BIO-DEMOGRAPHIC DETERMINANTS OF CHILD SURVIVAL IN SAUDI ARABIA

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A thesis submitted for the Degree of Doctor of Philosophy

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CITY UNIVERSITY

London

September 1992

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ACKNOWLEDGEMENTS

I would like to express my sincere thanks and gratitude to Professor Steven Haberman and Dr. Samir Farid for their ever helpful advice and guidance throughout the development of this study.

I should also like to thank Dr. Abdul-Rahman Al-Swailem, Deputy Minister of Executive Affairs, Ministry of Health, Kingdom of Saudi Arabia, for his support and continuous encourragement. Thanks are also due to Dr. Othman Al-Rabeah, Assistant Deputy Minister for Planning and Research, for permission to use the data files of the Saudi National Child Health Survey 1987, and for his support.

I have also benefited from discussions with my colleagues at the Ministry of Health, particularly Dr. M.U. Khan, Dr. M.H. Baldo, Dr. K.M.S. Aziz and Dr. M. Rao.

Finally, I am extremely grateful to my wife and children for support, cooperation and patience throughout the period of the study.

DECLARATION

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ABSTRACT

This study is concerned with an analysis of bio-demographic determinants of child survival in Saudi Arabia. The study is based on data derived from the National Child Health Survey, which was conducted in Saudi Arabia in 1987.

The study attempts to assess the recent trends in childhood mortality in Saudi Arabia; to assess the role played by structural factors versus social resources in shaping childhood mortality; to evaluate the relative importance of different social resources in different contextual settings in relation to child survival, and to understand the mechanisms of intervention of structural and social factors with special reference to maternal education.

The study follows the framework suggested by Mosley and Chen for the analysis of determinants of child survival. The data has been analysed at two levels: aggregate and individual. The individual level analysis is based on an application of multivariate analysis technique using the method developed by Trussell and Preston.

Between early 1970's and mid 1980's the infant mortality rate (IMR) and under five mortality rate (CMR) have declined sharply from 105 to 52 and from 155 to 63 respectively. The rates varied between regions, urban and rural areas and between illiterate and literate groups.

The most important differentials associated with the Saudi IMR and CMR were found to be: (a) social resources (mother's and father's education, father's occupation), (b) household infrastructure [piped/bottled water, flush-toilet, and (c) regional characteristics (urban/rural, geographical region of residence).

The observed household infrastructure and area characteristic differentials worked mainly through educational and socio-economic mechanisms.

Extension of female education, better job opportunity, piped water supply, flush toilets and further improving access to health services in deficient areas can reduce IMR and CMR further. Intensification of health education and further research in areas with inadequate knowledge are needed.

Chapter 1

BACKGROUND AND OBJECTIVES

1.1 Introduction

This study is mainly concerned with an analysis of bio-demographic determinants of child survival in the Kingdom of Saudi Arabia. The Kingdom of Saudi Arabia is in the midst of a period of economic and social transformation, the pace of which has seldom been equalled in the nation's long history. Over the past two decades or so, virtually all socio-economic indicators have moved in a direction that could only be considered development and modernization: the expansion of the educational system, and the resulting increases in levels of school enrollment and literacy; the vast expansion and improvement of health services and public sanitation, and the resulting dramatic declines in mortality and morbidity; the rapid and intensive urbanization of the country, the creation of new towns and the efforts to help settle the nomadic population; the electrification of urban and rural areas; the transformation of the economy and the expansion and diversification of the country's industrial potential; the construction of impressive networks of road transportation and of local and international airports; and the very rapid increase in the proportion of the population reached by the mass media.

The fundamental transformation of the economic structure of the country and the new realities that were forced on the social fabric of Saudi society, have introduced factors of change across the bio-demographic scene in the country.

Mortality and mortality related information play an important and diversified role in national planning process. Mortality data help to identify a country's current demographic situation and make clear its immediate demographic future. Beyond their role in demographic accounting, mortality data serve as important indicators of socio-economic and health development.

Infant mortality rate (IMR) and child mortality rate (CMR) are few such globally accepted indicators of health status not only of the reference population

but also of the whole population with its distinct socio-economic setting. IMR is also a sensitive indicator of availability, utilization and effectiveness of health care, particularly perinatal care. Child mortality rate apart from its association with available, utilized and effective maternal and child health (MCH) services, also reflects the spectrum of provided primary health care (PHC) services like nutrition, immunization, disease control and environmental health services and their acceptance by the community and their impact. As PHC demands inter-sectoral coordination, it also reflects the performance of other health related sectors in addition to the health sector. Whereas IMR may be more than 10 times higher in least developed countries, the CMR may be as much as 250 times higher, due to the inadequacies in the aforementioned health and health related services, socio- economic and cultural barriers (Park J.E. et al, 1989).

The United nations children's fund (UNICEF) has observed that in the developed countries of the world, over 97 percent of all children survive through the pre-school years, where as in many poor countries 20-25 percent of children die before reaching their fifth birthday, resulting in an estimated 15 million deaths annually (UNICEF, 1984).

Childhood mortality levels are also sensitive indicators of differences, within a national population, in the degree of progress in improving the quality of life, thereby helping to identify the hitherto unidentified socio-economic, cultural, geographical and ecological determinants. Furthermore, these indicators can identify substrata of target group of children for instituting intensive child health care programs, and also be useful in evaluating the success of instituted programs.

The last four decades have witnessed substantial reduction in childhood mortality in most developing countries, though the record of socio-economic progress has been less. Nevertheless, todays mothers are more likely than the mothers of the previous generation to be educated, to be living in favourable environment, to have access to MCH facilities, to be married at a later age, perhaps to a man with a non-manual occupation.

Before the 1970s childhood mortality (IMR, CMR) in the kingdom of Saudi Arabia were estimated to be high 170 and 292 per 1000 live births. The rapid socio- economic development experienced by the country since the early 1970s in all sectors (including health and health related sectors) with increased per capita income (26,066 SR/US $ 6,950) per annum, increased educational facilities, better environment and improved access to health services should have made a reciprocal impact on child mortality levels, thereby improving the chances of child survival. Astonishingly the estimates published by the international agencies (UN 1988) indicate a persistent higher level of IMR (< 1 year) and CMR (< 5 years)viz 120 and 186 in 1970-75, 85 and 120 in 1980-85, which were then attributed to a lag between economic and social development.

During the abovementioned period, though the impact of socio-economic development was visible in terms of improvement in health infrastructure, increased immunization coverage and increased attention to infant and child nutrition, the estimates of childhood mortality for the period did not show a proportionate decline.

