·7	98·7	98·6
	Twins	1·1	1·3	1·3	1·4
Refugee status	Refugees, including non-registered	40·3	40·2	41·1	42·1
	Non-refugees	59·7	59·8	58·9	57·9
Mother's highest completed education	None or incomplete elementary	61·4	42·0	28·2	19·0
	Elementary	20·6	26·1	27·5	26·6
	Preparatory	9·8	16·6	21·9	26·9
	Secondary or more	8·2	15·2	22·3	27·5
Education of mother's father	No education	65·1	57·2	49·7	41·5
	1 to 6 years	15·4	21·6	26·2	27·7
	7 and more years	3·5	5·9	10·3	18·0
	Not known	16·0	15·3	13·8	12·8
Education of mother's mother	No education	87·9	85·1	78·8	70·5
	1 to 6 years	5·1	7·6	11·7	15·0
	7 and more years	1·7	2·3	4·7	9·8
	Not known	5·4	4·9	4·8	4·7

Table 3. *Continued*

Variable	Value	1977 and before	1978 to 1984	1985 to 1990	1991 and after
Type of marriage	Cousin	29·5	30·4	30·1	29·3
	Hamulah	23·5	22·5	21·7	20·0
	No relation or unknown	47·0	47·1	48·2	50·8
Sex	Male	52·1	52·1	51·8	52·1
	Female	47·9	47·9	48·2	47·9
Age of mother at birth	[14,20] years	30·6	18·5	17·9	20·6
	[21,30> years	57·3	51·1	50·6	49·2
	[30,> years	12·1	30·4	31·5	30·1
Region	WB-north	27·3	24·7	24·2	24·5
	WB-central	27·2	25·0	22·2	21·0
	Hebron	15·0	17·0	16·6	16·3
	Northern Gaza	16·0	17·2	19·3	19·7
	Southern Gaza	14·5	16·1	17·7	18·5
Type of location	Town/city	41·2	38·3	38·2	36·7
	Refugee camp	17·0	17·3	18·5	20·3
	Village	41·8	44·4	43·3	43·0
Sink with piped water	Sink with piped water	85·3	84·0	83·3	83·7
	No sink with piped water	14·7	16·0	16·7	16·3
Index of household goods	Low	30·0	31·0	31·5	32·9
	Middle	28·0	30·8	31·3	31·7
	High	42·0	38·2	37·1	35·4
Total	Unweighted valid *n*	20,219	19,029	20,548	18,610

