Trans. Inst. Indian Geographers
Vol. 3, No. 1, January 1981

AN ENQUIRY INTO THE LEVELS OF INFANT MORTALITY VARIATIONS IN A MEDIUM SIZE TOWN : A CASE STUDY OF HAPUR

N. S. TYAGI, Shamli, A. K. TYAGI, Hapur, and R. C. TYAGI, Hapur.

ABSTRACT : Taking a clue from the empirical evidence of a sharp decline in the infant mortality rates in recent years, the present study examines **inter alia** the implication of the changes in the IMR over the last two decades (for the quality of urban residential mosaic). An attempt has also been made to answer the question whether or not the improvement in the IMR is leading to greater spatial equity. Finally, the relationship berween infant mortality and social status has been analysed in order to understand the phenomenon of infant mortality decline in a more proper perspective.

Introduction

The infant mortality rate (IMR) has long been considered a reliable and sensitive index of the level of living conditions of a community or a country. It is well known that communities or contries attaining a higher level of material progress have a lower IMR. A comparison of the figures of the developed and the developing countries in this regard seem to substantiate this assumption. True, considering the appaling poverty of the vast bulk of the populace and the chronic inrdequacy of the housing, protected water supply, sewage disposal facilites, and the provision of the minimal medical care facilities, it should not be surprising to find relatively high morbidity and mortality rates among the infants of the Third World countries. However, for some time past, the position appears to be improving in these couniries too as a result of public health measures and rise in the level of socio-medical consciousness of the people. In recent years, there has been a perceptible fall in the IMR in our own country, the gains apparently mopped up, more by the urban areas than by the rural population. On Registrar General's reckoning, the infant death rate in 1973 for urban India was 89 per 1000 live births while the corresponding figure for rural areas was 134. In fact, in the urban areas too, the gains are probably not uniformly distributed. The disposition of the social morphology of the urban centres with large number of poor and illiterate people living in traumatic environmental conditions in over-crowed slums and shanty towns with little access to the elementary medical care facilities, the gains will naturally be skewed in favour of the well-to-do sections.

If we take urban areas as the focus of our study, then the foremost question which concerns us is with the validity of the assumption of an all round (i. e. both at-the social and the spatial level) declining trend in the IMR during the recent years. Suppose it is so, then obviously it requires an explanation. But more significantly it will entail the question of its implications for the environmental quality of the urban residential mosaic in the sense that if IMR is taken as a surrogate to measure the level of living conditions (or residential

environment quality) then what do the IMR difierntiations imply for the quality of the urban residential mosaic ?

The intention of the present paper is to seek answers of these questions through an inquiry into the IMR variations in a medium size town of North India, Hapur. The study is based on the data of the two decades beginning from the sixties i. e. from 1961-62 to 1978-79.

Methodology and Data Base

In our country, the most challenging and ticklish problem of the infant mortality studies is the availability of reliable data. At present, there are two principal sources of such data ; one is the Registrar-General of India who brings out an annual publication (not regulary of course, entitled **Vital Statistics of India**, and the other one is the National Sample Survey (NSS) which conducts annual sample surveys and gathers **inter alia** information on current birth, death and infant mortality rates. The former accomplishes thie task by adopting two methods namely, an annual sample census method and an annual sample registration method. Nevertheless these methods are by no means full-proof ; while the non - sampling bias is too high in the sample census method, in the work of sample registration, different field agencies often lack co-ordination and necessary efficiency (Chandrasekhar, 1972). Likewise, the NSS source suffers from the effect of non sampling errors. Moreover, these data are not available on town basis. In this situation if a researcher undertakes the study at a town level, then it becomes quite difficult to adopt these methods at micro level. Infact it is a very cumbersome venture for an individual to undertake.

The data of this study are based on the vital statistics available in the death and birth registers maintained by the municipality under statutory provision of compulsory registration of birth and deaths. While in the case of births, the date of birth, sex, name of parents and their religious/caste affiliation together with their residential address are recorded, the death registers, beside details, record the name, age and cause of the deceased infant.