This suggests that the measurement of the impact of Saudi socio-economic development was perhaps hindered by the non- availability of accurate data on mortality. Though indirect techniques for mortality estimation have been developed and available since the late 1960s, the inadequacies in the then available data in itself perhaps led to the inflated estimates.

Hence, there is a need for systematic investigation of mortality differentials through developing a conceptual framework, which would incorporate, apart from demographic and socio-economic factors, the biological mechanisms involved in the process of health impairment, some of which eventually lead to a fatal outcome. The concepts developed in the discipline of medicine, epidemiology, public health, social medicine and nutrition all have to be adopted along with others, developed in social sciences other than demography.

So far the main concern of demographers was to document the levels and differences in mortality and patterns among populations. While doing so,

demographers have by and large neglected to take into account of the biological process linking the socio-economic, environment and health impairment. Yet, where there is an external cause, death can not occur without being preceded by a shorter or longer illness, a process largely governed by biological forces. Our understanding of the mortality differentials would also be incomplete and hence inconclusive, if the close links between socio-economic characteristics of individuals, families and communities and the biological process leading to mortality differentials are not accounted for.

The study of such a complex process would need the tools available in the field of epidemiology to unfurl the intricate interrelationship between social, environmental and biological processes, the study of the ecosystem in which man and his cohabitant human beings and other living beings constantly interact with each other and with the physical and social environment; leading either to disease and death of the host or to the establishment of a dynamic equilibrium, the later state is in fact *survival* or *health*. Further, the complex mosaic of links between health, morbidity and fatal outcome of disease on the one hand, and the social, cultural, behavioural and biological aspects of the processes involved on the other hand, requires the use of a suitable analytical model to handle empirical data obtained through studies conducted in line with principles mentioned above. Such a study based on an appropriate model can identify the more proximate determinants from among many factors and establish the line of causation between these variations and mortality, as satisfactory as possible.

Such a planned study was undertaken by the Ministry of Health of Saudi Arabia in 1987 through the implementation of the National Child Health Survey (NCHS). The NCHS generated a wealth of data, which can be used to estimate the levels of childhood mortality (both IMR and CMR), its trend and some of the differentials and determinants. The study further indicated that health services access and coverage, child nutrition, marriage patterns, fertility patterns, birth practices, level of immunization, parents education and environmental determinants are the "proximate" variables though their quantitative impact varied between different geographical regions and place of residence (urban, rural) in shaping IMR and CMR in Saudi Arabia.

However, there is a further need to assess the cumulative and individual effect of 'proximate variables' to understand the relative contribution they make in enhancing child survival chances. The factors brought out would be of major importance in formulating health policies and programs so as to focus on the major determinants of child survival. This can speed up the decline in mortality levels and further improve child survival chances to the desired level of "health for all" goals. Accordingly the NCHS data were subjected to multivariate analysis as would be discussed in the following chapters.

1.2 The Saudi setting

1.2.1 The land

The Kingdom of Saudi Arabia occupies an area of nearly 2,149,690 square kilometers and constitutes 87 percent of the Arabian Peninsula. The country is bordered on the west by the Red Sea and the Gulf of Aqaba, on the north by Jordan, Iraq and Kuwait. On the east, it is bounded by the Arabian Gulf, Qatar and the United Arab Emirates, and on the south by Oman and Yemen. On its western coast, running parallel with the Red Sea, is the narrow coastal plain of Tihama. Farther inland, the Hejaz mountains rise to 9,000 feet, then slope gently towards the east, forming a desert plateau with an average elevation of 2,000 to 3,000 feet. The southern part of the country contains the *Rub Al-Khali* or Empty Quarter, one of the world's most forbidding terrains.

Saudi Arabia does not have any rivers or lakes except for *wadis* or river beds that contain water only during the seasonal rains. The only other running waters are small streams fed by wells. To a large extent, the country depends for its water on underground sources and desalination plants.

Saudi Arabia has a very dry, hot climate weather with frequent sandstorms. During the day the summer temperatures can rise to an average of 45 degrees celsius. It is not so hot along the coasts of the Red Sea and Arabian Gulf, but humidity is much higher, particularly on the Arabian Gulf, known for its frequent heavy fogs. In the central and northern parts of the country, temperatures drop sharply, but rarely below freezing, in winter. The average rainfall is 3 to 5 inches annually, with the Asir region in the southwest getting the greatest amount, about

10 - 20 inches a year. The most important cultivated plant is the date palm. Other important crops include wheat, corn, vegetables and fruits.

Wild animals include two antelopes - the small, flat footed gazelle and the large, stately oryx (now close to extinction). Small mammals include the hedgehog, hare and hyrax. Locusts used to be so numerous as to constitute a plague. There are many other species of insects, and the coastal waters contain many varieties of fish. The most common bird in the oasis is the bulbul, and this songbird figures often in the popular poetry of the country. Finally, the most important animals in the history of Saudi Arabia are the camel and the Arabian horse.

1.2.2 Demographic characteristics

1.2.2.1 Population size and growth

Information on the country's demographic situation was scanty and relatively unreliable until the mid-1960s when the Central Department of Statistics of the Ministry of Finance and National Economy inaugurated the publication of an annual series of Statistical Year Books. The most recent and also first comprehensive national census, which was conducted in 1974 and published in 1977, gave the first official published figures of Saudi population which was estimated at 6,939,642 persons.

According to population estimates prepared by the United Nations, the population of Saudi Arabia in 1985 was estimated at almost 11.6 million. The 67 percent increase in population size is attributed to a high growth rate among the native Saudi population and also to the influx of considerable large number of expatriates (UN, 1991).

Most of the sharp increase in population size had occurred during the period from the mid-1970s to the mid-1980s. For Saudis, this growth may be explained by a continuing high level of fertility combined with rapidly declining mortality rates. For non-Saudis, the high growth is explained by the great influx of considerably large numbers of foreign workers who migrated to Saudi Arabia to fulfil labour requirements necessary to implement ambitious development plans.

The 1974 census showed a very young age structure for the population of Saudi Arabia, with 49 perecnt of the population aged under 15 years and only four percent aged 65 and over. Current population estimates show that children under 5 years of age constitute 19 percent of the total population and that women in the reproductive age span (15-49 years) constitute almost 20 percent of the total population.

According to the medium-variant projections published by the United Nations, the population of Saudi Arabia is estimated at 14.1 million in 1990 and is projected to increase to 20.8 million in the year 2000, and to 44.8 million in the year 2025 (UN,1991).