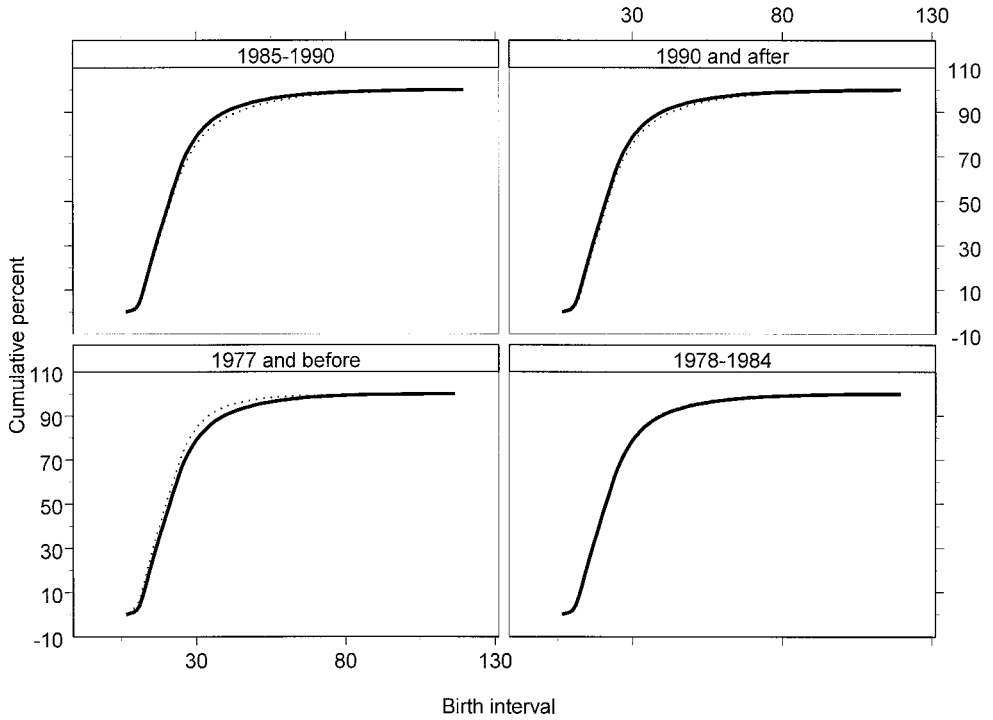

Fig. 1. Cumulative distribution of birth spacing (months) by year. Dotted line is average for all years; solid line is for each period.

The coefficients for each level of the variables are given in Table 6, which allows the pattern to be examined in detail. The effect of the birth interval variable is mainly created through the effect of being first born or having a preceding birth interval of 17 months or less. With one exception, in each of the four time periods these factors are associated with hazards ratios above 2, but the results of the regression also indicate that the effect of short birth intervals on mortality has been reduced over time. Twin status results in very high hazards ratios but, as noted above, they do not contribute significantly to the overall mortality level.

Maternal education is of greater importance in terms of contribution to the overall mortality level. The effect is partially, but not exclusively, brought about by the increased hazard for births to mothers with no education or incomplete education. However, as previously shown, this is a group of women that is sharply decreasing in number in the West Bank and Gaza Strip. The education of the parents of the mother does not seem to have any effect. If such an effect does exist it may be primarily associated with the mother, but since the direction of the effect is inconsistent it is rather difficult to interpret.

The strong effect exerted by marriage type arises mainly through the effect of cousin marriage. While marriages within the *hamulah* do show an effect, it is less pronounced. In contrast to the finding with the bivariate analysis, it appears that the importance of cousin marriage as a determinant of mortality increases over time.

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Table 4. Associations between selected variables and infant and child mortality (deaths per 1000). Year is start of 5 year period

Year	Characteristic	Neonatal	Postneonatal	$_1Q_0$	$_2Q_0$	$_3Q_0$	$_4Q_0$	$_5Q_0$
A: Highest education completed by mother								
1980	None or incomplete elementary	28·8	27·8	56·7	61·2	62·2	63·0	64·0
1980	Elementary	27·4	25·8	53·3	59·4	61·2	62·5	62·6
1980	Preparatory	24·0	15·0	39·0	42·9	43·1	43·1	44·7
1980	Secondary or more	27·3	15·7	43·1	46·5	46·9	47·7	48·1
1985	None or incomplete elementary	26·3	19·7	46·0	48·7	50·5	51·1	52·0
1985	Elementary	22·9	13·2	36·2	38·6	40·3	41·5	41·7
1985	Preparatory	17·8	9·2	26·9	28·1	31·4	32·1	32·8
1985	Secondary or more	17·6	9·6	27·1	30·9	31·4	31·4	32·1
1990	None or incomplete elementary	15·0	14·0	28·9	31·8	33·6	35·6	36·7
1990	Elementary	18·2	13·0	31·2	32·5	33·5	34·0	34·5
1990	Preparatory	18·2	10·0	28·3	31·1	33·2	33·9	35·7
1990	Secondary or more	13·6	7·6	21·2	23·3	24·3	25·7	27·0
B: Education of mother's mother								
1980	No education	27·2	24·3	51·4	56·0	57·1	58·0	58·9
1980	1 to 6 years	36·4	12·1	48·5	53·0	53·6	53·6	53·6
1980	7 and more years	22·1	10·0	32·1	32·1	32·1	32·1	32·1
1980	Not known	17·0	31·6	48·7	58·3	58·3	58·3	58·3
1985	No education	22·4	14·5	36·9	39·8	41·9	42·7	43·4
1985	1 to 6 years	16·8	10·2	27·1	27·1	27·7	27·7	28·3
1985	7 and more years	22·9	6·1	29·0	30·6	32·2	32·2	32·2
1985	Not known	19·8	11·0	30·8	32·3	32·3	33·3	33·3
1990	No education	17·0	10·6	27·6	30·1	31·8	33·0	34·2
1990	1 to 6 years	11·4	12·6	24·0	24·8	25·6	26·2	28·0
1990	7 and more years	22·1	8·9	31·0	34·3	34·8	36·0	36·0
1990	Not known	10·0	14·9	24·9	25·5	26·0	27·0	28·0

