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On Critical Level of Mortality for Natality Decline

Introduction

IT was about two decades ago that Rupert Vance challenged demographers in his address to the Population Association of America to develop theories of wider generality and of greater scope. Surely, in the last decade, demography through model building has tried to enlarge the scope of demographic theory but no one has come up with a grand theory of population as Talcott Parsons, Oswald Spengler, or Robert Malthus tried to do. Of course, demography is not poverty stricken in regard to theory. Gutman (1960) maintained that our feeling of relative deprivation derives from too rigid or unrealistic notions of what constitutes a theory. Nonetheless, the theory of demographic transition has not only been understood widely but used as a tool to provide more extensive and explicit generalities of the transition theory. In fact, transition theory is perhaps the *only* "middle range theory" (Merton, 1957) in demography which continues to be of immense value to demographers even if they are out to invalidate it.

The theory of demographic transition is based upon historical data from northwest European countries before twentieth century, and is supposed to show prospects on the global scale. As George J. Stolnitz (1964) points out:

> All nations in the Modern Era which have moved from a traditional, agrarian-based economic system to a largely industrialized base have also moved from a condition of high mortality and fertility to low mortality and fertility. In so doing they have almost all experienced enormous increase in population along with massive shifts in their relative numbers of children, adult, and aged.

No one would argue with the history of the West in regard to the demographic transition and the relevant experience it provides.[1] Yet, the experience of the develop-

1. Giving the theory of demographic transition a frame of reference, we find that the period for decline of both high fertility and mortality was a long one; the trend once started in northwestern European countries was irreversible except in case of fertility after war in the Western hemisphere; there were massive increases in population and massive changes in age structure; and lower mortality and fertility rates resulted

ing nations in regard to demographic transition is dissimilar, if not absolutely different. The mounting rates of natural increase in population in the developing nations have occurred in decades rather than generation or centuries as was the case in Western countries. The task of raising often abysmally low levels of living in developing countries is more depressing with mounting rates of natural increases than it was in the Western countries. The transatlantic migrations before World War I lessened the population acceleration in Europe and enhanced it in the United States, but something like this is unlikely to happen for the developing nations. It might thus appear that the prospects for demographic transition in the developing societies are likely to be quite different.

Yet some demographers view the success of Japanese transition as a miracle which can be duplicated in other developing nations within next twenty to thirty years.[2] This is not likely to happen. The conscious and organized action for birth control and family planning through more safe and effective methods of contraception, for breaking the hold of tradition and custom, and for increasing the degree of rational self-interest in individual decision process, is not likely to bring down rapidly the birth rate in developing nations, at least in a majority segment of the population.[3] For the "average man" of the developing countries, substantial and persistence reduction in mortality will eventually introduce new sets of pressure on reproductive behaviour. But the question is how and in what length of time this pressure would come into being or what can be done to bring this pressure on the population of a developing nation? In view of the crucial importance assumed by this question at the global level, I shall try to integrate generalizations of transition theory into a new perspective.

Mortality Level: Is There A Critical Level?

In the past three decades demographers have been concerned with mounting rate of population increase (explosion) created by a declining mortality and stable birth rates. These demographers in consequence have been more preoccupied with fertility and family

(Footnote 1 contd. from page 250)

because of multiphasic response of the population and a vast break with the past. The stages of demographic transition are described as (1) high birth rate and high death rate, *(2}* high birth rate, low death rate, (3) low birth rate, low death rate and (4) low birth rate, high death rate. The last type is rare and obviously cannot be maintained for many generations. A substitute slogan in Western countries is now for "zero population growth".

For detailed discussion see Warren S. Thompson. "Recent Trend in World Population," *American Journal of Sociology,* Vol. XXXIV, No. G, May 1929, pp. 959-975.

1. Japanese case of demographic transition has caused much misunderstanding. Japan just before World War II was not an under developed society. Her population was highly literate, well educated, and avid readers of newspaper and periodicals. Afler the war, it became highly urban and heavily involved in industry. Legal abortions were made available on wide basis because of public pressure embedded in the social customs of Tokugawa Japan and not because of governmental policy.
3. During the next few years these action programs should be concentrated upon middle class and upper class or such limited groups as have begun to show break with traditionalism and will respond fairly soon.