The Government's perception of the acceptability of levels and trends of population growth were primarily determined by the availability of labour, required to cope with the continued and rapidly accelerating level of capital inflow and economic expansion. Thus, it is perceived that the rate of growth to be unsatisfactory if it is too low.

No specific statement concerning policy in reference to size and growth of the population has been made by the Government. Because of the continued and rapidly accelerating level of capital inflow and economic expansion, the Government did attempt, however, to resolve in the short term the problems associated with total population vis-a-vis the size of the labour force through immigration and also through technological and organizational modernization including spatial redistribution of the population. Thus, improvements in health services are expected to result in a future increase of population size.

In the national development plans in the 1970s, various measures were reported for the amelioration of the shortage of manpower, including improvement in productivity by means of education and training, as well as the temporary employment of foreign labour until self-sufficiency in labour was achieved. On the basis of the direction of the Government actions in this area, it can be assumed that it supported continued high levels of natural increase

while investing substantially in a comprehensive improvement of labour productivity.

1.2.2.2 Mortality and morbidity

Until 1963, estimates of levels of mortality were at best only informed guesses. Although no authentic records existed, infant, child and maternal mortality rates were thought to be very high. According to estimates published by the United Nations, the crude death rate declined from 25.9 per thousand in 1950-55, to 21.3 per thousand in 1960-65, 16.9 per thousand in 1970-75 and to 9 per thousand in 1980-85 (UN 1991).

The Government's objectives in its social welfare programme included strengthening child welfare and maternal and child health, improving environmental sanitation, and providing increased activities for the improvement of the social situation of girls and women. Priority in the public health programme was to be given to maternal and child health, to health education campaigns against bilharzia and malaria, to the vaccination of children under age five, and to the provision of services to pilgrims.

1.2.2.3 Fertility

Information on fertility was also difficult to obtain. Levels of fertility were assumed to be high, especially since the bearing and rearing of children, particularly of male children, was accorded high social esteem; also, nuptiality rates were extremely high, and it was considered desirable that girls should be married no later than 16 years of age.

According to estimates published by the United Nations, the crude birth rate was more or less stable at a level of between 48 and 50 per thousand during the period 1950-70, falling thereafter to 45.9 per thousand during 1975-80, and to 43.2 per thousand during 1980-85.

The government has at no time made any explicit statement of its perception of the acceptability of fertility levels and trends. However, it is believed that the government considers the higher rate of growth, attained through high fertility, as desirable.

Though there is no formally declared official policy on fertility, various other policy measures, such as the expansion of facilities for female education, could foreshadow important social changes and lead to the removal of certain traditional constraints upon development.

The initiation by the government in 1960 of a programme of education for girls constituted a profound innovation within the traditional society. Since then there has been a monumental increase in both the number of schools and in the female student population. In 1970, there were only 135,000 girls enrolled at school and 434 female students at university. By 1990, female school enrollment had increased to 1.3 million and the number of female university students had risen to 53,000 as may be seen from Table 1.1, (Ministry of Planning, 1990).

Although changes in fertility as a result of modernization have not yet been identified, it is expected that some change in patterns has occurred. Other measures that are expected to have had some impact on levels and trends of fertility include the strengthening of the system of community centres - especially in the areas of child welfare, and maternal and child health - and the improvement of the social situation of girls and women. Nurseries, kindergartens, girls clubs and women's committees, and co-operative societies were also organized under the community development programme.

Certain social security benefits for salaried workers, such as maternity benefits, or for low-income families, such as child allowances, are in effect. They are likely to have some influence in encouraging or at least maintaining the currently high fertility levels.

Abortion is strictly restricted and permitted by Islamic law only to save the life of the mother. Therapeutic sterilization is permitted in selected individual cases for eugenic or medical reasons.

Table 1.1 Development indicators, Saudi Arabia 1970 and 1990

	1970	1990
Education		
Number of schools (All)	3,107	16,269
Number of colleges	6	75
Enrollment in higher education (Boys)	6,508	69,100
Enrollment in higher education (Girls)	434	53,000
Total enrollment	6,942	122,100
University graduates (Boys)	795	9,042
University graduates (Girls)	13	6,911
Total graduates	808	15,953
Percentage coverage of the population through television network	30	80
Industries		
Manufacturing industries	199	2,193
Capital investment (in SR million)	2,800	96,100
Power		
Electricity generated (in billion KW)	1,825	61,550
Electicity subscribers	216,000	2,300,000
Water		
Water desalination plants	3	27
Water desalination capacity /day (in cubic meter)	19,000	1,930,000
Water consumption in big six cities /day (cubic meters)	172,000	1,800,000
Communication		
Telephone lines	29,000	1,195,000
Inter-city roads (in km)	5492	20,106
Other		
Social security aid (in million SR)	42	1.370
Volume of cargo handled at sea-ports (in million weight tons)	1,800	20,300

1.2.2.4 Spatial distribution

Estimates of the distribution of population between urban and rural areas and of the distribution in the rural areas between sedentary rural, semi-nomdic, and nomadic populations vary in detail, but generally fall within a broad level of agreement. In 1969, it was reported that 14 percent of the population was nomadic and 51 percent sedentary rural. In 1976, the approximate proportion of nomads was given at seven percent, rural inhabitants at 48 percent, and urban dwellers 45 percent. Recent estimates for 1987 indicated the urban population at 69 percent and the combined rural and nomadic population at 31 percent.

Several factors had contributed to the intensive urbanization of Saudi Arabia. The establishment of new urban centres in the petroleum producing region resulted in substantial migration from all parts of the country. The high salaries offered by the oil companies and the reduction in opportunities for work in the traditional nomadic and semi-nomadic sectors caused a significant rural to urban migration which tended to depopulate rural areas. It was also felt that long periods of drought in the country had contributed to the high rate of urbanization. The major cities of the country have steadily increased in size over the past two decades.

The government recognized the problems that could result from rapid urban growth. The principal policies adopted by the government consisted of technological and organizational responses to this rapid urban growth, and of a concerted attempt to induce full sedentarization of nomadic and semi-nomadic populations through agricultural development.

The government pursued various programmes for planned regional development. Comprehensive institutional arrangements (such as a higher planning authority for metropolitan areas, an inter-ministerial high committee for village development) were undertaken with regard to the overall system of settlement in relation to the environment, water supply, provision of utilities and housing.