Table 4. *Continued*

Year	Characteristic	Neonatal	Postneonatal	$_1Q_0$	$_2Q_0$	$_3Q_0$	$_4Q_0$	$_5Q_0$
C: Education of mother's father								
1980	No education	25·6	23·8	49·4	54·9	55·8	56·6	57·4
1980	1 to 6 years	33·4	21·4	54·8	58·0	58·7	59·7	60·2
1980	7 and more years	32·5	12·3	44·8	48·3	53·9	56·1	58·0
1980	Not known	22·4	28·8	51·2	55·6	56·0	56·0	56·9
1985	No education	22·2	15·1	37·3	39·9	41·7	42·3	43·4
1985	1 to 6 years	21·2	10·8	32·0	33·9	36·5	37·1	37·2
1985	7 and more years	17·2	10·4	27·7	31·2	32·3	32·3	32·3
1985	Not known	23·5	14·8	38·3	41·1	42·2	43·6	43·6
1990	No education	17·1	12·5	29·6	32·4	33·9	35·3	36·7
1990	1 to 6 years	16·4	10·1	26·5	28·2	29·8	31·0	31·7
1990	7 and more years	15·2	9·8	24·9	27·0	28·4	29·3	30·7
1990	Not known	14·9	9·4	24·3	25·5	26·5	26·9	27·7
D: Type of marriage								
1980	Cousin	34·6	27·0	61·5	68·9	70·3	71·4	72·7
1980	*Hamulah*	33·0	25·2	58·2	62·8	63·6	64·4	65·1
1980	No relation or unknown	19·9	20·0	39·9	42·8	43·7	44·3	44·8
1985	Cousin	29·6	15·9	45·5	49·1	51·8	52·5	53·6
1985	*Hamulah*	19·7	13·1	32·8	34·2	36·9	37·7	38·6
1985	No relation or unknown	17·5	12·1	29·7	32·0	32·9	33·5	33·7
1990	Cousin	19·8	17·2	37·0	40·2	41·8	42·5	44·1
1990	*Hamulah*	15·4	11·1	26·4	29·5	31·3	32·8	33·7
1990	No relation or unknown	14·6	7·4	22·0	23·2	24·5	25·7	26·8
E: Refugee status								
1980	Refugees, including non-registered	30·9	22·2	53·1	57·9	58·6	59·3	60·3
1980	Non-refugees	24·9	24·1	49·0	53·6	54·8	55·7	56·4
1985	Refugees, including non-registered	21·0	13·2	34·2	36·8	39·8	40·5	41·3
1985	Non-refugees	22·1	13·8	35·8	38·4	39·4	40·1	40·7
1990	Refugees, including non-registered	15·9	11·4	27·3	29·8	31·1	32·6	33·7
1990	Non-refugees	16·6	10·7	27·2	29·2	30·8	31·7	32·9