planning[4] and have paid little attention to mortality. Invariably demographic theory has taken fertility and mortality to be *more or less* independent variables while the fact, considering the developing countries, is that mortality and natality are highly linked for "average man." There is, in other words, a "critical level of mortality" at which natality starts declining rapidly. This "critical level of mortality" may, therefore, prove to be an invaluable aid for controlling population growth.[5] David Heer (1966) drawing his conclusion based upon data from 41 countries has even supported the notion that high mortality may be a cause of high fertility. This assumption is based upon the fact that experience of infant or childhood mortality will tend to raise fertility. A negative hypothesis will be that absence of infant or childhood mortality would reduce natality significantly.[6] Under a prolonged and sustained drop in mortality, one can hypothesize that people accustomed to a particular kind of demographic behavior will find themselves handicapped in their effort to take advantage of the opportunities being provided by the emerging and industrializing economy and thus will be pressurised to change their reproductive behavior. Kingsley Davis (1963) has argued that mortality decline enlarges the family, increases siblings, where younger people have to reckon with parents for a longer period of life and a delayed share of patromony.[7] These factors do bring a train of disadvantages for those segments of society which continue to experience high natality, particularly during the period of transition, industrialization, and urbanization.[8] Moreover, the European demographic transition occurred during "lais-

4. KAP surveys in most underdeveloped countries have indicated a desire for small families, motivation to use contraception, and a desire to have a simple, cheap, effective, and reliable method of contraception. However Freedman has argued that availability of means of fertility control may be irrelevant until what is regarded as essential minimum number of children is achieved. R. Freedman, "The Sociology of Human Fertility, A Trend Report and Bibliography," *Current Sociology,* Volume XXI.No. 2,1961, pp. 48.
5. This argument has also been put forward by Harold Frederickson, "Determinants and Consequences of Mortality and Fertility Trends," *Public Health Reports,* Volume 81, No. 8, August 1966, pp. 715-28 and Ronald Freedman, "The Transition from High to Low Fertility: Challenge to Demographers," *Population Index,* XXI, 4, October 1965, pp. 419.
6. David M. Heer and Dean O. Smith have argued in regard to effect of mortality on natality as being (1) mortality decline increases economic cost of child throughout society, (2) a high rate of infant mortality leads to increased fertility, (3) low rate of mortality encourages intentional emotional involvement with child, and promote low fertility, and (4) desire for a minimum number of Surving Children elevate fertility in high mortality areas. David M. Heer and Dean O. Smith, "Mortality Level, Desired Fa'mily Size, and Population Increse," *Demography,* V. 1, pp. 104-121.
7. The obligation of marriage and expanded parenthood threatened one's position in nineteenth century Britain as one was to acquire for his children new and costly education. I A. Banks, Prosperity and Parenthood: *A Study of Family Planning Among Victorian Middle Classes,* London: Routledge & Kegan Paul, 1954, pp. 76-113.
8. Though accepted in theory, we are not certain if the transition theory describes the historical past of the West with sufficient accuracy. Data in support of transition theory are *largely* measures of consequent conditions superimposed upon assumption concerning antecedents conditions. Recent empirical studies have shown that traditional European associations between birth rate and such variables as industrialization and urbanization is lacking in the developing countries. See Dudley Kirk. "Natality in the Developing Countries: Recent Trends and Prospects," in *S. 3.* Behrman, Leslie Corsa and R. Freedman (eds.) *Fertility and Family Planning: A World View.* Ann Arbor: University of Michigan Press, 1969.

sez-faire" economic conditions, whereas most developing countries are struggling to have planned economics and some of them have active population policies to promote goals of fertility control. In the developing nations, mortality is declining much more rapidly and birth rates are commonly higher than they were during 17--19th century Europe. The rates of natural increase exceed the highest rates recorded in Europe. As recently as 1960 the natality transition, with the exception of Japan, was confined to European peoples or those in North America, but since 1960 a few countries in Asia and Latin America are experiencing rapid reduction in birth rates simultaneously with demographic and other aspects of modernization in spite of the fact that they are in no way closer to socio-economic development of 19th century Europe. Toward this goal, lowered mortality, improved health, rise in expectation of life, altered opportunities structure, literacy etc., have made a large contribution but the literature has continued to emphasize fertility reduction programs in terms of birth control and family planning movement independently of mortality levels. Some countries, such as India, Taiwan, and Korea, have made family planning and fertility reduction as "leading sectors" of the modernization process. Yet, analysis has often focussed more heavily on family planning program than on social variables.