Specific programmes were developed not only for metropolitan, second and third order urban centres and rural areas, but also with regard to the nomadic population. Measures were aimed primarily at providing the basic amenities of life so as to have healthier and more comfortable living in the cities, towns and villages. Thus, numerous projects were launched, such as infrastructure development, improvements in transport and communications, creation of medium sized towns, restructuring of the labour force, and so forth, all within the context of regional development planning. Specific programmes to help settle the nomadic population were given considerable attention, particularly in the context of the provision of water resources sufficient to permit agriculture. Investment in certain rural areas, notably in the Asir region, had greatly increased in an attempt to retain an adequate rural population needed to ensure national independence in agricultural supply.

The government also decided to diversify and expand its manufacturing activities, and to distribute industry evenly throughout the country. Recently, the government has completed the construction of Jubail, a planned industrial city on the Arabian Gulf, and Yanbu, a smaller development across the country on the Red Sea. Guidelines for the fifth five year plan (1990-1994) place emphasis on achieving balanced development between various regions by linking development to the actual needs of the population, selecting growth centres to make full use of available facilities and checking the trend towards dispersing services and resources.

It should be noted that Saudi Arabia, compared with most other developing countries, had the advantage of having the requisite economic means to implement effectively its spatial distribution policy, which required a rather massive initial capital investment.

1.2.3 Health infrastructure

Health policy is embodied in five year health plans which are included in national development plans. Up to the late 1950s, the greater part of the population received only traditional forms of public welfare through religious and private charities. In 1960, a community development project (multi-sectoral at the local level with various components including health) was begun centrally

and later expanded to five other regions. The government considered the shortage of trained medical personnel a major problem, and facilities had been provided mainly in the Eastern region along the oil tapline. Because there were almost no female Saudi doctors or nurses, the provision of services to women was severely limited.

In the 1960s, increasing development funds were allocated to the health sector: from a budget allocation of 60 million riyals ($16 million) in 1959, to 140 million in 1968/69. During the 1970s, the budget increases were substantial, increasing from 166 million riyals in 1970/ 71 to 499 million in 1973/74, to 2,972 million in 1976/77, and to 4,177 million in 1979/80. During the 1980s, the budget increases were even larger; in 1984/85 the Ministry of Health budget reached a record of 10,743 million riyals.

The First Development Plan, 1970-71 - 1975/76, proposed the adoption of a health programme in two phases: to consolidate and improve the physical infrastructure and available equipment in the first phase while carrying out research and planning for the second phase, which would emphasize the expansion of the preventive health services and education on health and nutrition.

A primary objective of the development of the health sector in the Second Development Plan, 1975 - 1980, was to provide a comprehensive range of preventive and curative health services in all regions, so that the total population could, through higher levels of health, contribute to and benefit from the socio-economic progress of the country. Expansion of services was planned both horizontally and vertically, and high priority was given to the integration of preventive and curative services at the administrative and delivery levels. A target of providing 2.5 beds per thousand population by the end of the plan period was established. Dispensaries were to be upgraded and increased in number, and district dispensaries were to be established in selected urban areas so as to reduce the existing out- patient load of hospitals. In the 1975-80 Plan, emphasis was also placed on Mother and Child Care Clinics, with the target of reducing

the infant mortality rate to no more than 110 per thousand live births in 1980 and also with the objective of improving mother and child care in general.

The Third Five Year Plan, 1980 - 1985, included broad objectives and guidelines to translate primary health care (PHC) policy into strategies for implementation, as detailed in the national plan of action.

The Fourth Five Year Plan, 1985 - 1990, defined more specific objectives, strategies and methods through which to implement PHC. According to this plan, MOH was to expand and extend the delivery of comprehensive health services to the whole population at three levels: primary, secondary and tertiary.

Until 1979, curative and preventive services used to be provided separately. Hospitals and some 251 dispensaries were offering curative services while only about 30 health offices, in addition to twelve MCH centres, provided preventive care.

The principles of PHC, as stated in the resolution of the World Health Assembly of 1979, were adopted by the Kingdom of Saudi Arabia in 1980. One of the first measures taken was a ministerial decree which provided for a comprehensive approach to health services and the integration of services provided by health offices and MCH centres with the curative activities provided by dispensaries. In line with this policy, the name of the existing 889 dispensaries was changed to "health centres". In the period following 1980, MOH concentrated on the horizontal expansion of health centres and improving the quality of their services.

PHC as defined by the MOH comprises the basic health services provided to all members of society and is considered to be the latter's first contact point with the government health services. Such contact can take place either in the health centres or in their surrounding areas. PHC activities rely on the effective participation of the community; they are envisaged as comprising promotive, curative, preventive and rehabilitative services, taking into account the psychological and social aspects of all community members.

The third five year plan (1980 - 85) provided for the integration of health services at primary health care level and the reorganization of the system of dispensaries, health points, health offices and MCH centres into a network of health centres.

The strategy of PHC as developed by Saudi Arabia (Al-Mazrou et al, 1990) can be summarized as follows:

(a) Expansion of health services and improvement of their quality to cover all health services required by the community in the Kingdom.

(b) Development of the relationship between the health centres and beneficiaries through visits by health centre staff to the health centre's catchment area, identifying health requirements and social problems of communities and reaching target beneficiaries in schools, farms, etc.

(c) Changing community understanding and image of the health centres from a mere place for dispensing drugs to a broader concept comprising identification of diseases and their radical treatment, with community participation.

(d) Integration of the prevention and cure of endemic diseases such as leishmaniasis, malaria and schistosomiasis through the services offered by health services.

(e) Increasing community awareness through health education, both within and outside the health centres, to enable them to derive maximum benefit from the services and cooperate with the centres in order to control endemic diseases and environmental problems.

(f) Coordination between all levels of health services in order to provide proper health care through referral systems.

(g) Coordination amongst health training institutions such as universities, nursing schools and health institutes, to modify their training curricula to fall in line with the principles of PHC.

(h) Coordination with other sectors providing health care (Ministry of Defence, Ministry of Interior, the National Guard etc) and health related sectors such as agriculture, municipalities, education, including girls' education, in order to improve the level of public health.

(i) Concentration on providing optimum health care to vulnerable groups such as pregnant women, pre-school children, etc.

Thus, primary health care in Saudi Arabia is based on services provided by health centres, each of which is staffed with at least one physician and one nurse. In many centres, other professional staff including additional physicians, nurses, dentists, midwives, pharmacists, health inspectors, X-ray and laboratory technicians may be present.

By 1990, 1,668 health centres existed, giving a total health centre/population ratio of 1:7219. The objective is that each centre will serve between 500 and 3,000 persons in rural areas and between five and ten thousand persons in urban areas. In 1990, more than 98 percent of the population had access to a health centre.