Table 4. *Continued*

Year	Characteristic	Neonatal	Postneonatal	$_1Q_0$	$_2Q_0$	$_3Q_0$	$_4Q_0$	$_5Q_0$
F: Age of mother								
1980	Mother 14–20 years	38·3	24·0	62·3	69·4	71·6	72·2	73·4
1980	Mother 21,30> years	23·3	24·0	47·2	51·8	52·6	52·8	53·5
1980	[30,> years	27·1	21·0	48·1	51·6	52·2	54·1	54·8
1985	[14,20] years	27·0	15·7	42·7	44·5	46·6	46·6	46·9
1985	[21,30> years	19·8	12·6	32·3	34·7	36·2	36·9	37·7
1985	[30,> years	21·6	13·8	35·4	38·6	40·9	41·9	42·4
1990	[14,20] years	17·8	12·4	30·2	31·9	33·1	34·2	35·6
1990	[21,30> years	16·4	10·6	27·0	29·4	30·9	31·7	32·4
1990	[30,> years	14·8	10·6	25·4	27·7	29·2	31·0	32·7
G: Preceding birth interval, twins included								
1980	First born	36·8	17·4	54·2	58·6	60·1	61·0	62·2
1980	≤17 mths	40·2	37·0	77·2	84·0	84·9	85·7	85·7
1980	18–23 mths	16·5	20·1	36·6	39·7	40·4	41·5	42·0
1980	24–35 mths	15·4	18·1	33·5	38·0	38·9	39·9	41·7
1980	36–47 mths	12·1	10·2	22·3	26·5	27·4	27·4	27·4
1980	48 mths and more	13·9	9·5	23·4	27·3	27·3	27·3	27·3
1985	First born	20·7	11·5	32·2	34·5	35·9	36·3	37·3
1985	≤17 mths	37·2	21·6	58·8	62·1	64·5	65·4	66·6
1985	18–23 mths	16·9	9·1	26·0	28·7	30·2	30·2	30·2
1985	24–35 mths	11·2	8·8	20·0	22·2	24·8	26·4	26·7
1985	36–47 mths	10·9	10·2	21·0	22·5	23·4	23·4	24·5
1985	48 mths and more	12·0	9·1	21·1	21·9	21·9	21·9	21·9
1990	First born	17·5	10·8	28·3	30·6	32·0	33·8	34·6
1990	≤17 mths	23·7	11·9	35·6	37·4	39·1	40·4	41·0
1990	18–23 mths	13·5	9·7	23·2	26·1	27·4	28·6	30·3
1990	24–35 mths	10·1	11·0	21·1	23·0	24·8	25·7	26·5
1990	36–47 mths	10·9	8·8	19·7	22·6	22·8	22·8	24·4
1990	48 mths and more	16·6	6·8	23·4	24·2	25·9	26·5	28·5

Table 4. *Continued*

Year	Characteristic	Neonatal	Postneonatal	$_1Q_0$	$_2Q_0$	$_3Q_0$	$_4Q_0$	$_5Q_0$
H: Sex								
1980	Male	26·4	22·1	48·5	52·3	53·4	53·9	54·6
1980	Female	28·3	24·6	52·9	58·5	59·4	60·6	61·5
1985	Male	24·3	11·7	36·0	38·1	39·8	40·5	41·2
1985	Female	18·8	15·5	34·3	37·2	39·3	40·0	40·5
1990	Male	19·1	11·2	30·3	32·4	34·7	35·4	36·7
1990	Female	13·2	10·7	24·0	26·2	26·7	28·3	29·3
I: Twin status								
1980	Not twins	25·6	22·8	48·4	53·2	54·1	54·9	55·6
1980	Twins	171·2	54·7	225·9	225·9	231·9	231·9	236·5
1985	Not twins	20·8	12·7	33·5	36·0	37·8	38·5	39·2
1985	Twins	88·6	68·8	157·4	162·0	164·4	164·4	164·4
1990	Not twins	15·9	10·4	26·3	28·4	29·9	31·0	32·2
1990	Twins	47·2	49·4	96·5	100·0	100·0	102·1	106·6
J: Index of household goods								
1990	Low	17·9	14·2	32·1	34·2	35·9	37·3	38·9
1990	Middle	17·4	9·0	26·4	28·6	30·0	31·5	32·2
1990	High	13·9	9·8	23·7	25·9	27·3	27·9	29·1
K: Region								
1980	West Bank	26·6	24·5	51·1	55·5	56·4	57·4	58·3
1980	Gaza	28·7	21·0	49·7	55·0	56·2	56·6	57·2
1985	West Bank	21·9	13·1	35·0	37·2	38·7	39·6	40·1
1985	Gaza	21·2	14·3	35·5	38·7	41·1	41·3	42·3
1990	West Bank	15·2	10·3	25·5	27·7	29·2	30·1	31·0
1990	Gaza	18·0	12·1	30·2	32·3	33·8	35·3	37·0
L: Region detailed								
1980	WB-north	27·9	21·8	49·7	54·5	55·1	57·4	58·8
1980	WB-central	26·7	22·5	49·2	53·5	54·2	54·6	55·4
1980	Hebron	24·6	31·3	55·9	60·0	61·5	61·5	61·7