However, the historical experience of demographic transition and the current experience of developing countries indicate that a strong downward trend in natality takes place at a "critical level" of demographic transition and modernization and that this critical level is different within each of the major cultural regions of India, East Asia, Southeast Asia, Moslem countries, and Latin America.[9] This "critical level" could be measured by the mortality levels of a country and the degree of its modernization. Further reductions in general mortality and infant mortality may in fact "switch on" the downward trend for natality decline.[10] It is easier for a government to reduce mortality level further and increase level of living to a great extent by effective community measures, whereas fertility reduction can only be achieved through individual motivation. There have been doubts whether reduction in mortality, considered to be independent of improvements in the level of living in the developing nations, would be followed by declines in the birth rate. But data from Ceylon, Mauritius, and British Guiana demonstrate such remarkable correlation between the previous levels of the death rates and current levels of the birth rates. Low death rates merit strongly as contributing factors,

9. According to the estimates made by Dudley Kirk, during the period 1875-99 nine Western countries reduced their birth rate from 35-20 in the range of 40-55 years. In the period 1903-1924, 7 countries representing Eastern and Western Europe, Latin America and Japan reduced their birth rate from 35-20 in the range of 24-64 years. Six developing nations in East Asia and Latin America are expected to take 11-32 years for their birth rate to decline from 35-20 in the period starting 1950. . .. Dudley Kirk, "Natality in the Developing Countries : Recent Trends and Prospects," in Behran *et al.* (eds.), *op. cit.*
10. Many people have criticized modern extention of health services in the developing nations on the basis that efficient services do more harm than good as far as natural increase in population is concerned. They ignore the fact that reduction in the death rates invariably produces reduction in the birth rates in synergism with other improvements resulting from the process of modernization.

if not as prerequisites, for low birth rates in the developing countries. In Ceylon, for example, measures were used to control disease, particularly malaria, at a cost of no more than 25 cents per capita per annum. This resulted in the reduction of death rate to a half in a decade, precipitating a rapid acceleration in the rate of population growth. This is what is called a Malthusian trap; but pushing health services further and controlling disease may indeed become a determinant of natality trend. It did in Ceylon by establishing an equilibrium situation. One way to bring this critical level is to make an all out effort to reduce levels of child and infant mortality, as quickly as possible. The experience of Taiwan, Korea, Hong Kong, and Singapore provides support for this argument. Well developed services in maternal and child health, community development and health education in these countries seem to lie at the root of the motivational change we are seeking in countries such as India. The failure of birth rates to fall turns less on lack of effective means than on the lack of strong motivation.

India : General Mortality

In the last three decades, modern health measures have rapidly reduced mortality in India as well as in other developing nations. We do not have reliable vital statistics for many developing nations including India. However, the countries with regular censuses provide basis for calculating inter-censal mortality by analytical methods. If we look at the case of India (Table 1), a consistent decline in mortality has been observed since 1920. Of particular importance is a rapid decline in mortality since 1951. If we examine the mortality data from the registration system,[11] it shows a much larger decline

TABLE 1
DEATH RATE PER 1000 POPULATION IN INDIA. 1901-1971

Period	*Death Rate Estimated by Reverse Survival Method*	*Period*	*UN-estimates*
1901-11	42.6	1945-46	27.4
1911-21	48.6	1950-51	27.4
1921-31	36.3	1952	24.0
1931-41	31.2	1953-54	20.8
1941-51	27.4	1955-56	19.0
1951-61	22.8	1958-59	19.0
1961-71	16.7	1S60-61	19.5
		1962-65	18.1
		1966-70	16.7

SOURCE: United Nations, *Demographic Year Book,* 1965, 1970, 1971.

11. Other sources of information on mortality in India are (1) National Sample Survey (NSS),and(2) Sample Registration Scheme. The 14th, 15th, and 16th rounds of NSS have yielded rural death rates of 19, 15, and 12 per thousand for 1958-59, 1959-60, and 1961-62 respectively. Estimates obtained through Sample Registration Scheme places the death rate of India at 15.2 per thousand for the year 1967-68.

in mortality than estimated by reverse survival method (Table 2).

TABLE 2
DEATH RATE PER 1000 POPULATION IN INDIA. 1945-60
REGISTRATION AREA ONLY

Period	*Death Rate*
1945-49	*17A*
1950-54	14.2
1955-59	10.2
1952	13.8
1953	14.5
1954	12.5
1955	11.7
1956	10.0
1957	10.8
1958	11.2
1959	9.2
1960	9.2

SOURCE : United Nations, *Demographic Year Book,* 1965.

India : Infant Mortality Rate

In the developing countries infant mortality rate (IMR) is the most reliable indicator not only in regard to the mortality conditions of a country but also as an index of modernization or socio-economic development. The data on IMR is even more defective than crude death rates in most developing nations and India is no exception to it. Even registration data do not tell the true picture. In Table 3 we have attempted to bring together data on the infant mortality in India from several sources. On the basis of the registration data, S. Chandrasekhar (1959) has estimated *quinquennial* averages of infant mortality rates in India, which show a decrease from 215 in 1901-1906 to 98 in 1956-1961. Based upon registered infant mortality data in 12 States in India for the period 1958-1964, Registrar General of India (1964) has estimated the IMR to have declined from 104 in 1958 to 74 in 1964. United Nations estimates (1962) based the same source show a rapid decline in IMR of 132.7 in period 1945-1949 to 86.5 in 1960. These retrospective analyses and surveys suffer from considerable underestimation. Examination of the data available from varied sources serves to indicate that the current level of infant mortality rates in India lies between 130 and 140. This means that even today one out of seven children dies within a year of birth. India ranks 80th on IMR in the community of nations. In any case, this rate seem to be much higher than India's modernization conditions justify. One way to reduce infant mortality in India is to link family planning programs with Maternal and Child Health. Some demonstration projects such as

