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Reduction in Infant and Child Mortality: A Strategic Key for Population Stabilization

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ABSTRACT

This study examined that infant and child mortality has adverse consequence on population stabilization in rural Punjab, Pakistan: The results of this study are based on a survey conducted in 2005 in three different regions of rural Punjab, Pakistan. The survey collected the retrospective birth histories for a sample of 1751 women under 49 years who experienced at least one live birth. A systematic random sample was employed by a three stage stratified random sampling design. It was concluded that the death of a child under the age of five years of age necessarily replaces it by another next live birth. Greater is the likelihood for next live birth if an infant or a child dies under the age of five years. Furthermore, population stabilization can be successfully achieved by reducing infant and child mortality.

Key Words: Population stabilization; Retrospective birth histories; Child replacement

INTRODUCTION

Death is certain: a universally accepted fact. The human society, even having acknowledged this universal truth has been continuously trying to postponing death since the dawn of civilization. Developed nations are to some extent successful in it but the developing or underdeveloped countries seem to be failed in reducing overall mortality and suffer from quite a high infant and child mortality rate. In Pakistan every eleventh child, who is born alive, dies before reaching one year of age (Cleland *et al*., 1998). This figure is extremely high when compared with infant mortality rates for some developed countries like New Zealand and United States, where these rates are 6.7 and 7.2, respectively (Boldstad, 2001). By 2000, a number of these developed countries had reached the replacement level of 2.1 births per women (Ross *et al*., 2004). However, in case of Pakistan it is a dream only, because of the high infant mortality rates, which are 9.5 and 10.6% in rural areas of Pakistan (Government of Pakistan, 2001a).

Following the world summit for children in 1990, government of Pakistan through health department introduced National Population Policy to achieve population stabilization by the year 2020 to improve quality of life (United Nations, 1999). This policy pays full attention towards awareness and promotion of family planning and family planning services to all married couples to limit their children. In researchers standpoint it would be un-wise to assume that the child replacement level can be achieved by focusing family planning services only as this has no conformity with high infant and child mortality rates (Ross *et al*., 2007), which seem to be the permanent constraints in meeting the objectives of the policy (Pollack *et al*., 2006). Therefore, there was a dire need to investigate and develop key strategies that could help in achieving the goal successfully. A pragmatic approach to meet the objective is perhaps the reduction of infant and child mortality rates as its high level contributes to high fertility (Sathar, 1987). This asserts that decline in infant and child mortality may decline the fertility to achieve the goal of population stabilization by 2020 (Government of Pakistan, 2001b). This research provides evidences that the death of an infant or child will necessarily be replaced by a new live birth, which would be the permanent constraint in achieving population replacement level by 2020.

MATERIALS AND METHODS

The universe. The universe for survey comprised all rural areas of the province of the Punjab, Pakistan defined by the 1998 Population Census Report (Government of Pakistan, 2001c).

Sampling details. A three stage sampling design was used to select a stratified sample from the population. The first two stages were area selection, while the third stage was a household selection, preferably a individual woman for ease of sampling. Married females below the age of 49 years, who experienced at least a single live birth, were eligible for interview. The districts in the region/stratum will be the first stage (primary) sampling units. Union councils in the district were treated as second stage sampling units. The first and second stage sampling units were selected randomly from each stratum. The sampling units at third stage were selected using systematic random sampling technique with probability proportional to size of stratum. The survey based on *de facto* method.

Sample size. In the light of varying characteristics of Punjab and variability for the parameters of which estimates are to be obtained, field resources available and reliability constraints a stratified random sample of size 1151

households were taken for reliable estimates of key characteristics (Cochran, 1977). The target area of survey consisted of 50.602 millions (68.73%) rural people out of 73.621 millions residing in 25875 villages spreading over 50602/359 = 140.95 sq. km.

Of course, there were shortcomings to sample implementation. In conducting the survey for present study, the lack of contact with each and every household selected for survey was the major one among many other sources of errors. Out of 1151 rural household selected for survey, 1021 households were successfully interviewed with a response rate (defined as the ratio of the number of selected units actually located & identified in the field) of 0.89 (1021/1151). This yielded 11% non-response a much more common problem in sampling survey, which often overestimates the true level and is unlikely to be a serious error (Marckwardt, 1984). Regarding the sample size of individual married women experiencing at least one live birth, the determined sample size comprised 1151*1.745 = 2008 individual married women. These women, below 49 years of age, were selected for interview, while the successfully achieved sample size was 1781. The response rates individual ever married women selected for survey was again observed as 89 = (1781/2008), which was reasonably high and un-likely to be serious in estimation.