As regards the exact age of the deceased infant, the information given may not be accurate. Devoid of other sources, we have but to scrutinise the available data carefully

Computation of the Infant Mortality Rates

The computation of the crude IMR requires the total infant deaths occurring in a given calendar year our of the total live births during that year, but this is apt to be misleading because the infants who die in a particular year are not necessarily born in the same year. This drawback has been overcome by adjusting the figures of the pervious year in the manner given below

$$q_0 = q'_0 + q''_0$$

and

$$q'_0 = \frac{d'_0}{N_0} \quad q''_0 = \frac{d''_1}{N_1}$$

where No is the number of births of the year considered, N^1 that of the previous years. d'o the number of deaths in the year considered among the children born during that same year, and d''o the number of deaths in the year considered among children aged less than 1 year born during the preceding year (Henry, 1976),

As regards the neonatal mortality rate (i. e. deaths occurring within the first month of life) and the post neonatal mortality rate (PNMR) i. e. the remaining infant deaths that occur between one month and one year of life, the computed values refer to the crude rates.

The reason for computing neonatal mortality and PNMR separately is that whereas neonatal mortality is mainly due to parenatal and natal influences (this is not to decry the danger of the vulnerability to environmental hazards after birth), the PN-MR is considered to be a result of post-natal influences involving environmental factors (Chandrashekhar 1972). Therefore, it is regarded an inverse relationship with socio-

economic conditions.

The Study Area

Hapur (28°43' N and 70°50' E) is one of the leading commercial centres of North India. It is situated about 60 km east of Delhi on No. 24 National Highway to Lucknow via Moradabad. Prior to its inclusion in the newly formed distsict of Ghaziabad, it was a tehsil headquarter in District Meerut.

The origin of the town is obscured in the 10th century AD. At present it is registering a fast population growth which in 1971 census stood at 71,266 and estimated to be in the neighbourhood of one lac in 1981. Administratively, the urban area is divided into nine wards (Fig1).

All religious faiths are represented in the town. Majority consists of the Hindus. (accounting for about 73% of the population in 1971) followed by the Muslims, accounting for about 22% of the population. Muslims are almost clustered into one segment of the old town covered by three wards 6, 7 and 5. As regards the Scheduled Castes, they too, form an important segment accounting for 21%of the population. Like Muslims, they too are segregated mainly in the outflanking areas and the old nucleus. The literates constitute 40% of the total population. intra-urban variations notwithstanding.

Infant Mortality Trends

The Table I reprsents the computed values of the IMR and PNMR for the town as a whole covering the period 1961–1979. it is evident that over these years, there has been a phenomenal slump in the IMR and INMR. It can also be noticed that whereas the first half of the decade 1961–71 was dominated by relatively high rates of infant mortality (the IMR and PNMR being generally above 70 and 50, per mille respectively), the second half of this decade experienced a sharp decline in these rates (the IMR and PNMR generally ranging between 40–50 and 20-40 respectively). The