Khanna Study and Narangwal Project have shown usefulness of combining family planning with maternal and child health for reducing **IMR.**

TABLE 3
INFANT MORTALITY RATES IN INDIA: 1901-1964

Period	S. *Chandrasekhar*[1]	*United Nations*[2] *(Registration Area Data)*	*Registrar General*[3] *of India (Based Upon 11 States)*
1901-06	215		
1906-11	228		
1911-16	204		
1916-21	219		
1921-26	174		
1926-31	178		
1931-36	174		
1936-41	161		
1941-46	161		
1946-51	134		
1951-56	113		
1956-61	98		
1945-49		132.7	
1950-54		118.9	
1952		115.9	
1953		117.8	
1954		109.4	
1955		99.2	
1956		102.2	
1957		99.4	
1958		100.2	102
1959		87.0	*88*
1960		86.5	87
1961			83
1962			81
1963			78
1964			74

SOURCES: 1. S. Chandrasekhar, *Infant Mortality in India,* 1901-1955, Alien and Unwin, London, 1959.
2. United Nations, *Demographic Year Book,* 1965.
3. Registrar General, India, *Vital Statistics of India,* 1963-64, New Delhi, 1965.

Decline of Mortality in Demographic Transition

An analysis of the data in Tables 1, 2, and 3, suggests that India has made a rapid headway in phase I of demographic transition. Mortality has consistently declined since 1921, but a rapid decline came after India's independence. During the decade 1941-1951 the death rate declined by 24.5 per cent and between 1951-1971, it has declined by about 38.0 percent. Rao, Mohapatra, and Bhatia (1970) have shown that during the period 1941-1961 both among males and females mortality has declined more than 25 per cent in the age group 1-30. In the age group 10-14 the mortality declined was as high as 69 per cent. The immediate relevance of such decline in mortality is that proportionately larger per cent of population enters child bearing ages from the later cohort and causes initially some increase in natality.

The causes of decline of mortality cannot be specified in terms of the modern classification. Yet it is evident that a major contribution to mortality was from famines, epidemics, and breakdown of the social order, including war. A remarkable fact about modern death control is its recency in terms of history. In 1800 there was some decline in English mortality but it was not until middle of the nineteenth century that a serious attempt was made to separate sewage from drinking water. Most specifics against various infections did not become available until several decades later. In most Western countries transition from a high mortality to declining mortality phase took anywhere from 100-150 years.[12] In the developing nations, similar declines in mortality have occurred in 30-40 years. In India the death rate of 36 in 1921-1931 declined to approximately 17 by 1961-1971 a period of 40 years. Since 1900 there has been a gradual decline in India of war and banditry, and an improvement of food supply which precipitated a declining death rate (Davis, 1951). After World War II, plague, smallpox, cholera and malaria became less important as a cause of death because of health measures and diffusion of social and preventive medicine in most of the developing nations. It has been argued that decline in mortality in India and other developing nations is taking place independent of the level of living.[13] Modernity might bring some consequential changes in environmental sanitation, level of nutrition, and traditional attitudes, but still mortality decline in India and other developing countries continues to be associated with introduction of life saving drugs, use of DDT, antibiotics, malaria control program, vaccination against infectious diseases, and introduction of Primary Health Centers (Rao *et. al*, 1970).

In spite of these reductions in mortality rates, both the CBR and IMR are high in India

12. In England and Wales it took approximately 150 years for the mortality to decline from 33 in 1741-1750 to a level of 18.2 in 1891-1900. See *World Population and Resource :* A Report by PEP. London : George Alien Unwin Ltd., 1964.
13. One must keep in view the fact that in the developing nations the improvements in level of living have not been significant. Famines in the last 4-5 decades have been averted because of wider distribution of food, but increase in food production and thus consumption has been low. High level of mortality continue to exist because of poor nutrition, yet it saves one from early death because of starvation.

compared to countries such as Ceylon, Mauritius, British Guiana., Taiwan, Singapore, and Israel. There is a great potential for further reduction of mortality rates in India, and if there is a critical level of mortality for natality decline, then sooner it is achieved better it would be. The important point here is that the scope for reducing both general mortality and infant mortality is quite significant and it can be achieved in a short period of time which is not true for natality.