Table 4. *Continued*

Year	Characteristic	Neonatal	Postneonatal	$_1Q_0$	$_2Q_0$	$_3Q_0$	$_4Q_0$	$_5Q_0$
L: Region detailed *continued*								
1980	Northern Gaza	28·0	18·2	46·2	49·4	49·8	49·8	50·6
1980	Southern Gaza	29·5	24·0	53·5	61·0	63·1	63·9	64·2
1985	WB-north	25·5	12·1	37·6	40·4	41·6	42·7	43·1
1985	WB-central	16·9	10·5	27·4	28·6	30·8	31·9	32·1
1985	Hebron	23·5	18·0	41·5	44·0	45·2	45·5	46·4
1985	Northern Gaza	16·9	13·2	30·1	32·4	34·6	34·6	35·6
1985	Southern Gaza	25·9	15·5	41·4	45·5	48·1	48·7	49·6
1990	WB-north	16·5	7·9	24·3	26·6	29·4	30·9	32·1
1990	WB-central	16·0	10·4	26·4	28·2	28·7	29·2	29·5
1990	Hebron	12·3	13·8	26·1	28·7	29·6	30·2	31·2
1990	Northern Gaza	16·9	11·3	28·2	30·8	31·6	32·7	34·3
1990	Southern Gaza	19·3	13·0	32·3	34·0	36·1	38·0	39·8
M: Place of residence								
1980	Town/city	25·7	16·0	41·7	44·9	45·9	46·8	47·4
1980	Refugee camp	34·4	22·5	57·0	62·3	63·5	64·2	65·4
1980	Village	25·9	30·0	55·9	61·6	62·5	63·2	64·0
1985	Town/city	17·1	10·8	27·9	29·9	31·9	32·3	33·3
1985	Refugee camp	21·1	11·1	32·1	36·0	38·7	39·1	39·3
1985	Village	26·0	17·0	42·9	45·3	46·7	47·7	48·2
1990	Town/city	13·7	10·1	23·8	26·3	27·5	28·6	29·9
1990	Refugee camp	17·9	11·0	28·9	30·9	32·4	33·8	35·1
1990	Village	17·7	11·8	29·5	31·5	33·1	34·2	35·2
N: Piped water in household								
1980	Sink with piped water	25·3	21·2	46·4	50·8	52·0	52·9	53·6
1980	No sink with piped water	38·3	34·6	72·8	79·2	79·4	79·8	81·1
1985	Sink with piped water	21·0	11·9	32·9	35·2	37·1	37·7	38·3
1985	No sink with piped water	24·8	21·5	46·3	50·1	51·9	52·5	53·5
1990	Sink with piped water	16·2	9·9	26·1	28·4	29·7	30·8	32·1
1990	No sink with piped water	16·6	15·7	32·3	34·5	36·6	38·1	38·5

Table 5. Overall model and variable measures for time-continuous proportional hazards regression model of months lived by children in the West Bank and Gaza Strip. Stratified by year of birth of child. Design-corrected Wald *F* statistic

Contrast	Degrees of freedom	1977 and before		1978–1984		1985–1990		1991–1995	
		Wald *F*	*p* value Wald *F*	Wald *F*	*p* value Wald *F*	Wald *F*	*p* value Wald *F*	Wald *F*	*p* value Wald *F*
Overall model	30	19·27	0·000	12·76	0·0000	8·61	0·000	3·9	0·000
Preceding birth interval	5	56·2	0·000*	38·38	0·0000*	20·27	0·000*	4·18	0·001*
Twin status	1	50·76	0·000*	12·45	0·0005*	1·05	0·306	18·96	0·000*
Refugee status	1	0·18	0·670	0·62	0·4316	0·15	0·698	0·01	0·918
Education of mother	3	14·96	0·000*	4·76	0·0029*	1·45	0·229	4·76	0·003*
Education of mother's mother	3	2·14	0·095	0·67	0·5713	2·14	0·095	1·49	0·216
Education of mother's father	3	0·49	0·692	0·41	0·7489	1·25	0·290	1·04	0·374
Type of marriage	2	6·08	0·003*	15·26	0·0000*	13·79	0·000*	10·66	0·000*
Sex	1	7·91	0·005*	4·31	0·0385*	0·85	0·356	8·25	0·004*
Age of mother at delivery	2	12·19	0·000*	2·4	0·0924	3	0·051	0·07	0·936
Region	4	10·46	0·000*	0·82	0·5120	3·12	0·015*	1·32	0·262
Type of location	2	0·26	0·772	1·34	0·2620	4·01	0·019*	1·56	0·211
Piped water	1	3·84	0·051	8·81	0·0032*	0·08	0·782	0·49	0·483
Index of household goods	2	4·39	0·013*	0·98	0·3781	0·44	0·643	0·01	0·991

*$p<0·05$.