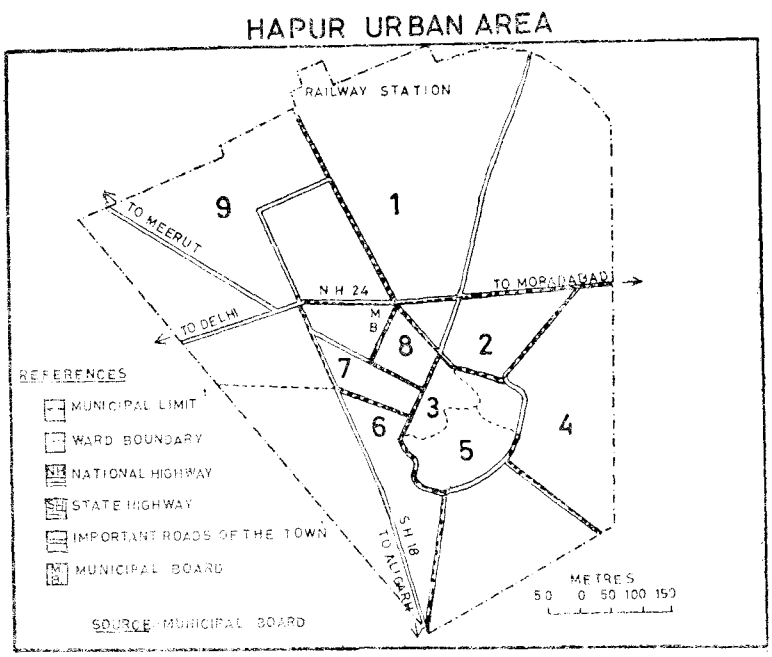

Fig. 1

Table I
Hapur : Infant/Post Neonatal Mortality Rates Per 1000 Live Births

Year	IMR	PNMR	Infant deaths as % of total deaths
1961–62	97.0	50·8	23·2
1962–63	82·4	61·1	22·5
1963–64	73·1	48·5	20·6
1964–65	76·2	66·3	23·6
1965–66	45·9	42·6	16·5
1966–67	50·3	36·2	16·2
1967–68	42·2	32·8	15·1
1968–69	35·9	17·9	16·6
1969–70	26·8	23·7	12·6
1970–71	39·2	32·6	16·6
1971–72	27·1	19·3	17·1
1972–73	34·1	36·8	14·6
1973–74	23·9	20·8	11·9
1974–75	17·7	17.4	11·0
1975–76	25·4	13·9	15·9
1976–77	33·1	23·9	17·0
1977–78	24·7	13·6	16·2
1978–79	20·8	13·7	14·5

Period beginning from the seventies has witnessed yet another decline, bringing down the level of the IMR and PNMR between 20–30 and 15-20 respectively.

The period in question can broadly be categorised into three phases, namely

(1) The phase of high infant mortality (1961-62 to 1964–65)

(2) The transitory phase of medium infant mortality (1965-66 to 1970–71)

(3) The phase of low infant mortality (1971-72 to 1978-79)

Table I also lists the figures of the proportion of infant deaths in total mortality. It can be discerned that the proportionate share of the infant deaths in the total mortality has been steadily decreasing. It dropped from 23 2% in 1961-62 to 14.5% in the 1978–79. This suggests a more rapid decline in the infant mortality, vis-a-vis general mortality.

As regards the neonatal mortality, the computed figures for the town as a whole show that one-third to two-fifth infants who do not complete even one year of age die within their first month of life.

The major factors responsible for bringing down the IMR over these years sudsume increased availability of the medical faciliities, improvement in the provision of public health faciliities, in general and maternity and child welfare services in particular, and rise in the level of socio-medical consciousness of the people. The modernisation process, urbanisation, education mobility and communication through mass media account for these factors.

The impact of the increased availability of the mordern medical facilities has been resounding in scaling down the rate of infant deaths in the town. A study of the figures of the IMR vis-a-vis the doctor-population ratio in the town for the period

Table II

Hapur:-Doctor Population Ratio

Year	Population Per doctor	Year	Population per doctor
1961-62	1,674	1970-71	1,439
1962-63	1,615	1971-72	1,426
1963-64	1,613	1972-73	1,379
1964-65	1,608	1973-74	1,270
1965-66	1,563	1974-75	1,238
1966-67	1,420	1975-76	1,226
1967-68	1 457	1976-77	1,121
1968-69	1,404	1977-78	1,103
1969-70	1,404	1978-19	1,012

Note. While the number of doctors of the preceding years has been obtained from filed survey, the population of different years has been estimated on the basis of average growthrate of 1961-71.

in question appears to substantiate such a claim (Table II). It is worth noting that the computed value of the correlation coefficient (r) between them is as high as. + 87.