Natality

Natality, contrasted to mortality, in developing countries has seemingly risen or has remained relatively stable. This appears to contradict partially the expectations based on conventional transition theory. In some countries birth rates are slowly changing in response to modernization as was the case in the Western countries, but these (birth rates) are also changing in response to governments' efforts at family planning and birth control. This shift suggests that some of the postulates underlying theory of transition are no longer valid.

As in case of mortality, information on natality is meagre in most developing countries. In case of India, crude birth rates are available from registration areas, decennial census. National Sample Surveys and Sample Registration Scheme. The reliability of rates derived from these sources is relative, but these are the best the statistics we have so far. Crude birth rates derived through analytical methods from registration and census data are presented in Tables 4 and 5.

TABLE 4
BIRTH RATE PER THOUSAND POPULATION IN INDIA

Period	*Estimated Rates (1)*	*Period*	*UN-Estimates (2)*
1901-10	48.1	1945-49	39.9
1911-20	49.2	1950-54	39.9
1921-30	464	1952	—
1931-40	45.2	1953-54	40.9
1941-50	39.9	1955-56	38.9
1951-60	41.7	1958-59	38.3
1961-65	42.8	1960-61	41.7
1966-70	413	1962-65	42.0
1971	42.0	1966-70	42.8

SOURCE: (1) "Growth of Population in India", S. K. Kuthiala. New Delhi, 1971 (Unpublished paper).
(2) *United Nations Demographic Year Book,* 1971.

It is obviously difficult to comment on the estimates presented in Table 4 ; however, the convergence of different estimates suggests the approximate level of birth rates in the country. The inference that can be drawn from these data is that birth rate had been

TABLE 5
BIRTH RATE PER 1000 POPULATION IN INDIA 1945-60
REGISTRATION AREA ONLY

Period	*Estimated Rates*
1945-49	26.0
1950-54	24.9
1955-59	22.3
1952	25.4
1953	24.8
1954	24.4
1955	27.0
1956	21.7
1957	21.1
1958	21.5
1959	21.9
1960	22.4
1960-64	20.8

SOURCE: *United Nations Demographic Year Book,* 1965.

declining slightly during 1901-1940, but since then it has either remained constant or risen slightly in each decade.

There is little evidence to suggest that the decline in birth rate between 1901-1940 was because of any significant change in the social structure of the country, adoption of any contraception by a substantial proportion of the population, or substantial increase in the age at marriage. It is aparent, however that since the Second World War, modernization has been exerting some pressure on fertility ; there has been heavy emphasis on the technical and instrumental elements of the strategy of controlling births through contraception technology. As yet, there are no signs indicative of the probable changes in overall level of fertility in India, though those connected with the official family planning program are of the opinion that such a decline probably started in 1966 (Rao *et. al,* p. 10).

Decline of Natality in Demographic Transition

Based upon the experience of the Western countries, there is an overall assumption that modernization results in a sizable decline in natality. The evidence for this is overwhelming if a comparison is made of fertility levels of the developed and developing countries. In the long run, it will probably be true as the anticipated change is indeed a part of the process of modernization. But the question is what happens in the transition stage? The transition theory tells us that natality declines in the transitional stage which, in the

best cases, may be measured in decades. However, the case of Taiwan which has reliable vital statistics indicates that modernization forces in fact increased natality (Peterson, 1967). Examining India's data on birth rate in Table 4, an inference can be drawn that in the transitional period India's natality is also going up, though at a very slow rate. Table 5 based on registration data on births, suggests that trend of fertility has been one of decline since 1945. Whether this is a real or spurious trend cannot be confirmed at the present stage.

Is there a Critical Level of Mortality: An International Comparison

Several of the developing nations are already on their way to a continuous trend of declining natality; in East Asia—Taiwan, Korea, and Hong Kong, in Southeast Asia-Singapore and Malasia, in middle South Asia—Ceylon, in the Caribbean—Puerto Rico and Trinidad and Tobago, and in Latin America—Chile and Costa Rico. In the last decade or so Taiwan, Korea, Hong Kong, Singapore have made a tremendous progress in their family planning and birth control programs and their performance as compared to that of India. This comparison is unfair because India's population is 10 times larger than the combined population of these countries and exhibits much more heterogeneity in social structure than that in any one of them. But more important is the fact that because of their small population size, these countries reached a very low level of mortality in mid-fifties, when their natality began a sustained downward trend. We must also note the factor of modernization[14] which is at a higher level in these countries than that of India.