For each cluster of 5-10 health centres, one 'major ' centre is being established to provide wider range of services. Eventually, groups of such centres will be linked with 30-50 bed rural hospitals, which in turn, will be linked to sub-regional hospital of 100-300 beds, depending on population size. These sub-regional hospitals will be further linked to tertiary service. It is proposed and is being progressively effected that access to secondary and tertiary care should only be by referral from PHC units.

Health centres are also expected to provide comprehensive maternal services to pregnant women, immunization and other child care services including growth monitoring, and prevention and treatment of dehydration due to diarrheal disease. MOH has adopted 'oral rehydration therapy' (ORT) as the preferred treatment for mild and moderately severe diarrhea cases. Each health centre is expected to organize "Well Baby Clinics" and to monitor the growth and development of infants and children using the "Well Baby Card", which has been developed specifically for the purpose, and also the child sheet in the "Family Health Record".

One of the corner-stones of PHC program in Saudi Arabia is community participation. A recent study has shown that national policies for the promotion of community involvement in the socio-economic development including health was well defined (Al-Mazrou and Al-Shammari, 1991).

Without question, the most significant improvement in vaccination coverage resulted from the 1979 Royal decree which mandated that all birth certificates for newborns would be held by health authorities until immunizations against diphtheria, pertussis, tetanus, poliomyelitis and tuberculosis were completed. In 1983, measles vaccination was added to the five above diseases by another Royal decree.

The massive investment in the health sector has naturally resulted in a substantial increase in national health facilities and manpower. For Example, the number of beds per 1,000 population has increased from 1.3 in 1971 to 3.4 in 1990. The ratio of physicians to total population has improved from 1:5900 in 1970 to 1:544 in 1990, while the ratio of nurses has changed from 1:2120 in 1970 to 1:248 in 1990.

1.3 Objectives of the study

This study is mainly concerned with an analysis of bio-demographic determinants of child survival in Saudi Arabia.

The major objectives of the study may be stated as follows:

1. To review the levels and recent trends in childhood mortality in Saudi Arabia

2. To assess the role played by structural factors versus social resources in shaping childhood mortality in Saudi Arabia.

3. To evaluate the relative importance of different social resources in different contextual settings in relation to child survival, with specific attention to the role of female education.

4. To understand the mechanisms of intervention of structural and social factors with specific reference to female education.

1.4 Presentation of the study

The presentation is organized into six major parts dealing with objectives of the study, literature review, methodology, data employed, results, discussion and conclusions.

Chapter 2 presents a review of literature and includes much of the available information in the last ten years, gathered from Popline and Medline data, published articles around the world especially by international health and social organizations, such as UNDP, UNICEF & WHO.

Chapter three on methods include the framework of analysis used and a brief discussion of other frameworks, indicating advantages of different frameworks.

Chapter four presents a descriptive analysis of data employed in this study which were drawn from the National Child Health Survey (1987).

Chapter five presents the main results of the study in table format and gives details of findings as related to each table, grouping them under the sub-heading of variables studied. Cross tables were constructed to highlight significance of factors studied through aggregate and multivariate analyses.

The discussion presented in Chapter Six is mainly centered around the levels and trends of IMR & CMR and the relative influence of the factors studied, individually & collectively. Each and every positive and negative associations were compared with similar studies conducted around the world in the past (in accordance with the literature cited earlier), the variation observed in the present study from other studies cited are highlighted and possible explanations for such variations are indicated. In doing so, much attention was focused on similar situations experienced by developing and neighboring Arab countries; though comparative information available was limited.

The concluding chapter presents a summary of the major findings of the study together with the policy implications and the required inputs to improve the levels of IMR & CMR in Saudi Arabia. Suggestions for further research need in the field of child survival are also included in chapter seven.

Chapter 2

REVIEW OF LITERATURE

2.1 Levels and trends of IMR and CMR

There is a dire need for continuous monitoring of the factors affecting child health and also of monitoring the implementation of strategies for improving the status of health of the people. The process needs to be carried out at national, regional and global levels to provide the answers to some searching questions, such as: Is it possible to make better progress, can we learn from other experiences, what are the obstacles still lying on our way, what assumptions were incorrect, and what appropriate actions need to be adopted?

With these questions in mind, we would proceed to monitor the global infant and child mortality trends and levels for comparison and for measuring the impact of various differentials shaping the infant and child mortality or survival in Saudi Arabia. This monitoring will contribute to a better understanding of world situation of infant (IMR) and child mortality (CMR) and survival patterns, differentials responsible for the trends and levels, and the extent of their influence on IMR and CMR. Since many variables influence the results, measuring the size of the effect of various factors using multivariate analysis will enable us to compare Saudi results with the results obtained in other countries. In the developed countries of the world, the UNICEF observed that over 97% of all children survive through pre-school years. By contrast, in many poor countries 20-25 percent of children die before reaching their fifth birthday, resulting in an estimated 15 million deaths annually (UNICEF, 1984).

In many countries, deaths of infants and children (1-4 years), constitute around a third of all deaths of the entire population. The UN estimates of mortality showed that, 33% of all deaths in developed countries, 34% in developing countries and 37% in Arab countries were constituted by infants and children (UNICEF, 1989). The study of levels, trends and differentials of infant mortality has a substantial implication for health policies and programmes. In addition,

infant mortality rate (IMR) is a most sensitive indicator of sanitary conditions, health and standard of living in many countries. IMR also influences the fertility pattern.

Before examining Saudi status and variables, we would look into the global mortality levels and trends both in developed and developing regions.

The review has been organized into three main sections as follows:

Mortality Levels and Trends

- Global Mortality Levels and Trends
- IMR & CMR for Specified Developed Countries
- IMR & CMR for Developing Countries
- African Countries
- Asian Countries
- Latin American Countries
- Recent Trends & Levels
- Saudi Arabia

Differentials Affecting the IMR & CMR

- Health Services
- Family Resources
- Household Infrastructure
- Area Characteristics
- Maternal and Child Health Variables
- Nutritional Factors

Multivariate Analysis

2.1.1. Global mortality levels and trends

Good health and low mortality in world population, are principally, recent phenomena. In 1990, newborn could expect to live some 30 years. Within the preceding 75-80 years, the life span is approaching 60 years, which is almost twice as long (Preston, 1976). But the life span differs widely between the continents and countries, specially between developed and developing nations. Nevertheless, an increase of life span by 0.50 to 0.58 years annually is anticipated in developing countries (UN, 1973, p. 141). The life expectancy at birth for the world population was 47.4 years in 1950-55 and 56.2 years in 1970-75. For developed regions the figures were 65.2 and 71.2 years, while for developing regions they were 42.6 and 53.4 years, respectively (UN, 1979, p. 62-66). Most of the deaths occur among children and this is followed by the oldest groups. Since child survival is our prime interest, we would look specially into the levels and trends of child mortality. Mortality rates help to identify the current demographic situations of a country and serve as important indicators of socio-economic and health progress.