Sampling frame and data collection. There were three divisions in each stratum and 11 districts in numbers in northern and central strata, while the southern stratum comprised 12 districts. The randomly selected primary sampling units were the districts Chakwal, Faisalabad and Layyah from northern, central and southern regions, respectively while the secondary sampling units selected were union council numbers 31 from village Khokar Bala in subtehsil Kalar Kahar of district Chakwal, 102 from village Muridwala of tehsil Samundary of Faisalabad district and 11 from village Sahu wala, Chak Shani of tehsil Karor Lal Esan of district Layya. The lists of households were obtained from Nazim and Naib Nazim of the respective union councils. The lists of households in the union councils were taken as sampling frame.

Questionnaire. The household questionnaire was developed to obtain information on certain characteristics of parents, family, housing, child and village indicating the region of stratification. The data on child characteristics regarding retrospective births and deaths history that included birth order, wants of birth, number of previous births, previous and succeeding birth intervals (birth spacing), place of birth, sex order, sex preference for boy, use of contraceptive for birth control, breast feeding duration, child and mother health condition at birth, child death, death of a previous child, sex of child died, age of child at child death, reason of death and next birth after death were collected.

Pre-testing. In order to ensure the validity and accuracy of interviewing schedule and quality of data, three pretests of the questionnaires were carried out in September 2004, when 114 households from villages 113 JB Sagodha road, district Faisalabad, 272 married women below the age of 49 from village Daulat Pur, Faisalabad and 300 married female respondents from Chistian, district Bahawalnagar were interviewed.

Proportion. The sample observations were divided into groups with common characteristics. One group was assigned number one (X = 1) to each member of this population while member of other group was assigned number zero (X = 0). After taking sample from population, the sum of assigned numbers $\sum X_i$, which was the sum of 1's and 0's was the number in sample belonging to group one and the mean of 1's and 0's is defined as proportion of the sample belonging to group one. The sampling distribution of proportions from the population was noted to have a finite variance and was approximately normal as the sample size was sufficiently large (Dixon, 1969).

Sampling distribution of proportion and test statistics. The sampling distribution of proportion from any population with a finite variance is approximately normal if the sample size is sufficiently large. The sample size in the present study was fairly large therefore, the hypothesis that p = 0.5 at any desired level of significance has been tested by the test statistics Z.

Confidence intervals. A statistics measured on one sample can rarely be exactly equal to a parameter. Therefore, 100(1-α) confidence belts were determined to describe the precision of the estimates.

Statistical hypothesis. A hypothesis typically arises in the form of speculation concerning observed phenomena of nature. When this speculation is translated into a statement concerning the distribution of the defined population or the distributions of several defined populations, the statement becomes a statistical hypothesis. Hypotheses in the present study were: there is likelihood for a live birth to occur after a child's death and likelihood for a live birth to occur after a child's death is greater if dead child is a male.

Definitions of parameters recorded. Household as a group of all those persons usually living together in a structure or dwelling and share their meals. A household may consist of one or more persons who may or may not be related to one another. The average household size in Punjab is 6.9 as reported in socio-economic indicators by Federal Bureau of Statistics (Government of Pakistan, 2000). Analysis of infant mortality has commonly been carried out in terms of the infant mortality rate (Shryock, 1976), which is defined as the number of deaths in one year. Child death is defined as a death between live birth and exact age five years as has been adopted for our study. Education was defined as the number of years of schooling completed. The present study classified education as literate and illiterate. Furthermore, nature of literate was recorded as religious or general at different levels. Sex of child refers to a child born to a mother whether a male or female. It is not itself a socio-economic, but a physiological attributes and is included to identify this behavioral response (Tekce & Shorter, 1984). A replacement child is defined as a person intentionally

conceived shortly after the death of an older sibling. Such substitutes endure the lifetime burden of competing with the lost and often idealized child. Thus when bereaved parents give the poor child or children subsequent to a prenatal death, there constructions of the family necessarily changes. The subsequent child is thought to be at risk of psychopathology (the replacement child syndrome) if parents have not sufficiently grieved their losses.

Computer programs and statistical packages for biostatistical analysis. For systematic approach to the analysis computer software version 13.00 of SPSS/PC+, Minitab V.14.2 and Microsoft Excel V.11.00 were used for organizing and analysis of data, to find meaningful differences among variables of interests, to build confidence intervals, for spreadsheets of data management and for graphic display of the relationship among important variables under study.