To illustrate the association of mortality with natality, we may have a. comparative view of the behaviour of vital rates for Taiwan, Singapore, Chile and Puerto Rico and India. The data is presented in Tables 6 and 7.

On examining Table 6 we find that in case of Taiwan, Singapore, and Puerto Rico, high rates show stability or constancy upto 1960, by which time a low death rate of 7 per thousand was firmly established. Then on, there is the downward trend in birth rates which is sustained through the period of 1960-70. In case of Chile, the downward trend in birth rate had set in when the death rate was 10.2; in Chile, the declining natality phase of the demographic transition could start at a higher level than was the case in Southeast and Middle Asia. India has not shown any such trend so far and we might have to wait until death rate declines to the critical range of 10-12 per thousand.

On examining Table 7, the trend lines in mortality rates in Taiwan, Singapore, and Puerto Rico are parallel to each other, with the Chile about 10 years and India about 25 years behind the experience of mortality transition into Phase II.

14. Demographically, we could have an index of modernization by taking the following characteristics of a population. (1) Infant Mortality, (2) Per cent Literate, (3) Per cent Urban, (4) Per cent Births attended by Physicians, (5) Per Capita Income, (6) Newspaper per 1,000 Population, (7) Radio Set per 1,000 Population, (8) Hospital Beds per 100,000 Population, and (9) Energy Consumption per Capita.

TABLE 6
CRUDE BIRTH RATES AND DEATH RATES IN SELECTED COUNTRIES

Period	Birth Rates					Death Rates					
	Taiwan	Singapore	Puerto Rico	Chile	India	Taiwan	Singapore	Puerto Rico	Chile	India	
1957	41.4	43.4	33.7	36.8	38.9	8.5	7.4	7.1	12.9	19.0	57
1958	41.7	42.0	33.2	36.0	38.3	7.6	7.0	7.0	12.2	19 0	58-59
1959	41.2	40.3	32.3	35.7		7.2	6.5	6.8	12.5		
1960	39.5	38.7	32.3	35.7		6.9	6.3	6.7	11.9		
1961	38.3	36.5	31.3	36.1	41.7	6.7	6.0	6.8	11.6	19.5	60-61
1962	37.4	35.1	31.1	35.7		6.4	5.9	6.7	11.8		
1963	36.3	34.7	30.7	35.2		6.1	5.8	6.9	12.0		
1964	34.5	33.2	30.6	34.1	42.0	5.7	5.5	7.2	11.2	18.1	62-65
1965	32.7	31.1	30.3	33.2		5.5	5.4	6.6			
1966	32.4	29.8	27.6	31.6		5.4	5.6	6.3	10.2		
1967	28.5	27.1	26.2	30.9	42.8	5.5	5.1	6.4	9.5	16.7	66-70
1968	29.3	24.8	25.1	26.6		5.1	5.2	6.6	9.0		
1969	28.3	23.1	24.9	25.0		5.1	5 4	6.5	8.8		
1970	28.1	23.0	24.8					6.6			
1971		22.8									

SOURCE: *United Nations Demographic Year Book*, 1965.

The infant mortality rate of approximately 140 recorded for India in 1970 existed in Taiwan and Singapore and Puerto Rico in 1935-39 and in Chile, in 1945-50. Here again, India is about 20-30 years behind in its control of infant mortality from these developing nations.

It would appear that each of these countries experienced inititation of natality decline at approximately the same level of general mortality and infant mortality. These critical levels of general mortality were 7.0, 6.5 and 6.5 per thousand in Taiwan, Singapore and Chile respectively. These were corresponded by IMRs of around 30, 33 and 42 respectively. In case of Chile the natality decline started in 1964—four years later, with a general level of mortality at around 10 per thousand and infant mortality rate at around 114.

TABLE 7
INFANT MORTALITY RATES IN TAIWAN, SINGAPORE, PUERTO RICO, CHILE AND INDIA

Period	*Taiwan*	*Singapore*	*Puerto Rico*	*Chile*	*India*	
					Estimated	*Registered*
1945-49					18.5	132.7
1950-54						118.9
1955-59						97.3
1951						
1952	35.3	70.0	66.4	129.2		115.9
1953	33.7	67.1	62.8	112.4		117.8
1954	30.1	56.0	57.6	125.1		109.4
1955	33.9	49.6	55.8	119.8		99.2
1956	33.1	42.5	53 1	110.4		102.2
1957	35.7	41.1	50.3	114.4		99.4
1958	34.9	43.4	53.2	127.7		100.2
1959	33.3	35.8	47.6	119.6	146	87.0
1960	30.5	34.8	44.4	127.9		865
1961	30.7	32.1	41.5	111.2	111	
1962	29.1	31.0	41.7	114.6		
1963	26.4	27.9	44.6	111.0		
1964	23.9	29.3	51.6	114.2		
1965	—	26.2	42.0	—		
1966	20.2	25.8	36.7	102.8		
1967	20.6	24.6	32.8	91.6		
1968	19.0	20.7	29.0	91.6		
1969	17.5	20.5	28.2			
1970		19.7	28.6		139	