Table 6. Coefficients of time-continuous proportional hazards models for months lived by children in the West Bank and Gaza Strip. Stratified by year of birth. Design-based estimates and standard errors

Independent variables and effects	1977 and before					1978–1984					1985–1990					1991–1995				
	β coeff.	SE β	t test $B=0$	p value t test $B=0$	Hazards ratio	β coeff.	SE β	t test $B=0$	p value t test $B=0$	Hazards ratio	β coeff.	SE β	t test $B=0$	p value t test $B=0$	Hazards ratio	β coeff.	SE β	t test $B=0$	p value t test $B=0$	Hazards ratio
Preceding birth interval																				
First born	0·9	0·23	3·83	0·0001	2·45	0·71	0·22	3·21	0·0015	2·04	0·52	0·23	2·31	0·0217	1·69	0·17	0·23	0·72	0·4701	1·18
≤17 mths	1·44	0·23	6·19	0	4·22	1·14	0·22	5·27	0	3·12	1	0·21	4·72	0	2·72	0·38	0·22	1·76	0·0793	1·46
18–23 mths	0·76	0·24	3·14	0·0018	2·13	0·33	0·22	1·47	0·143	1·39	0·25	0·21	1·15	0·2497	1·28	0·14	0·22	0·63	0·5289	1·15
24–35 mths	0·47	0·23	1·99	0·0473	1·59	0·26	0·22	1·19	0·2364	1·3	0·12	0·22	0·55	0·5794	1·13	−0·16	0·23	−0·69	0·4883	0·85
36–47 mths	0·4	0·3	1·32	0·1862	1·49	0·01	0·27	0·02	0·9814	1·01	0·06	0·24	0·24	0·8113	1·06	−0·18	0·28	−0·65	0·5184	0·83
48 mths and more	0	0			1	0	0			1	0	0			1	0	0			1
Twin status																				
Not twins	0	0			1	0	0			1	0	0			1	0	0			1
Twins	1·81	0·25	7·12	0	6·13	1·84	0·52	3·53	0·0005	6·27	0·54	0·53	1·02	0·306	1·72	1·68	0·39	4·35	0	5·37
Refugee status																				
Refugees, including non-registered	0·02	0·06	0·43	0·6695	1·03	0·07	0·09	0·79	0·4316	1·07	0·04	0·09	0·39	0·6978	1·04	−0·01	0·14	−0·1	0·918	0·99
Non-refugees	0	0			1	0	0			1	0	0			1	0	0			1
Highest education completed																				
None or incomplete elementary	0·71	0·16	4·55	0	2·03	0·32	0·12	2·68	0·0077	1·38	0·26	0·14	1·84	0·0661	1·29	0·55	0·17	3·34	0·0009	1·74
Elementary	0·45	0·17	2·58	0·0104	1·57	0·15	0·12	1·22	0·2248	1·16	0·11	0·13	0·83	0·4078	1·11	0·48	0·14	3·36	0·0009	1·62
Preparatory	0·22	0·16	1·41	0·1583	1·24	−0·04	0·12	−0·35	0·7257	0·96	0·04	0·13	0·28	0·7829	1·04	0·37	0·16	2·24	0·0258	1·44
Secondary or more	0	0			1	0	0			1	0	0			1	0	0			1
Education of mother's mother																				
No education	0·09	0·12	0·7	0·4851	1·09	0·15	0·15	1·01	0·3137	1·16	0·52	0·25	2·04	0·0416	1·68	−0·16	0·29	−0·56	0·5761	0·85
1 to 6 years	0	0·2	0·01	0·9914	1	0·17	0·2	0·85	0·3977	1·19	0·58	0·26	2·25	0·0247	1·79	−0·47	0·31	−1·51	0·1329	0·62
7 and more years	−0·75	0·36	−2·06	0·0404	0·47	−0·13	0·3	−0·42	0·672	0·88	0·73	0·31	2·33	0·0206	2·07	−0·05	0·31	−0·16	0·8735	0·95
Not known	0	0			1	0	0			1	0	0			1	0	0			1
Education of mother's father																				
No education	−0·01	0·08	−0·09	0·9305	0·99	−0·06	0·1	−0·6	0·5474	0·94	−0·06	0·13	−0·44	0·6628	0·94	0·22	0·17	1·33	0·1858	1·25
1 to 6 years	−0·11	0·11	−1·03	0·3043	0·89	0·04	0·11	0·31	0·7548	1·04	−0·21	0·14	−1·43	0·1527	0·81	0·3	0·19	1·58	0·116	1·36
7 and more years	0·02	0·2	0·08	0·9347	1·02	0·01	0·17	0·04	0·9692	1·01	−0·3	0·19	−1·56	0·1196	0·74	0·34	0·2	1·67	0·0962	1·41
Not known	0	0			1	0	0			1	0	0			1	0	0			1