RESULTS AND DISCUSSION

Replacement of a child after the death of earlier one is rather a craze in certain developing countries. This study for the first time substantiates the theory of child replacement in Pakistan on the basis of data collected from rural Punjab of Pakistan. it was hypothesized that the likelihood for a next live birth to occur within an interval of 10 to 24 months after the death of a child under five years of age will be greater than the likelihood for a next live birth to occur with in some other interval defined as < 9 months or > 25 months after the death of a child under five. This provoked collecting evidences to apprehend that the probability of a next live birth to occur after the death of a child under five would not be equal to the probability of no next live birth to occur after the death of a child under five. Fig. 1 presents the histogram of the frequency distribution of all next live births that occurred after the death of an older sibling under five years of age. The approximation of the bell-shaped curve is noted and assumed to be normal for a valid application of Z-test statistics for comparisons. Fig. 2 shows the normal probability plot of distribution of all next live births that occurred after the death of an older sibling under five years of age, which indicates that the population of next births after deaths is a normal one and thus provides a base to uphold the assumption of normality for a valid application of Z-test statistics for comparisons (Zar, 2007).

Table I provides statistical analysis of next live birth after death of an older sibling less than five years of age. The data were sufficiently large and thus enjoy the support of central limit for normality assumption. Previous data provides reasonably good base for assuming the data as distributed normal (Fig. 1 & 2). This provides the base for application of Z-test statistic to test the hypothesis that likelihood for a live birth to occur within 10 to 24 months duration after the death of a child is greater than that of a live birth to occur within some duration other than 10 to 24 months after the death of an older sibling under five years of

Fig. 1. Histogram of Distribution of Next Birth after Death of a Child Under Five Years of Age

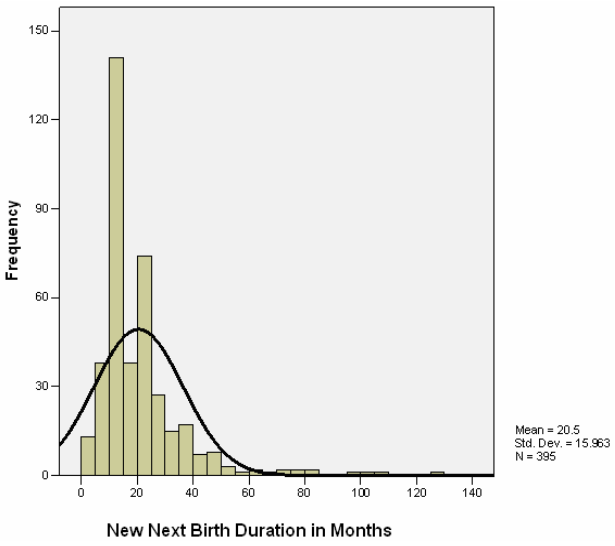
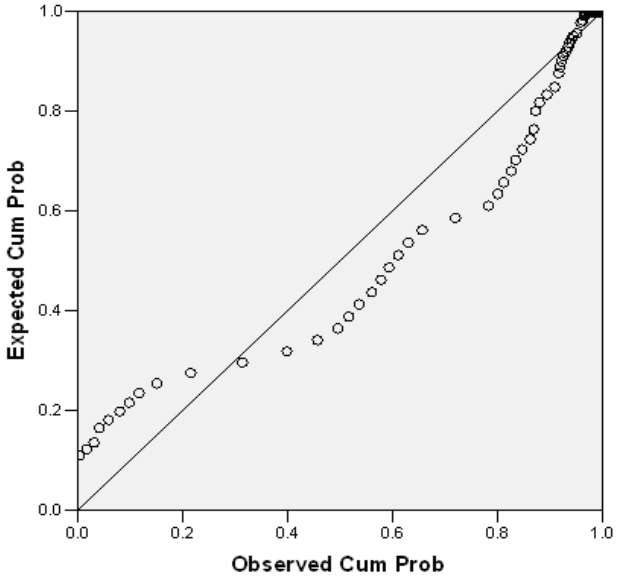


Fig. 2. Normal probability plot of Distribution of Next Birth after Death of a child under five years of age



age. The other duration is defined as the duration of occurrence of new next live births either before 10 months or after 24 months after the death of an older sibling less than the age of five years. This implied the dependent variable to be classified in to two different categories of dichotomous variables i.e., new live birth in the interval 10 - 24 months after the death of a child and no next live birth in 10 - 24 months interval after the death of a child. Probability-value for a Z-test statistic was less than 0.05 (level of significance) and concludes a significant difference between the occurrences of a next live birth between the two categories. It was found that the likelihood for a next live birth to occur between 10 - 24 months after the death of a

Table I. Child Replacement Estimates, Confidence Intervals and Probability Values of Standardized Normal Curve in Rural Punjab, Pakistan