SOURCE: United Nations, Demographic Year Book, 1965
Demographic Year Book, 1970
Demographic Year Book, 1971

It is obvious that at present in India both general level of mortality and infant mortality are much higher than those observed in countries at the time of the onset of a sustained trend of natality decline. From these data and in the light of the modernization levels of these countries, age structure of their population, and an active family planning program, it would appear that a consistent natality decline in India may be 10-15 years away unless attempts are made to further reduce the mortality levels. Family planning is no doubt an instrument of decreasing natality but in the initial stages of transition it must counter a probable increase in natality caused by reduction in mortality in the incidence of widowhood and of maternal mortality, and in sterility.

It appears that India's national policy adjusted in 1969 to reduce crude birth rate to 32 per 1,000 by 1974 is unrealistically based upon family planning programs and individual motivation. For this to happen even by 1980, only seven years away, critical levels of motality and modernization will have to be reached. Decline in natality and mortality in developing countries differs significantly than that experienced by nations of the West and we are still in the process of studying this complex mechanism.

Transition Theory and its Dynamics

Examining demographic transition in the West, one can infer in retrospect that there was an element of self-regulation of population growth. The feedback from this theory for the developing nations has been a rational one except that natality decline in Phases II and III in the West (when contraception was not extensively used), has been explained in terms of improvement in levels of living, urbanization and industrialization. The fact is that under a rational system of hemeostasis a reduction in natality is a sequel to a reduction in mortality. This factor suggests, though not to the exclusion of other factors of modernization, that a motivational structure develops in the society for restrains on natality.

Mathematically, the relative decline in natality (n) in number of years *(t)* can be expressed in the base year (0) and mortality *(m)* as the logarithm of the index of relative change in the birth rate being inversely proportional to the logarithm of the rate of natural increase:

$$\log n_t - \log_{no} = t \log a - b \log (n0 - m0)$$

$$\frac{n_t}{n_0} = \left[\frac{a}{(n_0 - m_0)b} \right]$$

The relative decline in mortality *(m)* in number of years *(t)* can be expressed for the base year (0) and per capita product at constant prices *(p)* as the logarithm of the index of relative change in the death rate being inversely proportion to the logarithm of the relative change in per capita product at constant prices:

$$\log m_t - \log_{mo} = t \log c - d(\log p_t - \log p_0)$$

$$\frac{mt}{m0} = t \left(\frac{c}{(pt/p0)^a} \right)$$

Combining the equations for relative change in natality and mortality, the rate of population increase in *(n—m)* in years *(t)* can be expressed in terms of natality *(n)* and mortality *(m)* in the base year 0 and the relative change in per capita product at constant prices *(p)* in year (t) as:

$$n - m = n0 \left(\frac{a}{(n0 - m0)^b} \right)^t - m0 \left(\frac{c}{(pt/p0)^d} \right)^t$$

A tentative conclusion based upon this equation would be that natality will tend toward an equilibrium at a critical level of mortality. On the other hand, mortality will vary inversely with the modernization indicators of a society. Taiwan, Singapore, and Puerto Rican data fully validate this hypothesis, whereas the data for Chile approximate the expected results. India has so far not entered upon these relationships to a sufficient degree to set in motion a sustained decline in natality.