Table 6. *Continued*

Independent variables and effects	1977 and before					1978–1984					1985–1990					1991–1995				
	β coeff.	SE β	t test $B=0$	p value t test $B=0$	Hazards ratio	β coeff.	SE β	t test $B=0$	p value t test $B=0$	Hazards ratio	β coeff.	SE β	t test $B=0$	p value t test $B=0$	Hazards ratio	β coeff.	SE β	t test $B=0$	p value t test $B=0$	Hazards ratio
Type of marriage																				
Cousin	0·2	0·06	3·47	0·0006	1·22	0·44	0·08	5·39	0	1·56	0·46	0·09	5·09	0	1·58	0·48	0·11	4·39	0	1·61
Hamulah	0·1	0·06	1·68	0·0943	1·11	0·31	0·09	3·51	0·0005	1·36	0·14	0·13	1·08	0·2816	1·14	0·07	0·14	0·5	0·615	1·08
No relation or unknown	0	0			1	0	0			1	0	0			1	0	0			1
Sex																				
Male	−0·12	0·04	−2·81	0·0052	0·88	−0·12	0·06	−2·08	0·0385	0·89	0·07	0·08	0·92	0·356	1·08	0·27	0·09	2·87	0·0043	1·3
Female	0	0			1	0	0			1	0	0			1	0	0			1
Age of mother																				
[14,20] years	0·34	0·1	3·52	0·0005	1·41	0·07	0·09	0·75	0·4514	1·07	−0·08	0·13	−0·6	0·5468	0·92	−0·04	0·18	−0·2	0·8407	0·97
[21,30> years	0·06	0·08	0·67	0·5022	1·06	−0·09	0·08	−1·13	0·2588	0·92	−0·25	0·11	−2·32	0·0209	0·78	0·02	0·11	0·19	0·8528	1·02
[30,> years	0	0			1	0	0			1	0	0			1	0	0			1
Region																				
WB-north	−0·51	0·09	−5·45	0	0·6	−0·04	0·13	−0·32	0·7526	0·96	−0·34	0·14	−2·37	0·0185	0·71	−0·26	0·18	−1·46	0·1449	0·77
WB-central	−0·33	0·1	−3·38	0·0008	0·72	−0·19	0·14	−1·32	0·1877	0·83	−0·53	0·17	−3·03	0·0026	0·59	−0·36	0·2	−1·78	0·0755	0·7
Hebron	−0·3	0·1	−3·02	0·0027	0·74	−0·16	0·14	−1·15	0·2511	0·85	−0·27	0·13	−2·13	0·0339	0·76	−0·42	0·2	−2·07	0·0394	0·66
Northern Gaza	0·06	0·09	0·66	0·5072	1·06	−0·02	0·12	−0·16	0·8733	0·98	−0·39	0·14	−2·84	0·0048	0·68	−0·11	0·15	−0·72	0·4708	0·9
Southern Gaza	0	0			1	0	0			1	0	0			1	0	0			1
Type of location																				
Town/city	−0·04	0·07	−0·64	0·5236	0·96	−0·11	0·09	−1·24	0·2141	0·9	−0·23	0·11	−2·08	0·038	0·8	−0·17	0·13	−1·31	0·1923	0·84
Refugee camp	−0·05	0·09	−0·59	0·554	0·95	0·04	0·13	0·33	0·7436	1·04	−0·38	0·14	−2·67	0·0079	0·69	0·02	0·17	0·09	0·9307	1·02
Village	0	0			1	0	0			1	0	0			1	0	0			1
Sink with piped water in household																				
Sink with piped water present	−0·13	0·07	−1·96	0·0506	0·87	−0·29	0·1	−2·97	0·0032	0·75	−0·03	0·11	−0·28	0·7818	0·97	−0·09	0·13	−0·7	0·4832	0·91
Sink with piped water absent	0	0			1	0	0			1	0	0			1	0	0			1
Household goods index																				
Low	0·19	0·07	2·73	0·0066	1·21	0·08	0·1	0·79	0·4309	1·09	0·1	0·12	0·8	0·4233	1·1	0	0·13	0·03	0·9798	1
Middle	0	0·06	0·04	0·9656	1	−0·04	0·09	−0·49	0·6222	0·96	0·01	0·11	0·09	0·9299	1·01	0·02	0·13	0·13	0·8946	1·02
High	0	0			1	0	0			1	0	0			1	0	0			1