Sex of dying Child	Next Birth after Death Group			Total	Estimate ($\hat{p}$)	95% Confidence Intervals	P-value
	<10 months	10-24 months	>24 months				
If male child died	30	144	52	226	0.637168	0.570792	0.000
	13.27 %	63.72 %	23.01 %	100%		0.699893	
If female child died	21	111	38	170	0.652941	0.576251	0.000
	12.35 %	65.30 %	22.35 %	100%		0.724193	
Total	51	255	90	396	0.643939	0.594577 0.691132	0.000
	12.9%	64.4%	22.7%	100%			

Table II. Child Replacement Estimates of Differences of Proportions of Male and Female, Z-Value and Probability Values of Standardized Normal Curve in Rural Punjab, Pakistan

Regions	Sex of dying child	Next Birth after Death Group			Total	Estimated ($\hat{p}_m - \hat{p}_f$)	Z- value	P-value
		<10 months	10-24 months	>24 months				
Over all Rural	If male child	30	144	52	226			
	died	13.27%	63.72%	23.01%	100.00%			
Punjab,	If female child	21	111	38	170			
	died	12.35%	65.30%	22.35%	100.00%	0.157330	0.32	0.745
Pakistan	Total	51	255	90	396			
		12.9%	64.4%	22.7%	100.0%			

child is greater than the likelihood for a next live birth to occur at some other interval (<9 or >24). The results hold not only for both sexes collectively but also separately. The findings indicated that the dying child had effect on subsequent fertility in the form of a next birth that would follow a child death in 10-24 months (REF). This is argued as an evidence of child replacement.

In short, the Table I reveals that 396 births occurred after the death of a child whether it was male or female child in over all Punjab. From these 396 next live births occurred during 10 - 24 months after the death of a child, 64.4% occurred within 10 - 24 months while 35.6% occurred either before 9 or after 24 months. Therefore, there is no logic to assume equal probability that a birth would or would not occur 10 - 24 months after the death of an older sibling under age five years. Hence a child death rapidly replaces it. Thus, to achieve replacement level, the child mortality reduction is must. The larger the child mortality rate, the longest would be the distant in achieving population stabilization, meaning the child replacement level.

To cement this child replacement theory on the basis of next birth after death group, all the next births that occurred in routine were put in the same next birth groups. It was observed that 3577 next births from 6074 total live births (58.9%) occurred with in 10 - 24 months, while 2497 occurred either before 9 or after 24 months after the previous birth. The estimated proportion for next live birth for both sexes was found 0.589 with confidence interval 0.576 to 0.601. The figure explained a difference of 55 more new live births in the interval 10 - 24 months if the next birth happened after the death of an older sibling under the age of five. The P-value concluded that a next live birth in 10 - 24 months after the death of child is more frequent to occur as compare to the occurrence of next live birth in 10 - 24 months after previous birth of a child. This evidence is argued as a mathematical base to support the child replacement theory of this study. This result of the study confirms the concept of Wolpin (1997) about population stabilization.

Table II provides statistical analysis of next live birth after death of an older sibling less than five years of age regarding their sex. Out of 514 died children, 396 were recorded as next live birth to follow the death of an older sibling. The estimates of proportions for male, female and for combined sexes are 0.637168, 0.652941 and 0.643939, respectively (Table I). Data revealed that 637 and 653 from each 1000 occurring next live births after death of an older sibling follow a child death with in 10 - 24 months in case of male and female child died, respectively. The difference in absolute number is only of 16 points higher for females. Thus a new next live birth in 10 - 24 months after the death of a female child is more frequent as compare to the occurrence of next live birth in 10 - 24 months after the death of a male child. This difference is very small. A very small difference is insignificant when compared by using Z-test for difference of two proportions. The p-value gives no impact of sex of in child replacement. The likelihood for male as well as for female is equal in replacing a child death. We argue that this insignificance might be due to the relationship of child death to some other variables, like mother education, birth order of dead child, mother age at the death of a child etc. This aspect, however needs further studies.

CONCLUSIONS

The study established a theory on child replacement by concluding that the likelihood for next live birth to occur between 10 - 24 months after the death of an older sibling was greater than that of the likelihood for a next live birth to

occur either before 9 months or after 24 months. It was established that the likelihood for the next live birth after death was more frequent to occur in 10 - 24 months than next live birth after birth of a child. This evidence is argued as a mathematical base to support the child replacement theory of this study. The sex differential in child replacement analysis was observed insignificant in overall Punjab. It is recommended that in order to established population stabilization by the year 2020, special attention may be given to reduce infant and child mortality, the only way to drop the fertility rate to achieve the goal.

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