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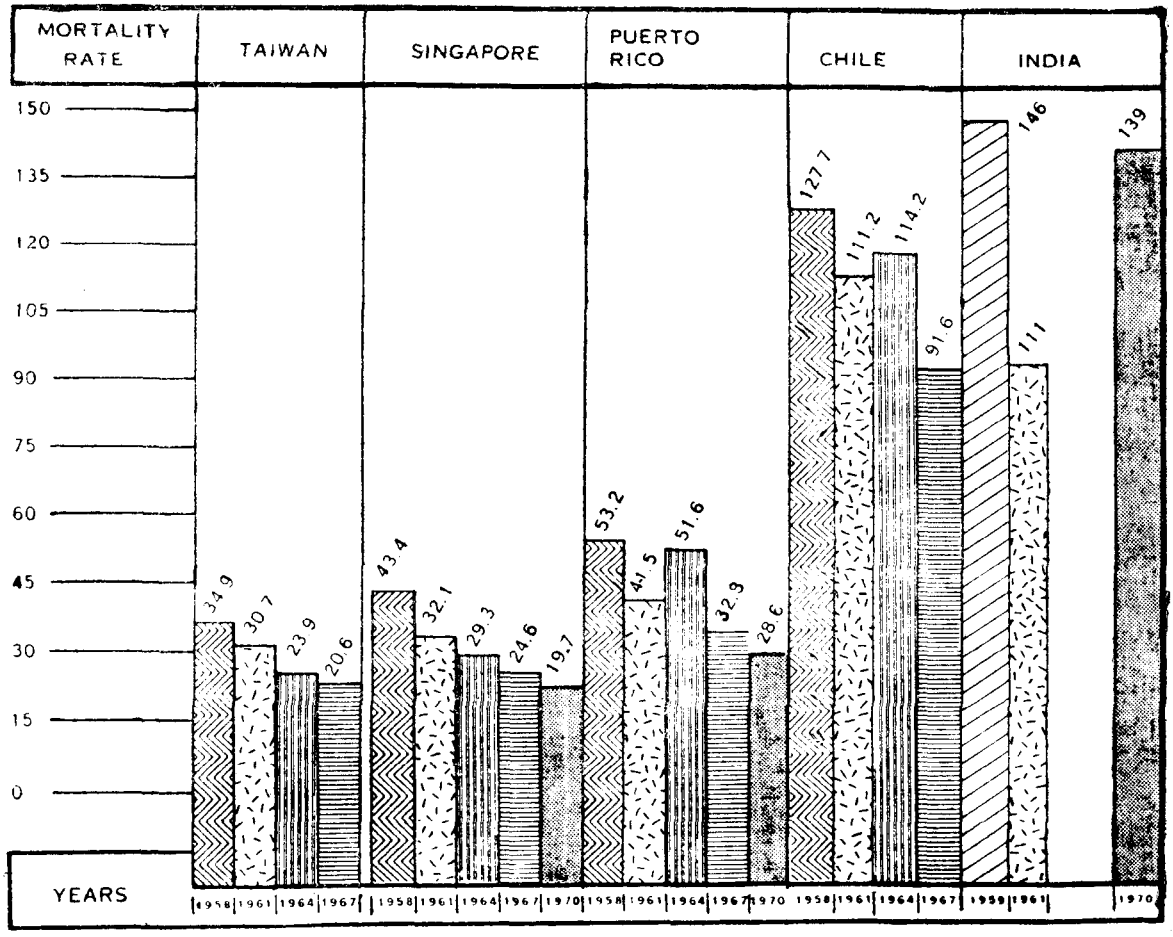
APPENDIX 1

INFANT MORTALITY RATES IN TAIWAN. SINGAPORE, PUERTO **RICO** CHILE AND INDIA



APPENDIX 2

MODERNITY INDICATORS IN SELECTED COUNTRIES OF ASIA AND LATIN AMERICA

Modernity Indicators	*Taiwan*	*Singapore*	*Puerto Rica*	*Chile*	*India*
1. Crude Birth Rate	27.2	22.1	24.8	28-29	40-42
Crude Death Rate	4.9	5.2	6.6	11-12	15-20
Natural Increase	22.3	16.9	18.2	17	23-27
1. Dependency Ratio	82	73	81	78	81
3. Percent in Urban Areas	63	100	44	74	20
In Cities of 100,000 +	35	100	22	37	JO
	(1970)	(1971)	(1960)	(1969)	(1970)
4. Percent Literate Male	90	NA	83	85	40
	68	NA	78	82	18
	(1970)		(1960)	(1960)	(1971)
5. Percent in Primary Schools					
Males	90	97	100	100	56
Females	89	93	100	100	40
Secondary Schools					
Males	62	54	68	25	15
Females	49	51	NA	30	7
	(1970)	(1970)	(1968)	(1967)	(1965)
6. Population in Thousands					
Per Physician	4	1.6	1.0	2.0	5
Per Hospital Bed	1	0.3	02	0.3	2
Per Midwife	7	1.0	3.0	7.0	21
	(1970)	(1970)	(1967)	(1968)	(1965)
7. Gross Domestic Product					
Per Capita (US Dollars)	292	779	1,622	556	77
Percent Derived from Agriculture	23	4	5	9	52
8. Annual Percent Increase	10.0	NA	9.2	5.1	3.1
In Real GDP (Total) Per Capita	7.1	NA	7.2	2.6	0.6
	(1960-69)		(1960-68)	(1960-68)	(1960-68)
9. Per Capita Food Production 1969-71 100 Index (1959-61)	116	NA	NA	93	98

SOURCE : Dorothy Norton, "Population and Family Planning Programs : A fact Book". Reports on Population/Family Planning. No 2, 4th Edition. New York : Population Council, Sept. 1972, pp. 20-29.