The programme of maternity and child health services was taken up in our country during the first two five year plans. However, these services were largely developed in the town mainly around 1964-65. It appears that the abrupt fall in the IMR durnig the year 1965-66 is a result of the cumulative effect of these services, together with the availability of added medical facilities, and the resultant awareness about maternity and child welfare.

In fact, upto the mid-sixties there were only two inadequately equipped maternity centres in the town. There was no other qualified medical practitioner (gynaecologist or obstetrician).

The result was that the obstetric work was largely performed by the traditional mid-wife (dai) with their well-known methods. The situation, however, began to improve after the mid-sixties with the setting up of clinics and nursing homes by some qualified lady doctors. In the same period a Medical College and number of lady doctors, clinics, nursing homes were setup at Meerut, a distance of one hour from the town. This facilitated the maternity services at times crucially needed and consequently enhancing the life chances of the new born babies. In addition, the decline of the infant mortality in the late sixties and the seventies can be attributed to the immunisations vaccine of Diptheria-Pertussis Tetanus (D. P. T.), Poliomyelitis. Cholera and Tuberculosis. The Triple (D. P. T.), and Polio vaccine is being offered freely in the town by the M. C H. centre and the member doctors of the Lions and Rotary Clubs from the early seventies,

And yet the fact remains that for some time past, the general level of the socio-medical consciousness of the people has also shown a considerable rise. Unlike their predecessors, the present day parents by and large appear to be more medically conscious. Indeed, the age old obscurantist practices of sorcery are fastly disappearing.

Table III

Hapur : Proportion of Infant deaths in the Total Mortality Among Major Social Groups.

Period	Infant deaths as % of Total Deaths		
	Caste Hindus	Muslim	Scheduled Castes
1961-62 to64-65	14.2	26.7	31.3
1965-66 to70-71	14.6	12.6	20.1
1971-72 to78-79	12.4	11.6	20.4

Table IV

Hapur : Infant Mortality Rate Among Major Social Groups (Per 1000 Live Births)

Period	Hindus including Scheduled Caste	Hindus Excluding Scheduled Caste	Muslims	Scheduled Castes
1961-62 to64-65	78.9 (55.1)	–	89.9 (58.9)	–
1965-66 to70-71	45.1 (33.5)	–	34.9 (25.2)	–
1971-72 to78-79	28.4(22.5)	13.1 (17.1)	17.1 (8.8)	53.6 (33.3)

Note : In the parenthesis are given values of PNMR.

Infant Mortality in Different Social Groups

Although the toll of infants taken by malnutrition and diseases has always been enormous in the Third Would Countries, its distribution among various social groups has not been equitable. To see the extent of this, we may look at the pattern of the proportion of infant mortality in the total deaths among the three major social grups caste Hindus, Muslims and Scheduled Castes. Table III shows that among all the social groups it is the infants of the under privilieged section of Scheduled Caste which continue to be the hardest hit by the environmental hazards. On the average the infants constitute about 20% of the total deaths even in the seventies.

Table IV shows the changes that have occurred during the two decades in the pattern of IMR and PNMR among the major social groups.

It can be seen that over these years, there has been a considerable break thoguh in the reduction of the infant mortality among all the social groups.

Nevertheless, as far as Scheduled Castes are concerned the pattern remains virtually

the same. Strikingly, the Muslims have registered the steepest fall. The question is how the phonomenal decline in the infant mortality among the 'deprived' 'Muslims' be explained when a similar reduction has not been registered by yet another 'deprived section of the scheduled castes ?

It is well known that the bulk of the Muslim masses has traditionally been a prisioner of the obscurantist sorcery and witchcraft practised by the **maulvis.** But of late, thanks to the growing social awareness in the Muslim messes, they have shaken off their shackles. Infact, the advantages of mordern methods of medical care and immunisation appear to have been well understood even by the veiled womenfolk. In this context, the role of the Muslim doctors who started practice in the Muslim localities after 1970 is particulary significant.