The infant mortality rates (IMR), per 1000 live births, for males in 28 developed countries combined, were 41.9 during 1950-54, 29.1 during 1960-64 and 22.4 in the 1970s. For females, these rates were 34.8, 23.0 and 17.5, respectively, for the years 1950-54, 1960-64 and 1970s. The child mortality rates (1-4 years) for males, per 1000 population, were 1.7, 0.99 and 0.80, respectively, for 1950-54, 1960-64 and the 1970s (UN, 1982, p. 12). In the next section, a review of recent levels and trends in infant and child mortality in some leading developed countries, is presented.

2.1.2. IMR and CMR for selected developed countries

In Canada, the IMR, per 1000 live births, declined from 41.6 during 1950-54, to 18.9 during 1970-74 for males, and from 32.3 to 14.7 for females, respectively. During the same period, the CMR, per 1000 population, were 1.97 and 0.90 for males and 1.61 and 0.74 for females (UN, 1982, p. 69). These rates were lower in the United States of America. During 1950-54 and 1970-74, the IMR in USA, were 31.5 and 20.7 for males, and 24.5 and 16.1 for females, respectively. During the same period, the CMR (1-4 years) for males were 1.44 and 0.88 per 1000, and for females these were 1.21 and 0.71 per 1000, respectively. Japan

is considered to be the most developed country in Asia. The IMR in Japan for those years were 55.9 and 13.3 for males, and 49.3 and 10.3 for females, respectively (UN, 1982, p. 69-70). Meanwhile, the CMR in Japan were 7.06 and 1.11 for males and 6.99 and 0.86 for females, respectively (UN, 1982, p. 69-70).

The IMR in Eastern European countries, such as Bulgaria, for the periods 1955-59 and 1970-74 were 71.7 and 29.2 for males and 60.2 and 22.6 for females, respectively. For the same periods, the CMR in Bulgaria were 4.89 and 1.21 for males and 4.64 and 1.02 for females, respectively (UN, 1982, p. 70). In Northern Europe, the IMR for Finland, for the same years, were 39.1 and 13.3 for males, and 31.1 and 10.5 for females, respectively. The CMR for those years were 2.22 and 0.77 for males, and 1.70 and 0.57 for females, respectively (UN, 1982, p 72).

In Southern Europe, the IMR for Italy, for the same period, were 67.3 and 29.6 for males and 58.6 and 23.6 for females. The CMR were 4.19 and 0.88 for males and 4.11 and 0.77 for females (UN, 1982, p. 76).

In Western Europe, the IMR for France, for the same period, were 47.2 and 15.2 for males, and 36.9 and 11.7 for females. The CMR were 2.28 and 0.86 for males and 1.98 and 0.67 for female children (UN, 1982, p. 78). In the United Kingdom, the IMR were 31.4 and 19.5 for males, and 24.3 and 14.9 for females, for the periods 1950-54 and 1970-74, respectively. The CMR were 1.31 and 0.77 for males, and 1.10 and 0.64 for females, respectively (UN, 1982, p. 74).

The IMR for Australia, for the years under consideration, were 26.5 and 19.2 for males, and 21.0 and 14.6 for females. The CMR were 1.78 and 0.99 for males, and 1.44 and 0.77 for females, respectively (UN, 1982, p. 79-80). The IMR derived from the "West" family regional model life tables for males was 54.2 and for females 31.8 for 1966. The CMR was 3.71 for males and 1.94 for females (Coale & Demeny, 1966).

It is found that in most instances, the IMR remained below 100, per 1000 live births, and CMR below 5, per 1000 population, for the period 1950-54, with a clear decreasing trend thereafter. The other important observation is that both IMR and CMR were lower among females than among males in almost all developed countries. In the meantime, the life expectancy increased gradually in almost all of these countries. The mortality rates, however, dramatically increased in oldest age groups as a rule.

2.1.3. IMR and CMR in developing countries

2.1.3.1. IMR and CMR in Africa

Mortality levels in Africa were higher than those in other continents. Data on mortality in Africa was very scarce. Whatever data were available were also very crude. However, the information available in Northern Africa was more complete and reliable than the remainder of the continent. The two areas are, therefore, considered separately.

A. NORTHERN AFRICA

Out of the many countries of Northern Africa data were reasonably available from Algeria, Egypt, Libya, Morocco, Sudan and Tunisia. In the early 1980's, death registration was nearly 13% incomplete in Egypt, and in the rest nearly 50% incomplete. Multiround surveys were needed for gathering complete information (UN, 1982, p.83). The estimated IMR in Algeria during 1966-68 were 133 for males and 121 for females. The IMR for Egypt for the years 1948-52 were 151 for males and 150 for females. These rates declined to 128 for males and 131 for females, during 1963-67. In Libya, the IMR for 1972 was 148 for males and 129 for females. In 1970, the IMR for Morocco was 152 for males and 121 for females. The IMR for Sudan in 1973 was 160 for both sexes combined. During 1968 the IMR for Tunisia was 124 for both males and females. The CMR for any of these five countries were not available (UN, 1982, p. 84-85). The rates shown here were not, however, free from error.

B. IMR AND CMR IN SUB-SAHARAN AREA

The exact rates for Sub-Saharan areas were not available. Some of the rates had been estimated by indirect means. None of the techniques used was fully satisfactory. However, the estimated IMR for both sexes combined, of some Sub-Saharan countries were as follows.

IMR for Burundi, for the years 1952-57 and 1970-71, were 155 and 140, respectively (UN, 1982, p.93). IMR for Kenya, during 1948, 1962 and 1969 were 185, 130 and 120, respectively. For United Republic of Tanzania, the IMR for the years 1956, 1967 and 1973 were 190, 145 and 95, respectively. During 1963-64, IMR for Chad was 195, compared to 175 for Zaire in 1960-65. The IMR in Zaire remained unchanged (175) till 1974. Lesotho had an IMR of 180 during 1956-57 which decreased to 110 during 1971-72. Ghana had a higher IMR of 165 during 1960, which decreased to 135 during 1968-69, with a further fall to 120 in 1971, while Liberia's rate was 190 in 1962, and this declined to 180 in 1970 and to 130 in 1974. IMR for Mali was 235 in 1956-58, with slight fall to 215 in 1960-61 (UN, 1982, p. 93). The IMR for Senegal was 225 in 1960-61; while Sierra Leone had the same IMR in 1963. Unusually, the IMR in Sierra Leone increased to 250 after 10 years (1973) (UN, 1982, p. 94).