Thus, the hazard ratios increase steadily from 1·22 for the period before 1977, to 1·61 for the period after 1991.

Sex is one of the variables that influences only in three out of four periods, and the coefficients indicate why this is so: it changes in importance from males having a lower hazard in the first period to a slightly lower one for females in the last period.

Except for the first time period, a reduction in the survival prospects of the children of young mothers is not substantiated.

The geographical variable that distinguishes between the various parts of the West Bank and Gaza is not entirely consistent, but it appears that the Central West Bank (which includes East Jerusalem and Ramallah as well as Hebron) is better off than the other areas. The location variable that discriminates between towns, refugee camps and villages appears to lose much of its explanatory power when it is controlled by the other variables in the regression.

Conclusion

Birth intervals and first births remain associated with mortality even when at least some socioeconomic factors and factors related to reproduction, such as maternal age, are controlled for. Short birth intervals are particularly important in the West Bank and Gaza, because so far the birth intervals have been extremely stable. However, the effects of short birth intervals and the status of first born on mortality have reduced considerably during the period covered in this study, which could be interpreted as signifying improvements in maternal and child care.

Similarly, there are few signs that consanguineous marriages may be on the wane, and the effect of consanguinity on mortality remains considerable, even when controlling for other variables. In this respect the results from the West Bank and Gaza Strip are in contrast to what has been reported from Beirut, where the frequency of more remote forms of inbred unions appears to be declining and there is an inverse relation between frequency and social class (Khlat, 1988).

The education of women does not appear to have much effect on either birth spacing or marriage to close kin. However, there is a significant inverse relationship between maternal education and infant and child mortality. Thus, while education is only related to fertility through its effect on age at marriage and the proportion married, it does have an effect on the child mortality level. Thus, while educated women have somewhat fewer children than women with little education, this is compensated for by the fact that slightly more of their children survive.

The question of the relative effects exerted by the different variables on mortality levels over time is more difficult to answer. The best example of a change in the importance of a specific variable through time is that of sex, which follows the pattern outlined by Tabutin (1994), whereby a slight surplus in female mortality is turned into a slight male excess over time. The role of consanguineous marriage as a predictor of mortality appears to increase during the study period, while birth intervals and first-born status appear to decrease in importance. Thus it is tempting to speculate that as mortality rates decline in general, the significance of the genetic contribution to deaths in infancy and childhood associated with close-kin marriage will simultaneously increase in proportional terms, a trend that seems set to continue into the foreseeable future.

Seen as a whole, the findings in this study indicate that studies of the determinants of infant and child mortality in societies where consanguineous marriages are common must take into account the degree of consanguinity of the parents, in addition to the more commonly investigated sociodemographic factors. If that is not done, the analytical models will be mis-specified and therefore potentially seriously biased.

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