It must also be noted that whatever be the extent and scale of the economic deprivation among the Muslims, then cannot be considered by any means. to be socially under priviledged. On the other hand, the Scheduled Castes continue to suffer from the scourage of all kinds of discrimination and oppression-social as well as economic. The economic factors apart, the level of social backwardness, continues to inhibit the socio medical consciousness. It is in this perspective that the differential in the level of infant mortality between the Muslims and the Schedule Castes has to be understood.

Pattern of Spatial Variations

Table V carries ward-wise figures of IMR-PNMR for the three distinct phases mentioned earlier.

It can be discerned that notwithstanding the general declining propensity, variations by wards exist. The trend of the spatial

Table V

Hapur : Ward-wise Infant Mortality Rates
(Per 1000 Live Births)

Wards	Years					
	1961-62 to 1964-65		1965-66 to 1970-71		1970.72 to 1978-79	
	IMR	PNMR	IMR	PNMR	IMR	PNMR
1	74.8	52.7	37.1	38.3	17.5	11.7
2	79.4	40.5	72.4	55.7	32.1	17.6
3	37.4	22.3	27.8	20.4	29.7	16.7
4	103.1	75.2	45.0	35.5	40.0	29.2
5	63.1	37.2	30.8	17.7	28.4	16.2
6	135.1	95.6	46.2	38.7	37.7	22.8
7	117.1	74.3	44.9	34.6	24.4	12.8
8	63.7	37.3	33.2	19.8	10.4	7.5
9	48.4	24.3	25.0	19.2	16.1	9.2
Town	82.1	56.6	40.0	30.9	25.8	20.0

pattern of change in the level of the infant mortality appears to be influenced **inter alia** by its initial magnitude and the uneven socio-medical awareness among different social groups. The first is witnessed in those areas which have already marked significant reduction in IMR which left a limited scope for further decline. Hence the rate of reduction remanied moderate in such area (e. g. ward 3). The story has been different with the areas previously having high IMR. These areas have witnessed a comparatively great decline in the IMR. Nevertheless, the level of infant mortality among the areas predominontly inhabited by the scheduled castes (e. g. ward 2, 4, 6) is distinctly higher from those of other social greups (e. g Wards 9, 9, 8, 7, 5),

The spatial distribution is characterized by high rates in the areas of old nucleus and a comparatively lower rates in the central and outer zone. Incidently, the former happen to be either Scheduled Caste dominated or Muslim-cum-Scheduled caste and other weaker section dominated areas while the latter are the residential areas of the socio-economically advanced sections.

Intra-Ward Variations

Since wards comprise aggregates of socio economically heterogeneous population, to average figures computed at ward basis are likely to odscure the actual conditions of a ward. This anomaly is sought to be rectified by computing intrward IMR/PMNR separately for the areas of Scheduled Castes and non-Scheduled Castes for the period 1971-79. The results are summarised in Table VI.

Two inferences can be drawn from the Table

(i) The disparities in the IMR in general and PNMR in particular between the areas of the priviledged and under-privileged sections testifies to the inequalities in the environmental quality of their respective residential areas. Infact, a close look at the magnitude of the differentials of the Scheduled Caste localities with those of the non-Scheduled Caste would suggest comparatively

Table VI

Hapur : Intra-ward Distribution of IMR/PNMR (Based on Average of the period 1971-72 to 1978-79

(Per 1000 Live Births)

Wards	Non Scheduled Caste population		Scheduled Caste population	
	IMR	PNMR	IMR	PNMR
1	9.72	2.0	40.1	28.2
2	17.2	7.1	53.7	34.6
3	29.3	16.7	—	—
4	4.5	2.6	76.7	59.9
5	21.2	6.9	74.4	70.4
6	17 9	8.1	62.1	46.2
7	16.9	6.0	55.9	40.0
8	7.0	1.1	125.0	62.2
9	10.2	4.6	30.3	21.4

obnoxious environmentat conditions of the Scheduled Caste ghettos festering on the urban space,

(ii) The Muslim dominated areas have comparatively high IMR than those of the caste Hindus. This implies better environmental conditions in the areas of the latter than those of the former.