The IMR and CMR of Kenya for the year 1969 were 136.4 and 22.0 for males, and 137.9 and 24.5 for females. For Madagascar, these were 220.2 and 27.6 for males, and 157.4 and 23.3 for females during 1966; while the rates for Mauritius were 54.1 and 6.5 for females, and 68.2 and 5.7 for males during the year 1972. In Reunion, IMR and CMR were 102.2 and 6.0 for males, and 84.2 and 5.9 for females during 1967.

It was observed that these estimated IMR and CMR were very high in Sub-Saharan Africa except in Mauritius and Reunion, compared to other countries. Nevertheless, the trends in IMR and CMR in all these countries were decreasing, except in Sierra Leone. In many cases the male and female rates were close to each other, while in some the rates for females were lower than for males as is the case in developed countries. This might be due to inadequate

reporting of female child deaths. The registration systems of many of these countries were not satisfactory and the rates had to be estimated based on isolated reports. There were serious constraints on health progress in Sub-Saharan Africa. These constraints included very low incomes and national budgets, shortages of administrative skills and experiences and lacking of international commitments to solve the problems. Additionally, poverty, lack of food production, lack of economic growth, high population growth, rapid inflation, natural disasters, wars and building-up of armies contributed to the situation (UN, 1982, p. 95-99). The wide fluctuations in IMR and CMR in different parts of Africa might be due also to the presence of certain specific diseases in some specific parts of this continent. These diseases, along with malnutrition contributed to the different rates of IMR and CMR of this continent.

2.1.3.2. IMR and CMR in Asian countries

The data availability in Asia falls between Africa and Latin America. In 1950, only Hong Kong, Singapore and Peninsular Malaysia claimed to have "complete" vital registration system. By 1975, Sri Lanka was added to this list. These four countries, however, represented only 2% of the Asian population. The social and economic lives of Hong Kong, Malaysia and Singapore were hardly representative of Asian countries. Japan has already been considered with developed countries. China, having nearly 40 % of Asian population had not published its country wide vital registration regularly. However, the Asian countries may be categorized into low, medium and high mortality areas (UN, 1982, p. 113-115).

The IMR of rural China before 1950 ranged between 125 and 200. The rate for Peking only, according to Janet (1973), during 1956-58, was 35-40, and in rural areas, during 1955, IMR was 74 and in urban areas 44. During almost the same period (1954-55), the overall IMR in rural areas of China varied between 110 and 140, while the urban IMR ranged between 42 to 47 per 1000 (UN, 1982, p. 124). In Hong Kong, the IMR was 81.8 during 1954-55 which dropped to only 15 during 1975. But the IMR in the Republic of Korea was 125 for males and 103 for females during 1955, and these dropped to 39.6 and 36.7 for males and females, respectively, during 1971-75. In Indonesia, the IMR was 151 for males and 136 for females during 1961, which remained almost unchanged (152.2 for males and 128.9 for females) during 1971. But Singapore had a spectacular fall

in IMR from 69.0 in 1954-55 to only 13.9 in 1975. The IMR of Thailand was 116.9 for males and 96.0 for females during the 1960s, while the sex combined rate fell to 56 during 1974-75 (UN, 1982, p. 124).

In the middle south Asia, Afghanistan had the highest rate of IMR 217-235 during 1972-73. The rates in Bangladesh increased from 139 (1960-62) to 153 (1974). However, the high rate of 1974 in Bangladesh was an effect of post-war situation. The IMR in India during 1951-61 was 153.2 for males and 138.3 for females, falling to 120.7 for males and 124.1 for females by 1970-72. Pakistan had a higher IMR of 135 in 1962-65 which dropped to 106 in 1970. But Sri Lankan rate of 63 in 1956-60 dropped to 51.2 in 1974 (UN, 1982, p. 124).

The IMR of Democratic Yemen was high (190.7) in 1973 compared to Jordan (86) in 1972, and Kuwait (43.4) in 1975. The IMR of Turkey, decreased from 187 in 1955-60 to 145 in 1968. IMR increased in Yemen from 159 in 1970 to 210 in 1975 (UN, 1982, p. 125).

The child mortality rates (CMR, 1-4 years per 1000 population of that age group) in countries with complete registration system, in Asia, for the year 1971, were for Hong Kong 1.07 for males and 0.82 for females, for Malaysia 4.50 and 4.24, for Singapore 1.12 and 1.11 and for Sri Lankan 5.51 and 6.47 for males and females, respectively (UN, 1982, p. 129).

2.1.3.3. IMR and CMR status in Latin America

The vital registration systems in Latin American countries were better than in Africa and Asia in general. In some countries of Latin America, the life expectancy increased at a higher pace than the European countries (1 year vs. 0.5 years) annually. These were of course after the introduction of modern curative and preventive medicine, chemotherapy, vaccination, vector elimination, import of technology, etc. The mortality decline, however, took place in the absence of substantial socio-economic progress (UN, 1982, p. 144-145).

A. LEVELS AND TRENDS IN THE CARIBBEAN

The IMR and CMR in the Caribbean countries changed rapidly. The IMR in Barbados during 1950-52, for males was 143.1 and for females was 129.3. These came down to 49.9 for males and 37.7 for females in 1969-71. The CMR (1-4 years per 1000 population of that age) of Barbados also declined sharply from 17.2 for males and 14.6 for females to 6.5 and 6.0 by 1969-71. The IMR of Cuba dropped from 109.6 for males and 85.5 for females during 1950, to 43.6 for males and 31.9 for females during 1970. The CMR (1-4 years) for Cuba also came down from 62.5 for males and 46.4 for females in 1950, to 13.1 for males and 12.1 for females in 1970. During 1949-51, in Puerto Rico, the IMR was 70.5 for males 58.5 for females. The IMR came down to 30.3 for males and 23.5 for females in 1971-73. The CMR was 3.3 for males and 2.8 for females in 1971-73 (UN, 1982, p.174-76). All these countries showed downward trends in IMR and CMR since World War II.