Let us now examine the temporal changes from the view point of distributional equity i. e. whether or not the improvement in the infant mortality is leading to greater spatial equity. Two measures have been adopted for this purpose namely, (i) The Gini, coefficient (G) and (ii) The ratios of advantage.

The Gini-coefficient has been calculated by using the following expression

$$G = \frac{1}{2} \sum_{i=1}^{N} \left| X_i - Y_i \right|$$

Where X_1 and Y_1 are percentage frequencies of births and infant deaths and the vertical brackets indicate that the difference between the proportions in each set are summarised irrespective of their sign (Smith, 1975). N is the uumber of wards.

The Values of ' G ' are summarised in the following table.

Table VII

Hapur : The Values of Gini Co-efficient computed at ward level.

Period	Value of ' G ' for	
	IMR	PNMR
1961-62—64-65	14·7	21·0
1965-66—70-71	12·8	13·4
1971-72—78-79	14·1	21·5

Although the values of the Gini-Coefficient confirm the inequality in the spatial distribution of the infant/post-neonatal mortality, the impression of widening spatial disparities fails to be substantiated as these values exhibit virtually no change between 1961-65 (G for PNMR — 21.00) and 1971-79 (G — 21.5). This may be due to the sensitiveness of ' G ' to the level of territorial aggregation (Simith, 1977). Nevertheless, if their is any change, it is, of course, towards distributional inequality.

To what extent the conditions of the infant mortality are unequally distributed in the town has been shown by means of ratios of advantage which have been computed in the following manner.

$$\text{Ratio of Advantage of a ward} = \frac{\text{Percentage share of the ward in the total births of the town}}{\text{Percentage share of the ward in the total infant death of the town.}}$$

A ratio of 1.00 would indicate a ward experiencing conditions in excat proportion at risk. The higher the ratio above unity, the more advantaged the ward (Smith, - 1977).

The following table lists the ratios of advantage

TABLE VIII

Ratios of Advantage in Distribution of Infant Mortality for Wards of Hapur

Ward	1961-62 to 64-65		1965-66 to 70-71		1971-72 to 78-79	
	IMR	PNMR	IMR	PNMR	IMR	PNMR
1	1.17	1.10	1.48	1.21	1.40	1.60
2	0,98	1.20	0.55	0.55	0.80	0.80
3	1.99	2.33	1.60	1.80	0.86	0.60
4	0.81	0.75	0.72	0.71	0.60	0.55
5	1.33	1.48	1.31	1.63	0.90	1.00
6	0.61	1.57	0.86	0.82	0.80	0.80
7	0.73	0.65	0.89	0.91	1.08	1.30
8	1.31	1.46	1.23	1.70	2.60	5.60
9	1.80	2.30	1.66	1.33	1.60	2.10

Table VIII reveals that the gains in the infant mortality and in particular the post neonatal mortality (and thereby in the environmental quality), insted of being distributed in an equitable manner, have rather gone in favour of some selected areas. Thus, while in the old nucleus (e. g. wards 3, 6, 5) and the areas of the under-privileged (wards 2 and 4) there has been a deterioration in the eavironmental conditions; in the areas of high socio-economic groups (ward 1, 8, 9 and 7), the trend is towards improvement. This lends support to the growing conditions of a territorial imbalance in the urban areas which to quote Mingione (1977) is a symptom of the underlying situation of class exploitation and conflict '.

Infant Mortality and Social Status

We may now finally examine the proposition that infant mortality holds inverse relationship with the social status. Such an examination is crucial for understanding the nature of the infant mortality trends in the social spectrum of ths urban areas.

In our social setup, the social status is essentially determined by caste, occupation, education and income. As data on caste population are not available, we have restricted ourselves with the data on scheduled and non-scheduled caste population. However, the data on backward communities have been collected from field survey. For occupation, data of census work force have been used while for measuring education level literacy figures are used. As for income, data on television sets have been taken as its indicator (Tyagi 1979). The values of the correlation co-efficient computed at wardwise data between infant/post neonatal mortality and other attributes of social status are presented in the table.

Since a negative correlation holds between the attributes of social status (literacy, female literacy, T. V. Sets, trade and commerce, other professionals) and the infant/post neonatal mortality it is consequently the socially privileged and well to do sections which have relatively low infant mortality. The positive correlation between Scheduled Castes/Backward communities and infant mortality substantiates this assumption all the more.

Table Ix
Values of Correlation coefficient

	1961-62 to64-65		1971-72 to78-79	
	IMR	PNMR	IMR	PNMR
Literacy	-0·49	--0·71	--0·28	-0·41
Female Literacy	-0·76	--0·30	-0·45	-0·45
Scheduled Castes	+0-35	+0-39	+0.74	+0.51
Backward Communities	—	—	+0.59	+ 0.58
Trade and Commerce	-0.49	-0.28	-0.17	-0.16
Other services	-0.10	-0.23	-0.23	-0.38
Manufacturing Workers	+0.21	-0.06	+0.31	+0.02
Television Sets	—	—	-0 48	-0.75

If would also appeer from the differentials of the ' r ' for the two periods in question that the improved literacy has undoubtedly brought down the infant mortality. But besides this, there are other factors also which have brought about consciousness among the illiterates too.

The level of socio-medical consciousness among the professional group is higher than that of other occupations including trade and commerce.

The high negative value of the ' r ' between the T. V. Sets and the infant mortality decisively proves strong inverse relationship between the level of social well-being and IMR.

Conclusion

The study conclusively proves that over the last two decades, the incidence of infant mortality has steeply gone down as a result of increased medical facilities, provision of public health measures and rise in the socio-medical cousciousness. Nevertheless the social and spatial variation continue to exist. Among the social groups, it is the Muslims who have experienced the most phenomenal decline in the IMR owing among other factors, to their growing medical consciousness and consequent emancipation from the age old obscurantist methods of sorcery etc. The scheduled castes on the other hand, continue to have the highest infant death rate Again not unexpected.

In the spatial context, there is enough evidence to support the increasing distributional inequalities. The study clearly brings out a growing zonal imbalance in the environmental quality between the old nucleus aud the central and the outer zone. Same is the case with the areas of the privileged and the under-privileged. And finally it is also confirmed that there exists an inverse relatlonship between social status and the IMR/PNMR. The enconomie factor convincingly shows its contempt for high IMR.

Acknowledgement

We are deeply grateful to Dr. N. P. Saxena, Head of the Geography Meerut College, Meerut for his unstained support in the preparation of this paper. Our thanks are also due to Prof. P R. Dhayal, Deptt. of Pol, Sc. S S. V. College, Hapur for his critical comments.

References

Chandra Sekhar, S. (1972) : *Infant Mortality, Population Growth and Family Planning in India* (London).

Henry, Louis. (1976); *Population: Analysis and Models* (London).

Mingione, Enzo (1977) : Theoretical Elements for a Marxist Analysis of Urban Development, in Michael Harloe (ed), *Captive Cities* (London).

Registrar-General of India (1973) : Personal communication from Vital Statistics Division in Feb. 1980.

tr Smith, D. M. (1975) : *Patterns in Human Geography* (Penguin, Harmondsworth)

——————— (1977) : *Human Gergraphy: A Welfare Approach* (London).

Tyagi, R, C. and Tyagi N. S. (1979) : The Geography of the Television Sets in Urbau Apeas, Paper submitted to *the Geog. Rev. of India.*

Addresses of the authors

N. S. Tyagi, Dept. of Gegraphy, V. V. College, Shamli, U. P., A. K. Tyagi Research scholar, S. S. V. College, Hapur, R. C. Tyagi, Dept. of Gergraphy, S. S. V. College, Hapur.