B. CENTRAL AMERICA

In Costa Rica, the IMR was 104.6 for males and 89.1 for females in 1949-51, which dropped to 56.3 for males and 42.5 for females during 1972-74. CMR also dropped in Costa Rica from 60.7 for males and 59.9 for females in 1949-51 to 12.0 for both males and females in 1972-74. The IMR in El Salvador, came down to 114.2 for males and 96.1 for females during 1970-72. But the CMR of El Salvador increased instead of falling from 67.4 for males and 65.6 for females in 1948-51, to 77.4 for males and 73.8 for females in 1970-71, exceeding lower rates in previous years. In Mexico, the IMR was 107.5 for males and 94.7 for females in 1949-51, and this dropped to 79.6 for males and 67.1 for females in 1969-71. The CMR (1-4 years) also decreased from 100.4 for males and 107.9 for females, in 1949-51, to 42.7 for males and 41.0 for females in 1969-71 (UN, 1982, p. 174-76).

C. SOUTH AMERICA

The IMR of Argentina was 72.2 for males and 63.0 for females during 1946-48, and these decreased to 64.8 for males and 54.4 for females in 1969-71. The CMR (1-4 years) also declined in Argentina, from 20.3 for males and 20.0 for females in 1946-48, to 9.6 for males and 9.3 for females in 1969-71. The IMR of Brazil was 106.0 for males and 55.6 for females during 1950-60, which dropped to 79.1 for males and increased to 59.7 for females in 1960-70. The CMR decreased at a low pace. The IMR and CMR of Colombia remained more or less steady between 1963 and 1974. The IMR was 81.2 for males and 76.2 for females in 1963-65, which changed slightly to 82.6 for males and 71.4 for females in 1972-74. The CMR also remained steady. It was 38.6 for males and 50.3 for females in 1963-65, which changed to 41.1 for males and 42.7 for females in 1972-74. The Venezuelan IMR were 60.0 for males and 51.1 for females in 1961-62, and that changed to 56.0 for males and 46.0 for females during the next 10 years (1970-72). The CMR for 1961-62 were 27.4 for males and 27.3 for females (UN, 1982, p. 175-176).

Male mortality has generally been found to be higher than that of females, and there were exceptions to this rule, due to different biological and environmental factors, leading to the reversal of this phenomenon in few instances (UN, 1982, p-154).

2.1.4. Recent levels and trends of IMR and CMR

So far, we have presented a review of levels and trends in mortality of infants and children covering mostly up to the mid-1970s. In this section, a brief review of levels and trends in IMR and CMR during the 1980s is presented.

There was a clear decline in mortality during the past 20 years in Cameroon, Ivory Coast, Kenya, Nigeria and Senegal (UNECA, 1987). During 1988, Lindskog et al, have estimated that probability of death of Malawi children before the age of five years was 270 per 1000 children (Lindskog et al, 1988). In Gambia, Lamb et al, found in 1984 that the IMR had dropped from 148.5 to 24.5 per 1000, and CMR (1-4) from 109.1 to 13.3 per 1000 (Lamb, 1984). In 1964, CMR was found

to be as high as 560 in most under privileged rural areas of Mozambique (Lijestrand & Berstrom, 1984).

The most recent status of IMR and CMR for Sub-Saharan areas of Africa have been presented at the Demographic and Health Surveys World Conference in Washington in 1991 (Barbieri, 1991). It had been shown that in 1988 IMR and CMR were 46.8 and 18.0 for Zimbabwe; 64.9 and 51.2 in 1989 for Kenya; 74.7 and 60.8 in 1987 for Burundi; 74.5 and 67.9 in 1988 for Ghana; 95.8 and 77.2 in 1988/89 for Uganda; 86.1 and 97.0 in 1986 for Senegal and 88.7 and 105.2 in 1987 for Mali. The overall CMR status for some other African countries were presented in the same conference (Cleland et al, 1991). The national under-5 mortality levels for 1985 were, 191 for Senegal, 107 for Egypt, 102 for Morocco, 88 for Dominican Republic, 65 for Tunisia and 127 for Sudan. The decline in CMR ranged from 14 to 57 percent in these countries. Taking the entire Africa as a whole, the overall decline in CMR amounted to 43.5% between 1950-55 and 1980-85, and in IMR 41.4% for the same period (UN, 1988).

The more recent IMR and CMR for Asian countries presented were as follows: The 1979 fertility survey report of Yemen showed that the IMR for males was 163 and for females 145 for the birth cohort of 1976-78. The CMR for the birth cohort 1971-75 was 78 for males and 112 for females. During 1961-75, child mortality in Yemen declined by about 39% (Suchindran & Adlakha, 1985). The 1987 IMR in India (Patna slum) was 64.7 per 1000 (Choudhury & Aswal, 1987). During 1985, the IMR of Sri Lanka was 44, ranging from 21 to 100 in different districts per 1000 (Waxler et al, 1985). The CMR (under-5 years of age) for Indonesia, during 1985 was 95, and for Thailand 45. In Indonesia, there was a 54%, and in Thailand 66% decline in CMR from 1965 (Cleland et al, 1991). The estimated CMR (under-5 years) during 1980-85 for East Asia was 50.0 for China, 9 for Japan, and 38 for other East Asian countries. The decline was 79.8% for East Asia, 79.3% for China, 88% for Japan and 76.7% for other East Asian countries (UN, 1988). However, the CMR (under-5 years) for South Asian countries remained high. In 1980-85, it was 111 for South Eastern Asia, 177 for Southern Asia and 115 for Western Asia. The rates of decline were also lower. For the whole South Asia, it was 48.5%, for South Eastern Asia 54.5%, Southern

Asia 45.9% and for Western Asia 62.5% (UN, 1988). The estimated IMR for China was 39, for Japan 6, other East Asia 29 and South Asia as a whole 103 for 1980-85. The reduction in 1980-85 in IMR in China was 80%, Japan 80.2%, other East Asia 74.6% and in South Asia 42.8% from 1950-55 statuses (UN, 1988).

In Latin and Central America during 1985 CMR (under-5 years) was 111 for Peru, 82 for Ecuador, 61 for Mexico and 43 for Colombia. The decline in these four countries were 43% for Peru, 47% for Ecuador, 52% for Mexico and 65% for Colombia (Cleland et al, 1991). The IMR of Costa Rica had a spectacular fall from the past to 18 per 1000 during 1982 (Mohs, 1985). The estimated CMR (under-5 years) during 1980-85 for Caribbean was 91, for Central America 84, Temperate South America 38 and for Tropical South America 97. For Latin America as a whole CMR was 88. The downward trends of CMR were 53.4% for Latin America, 51.5% for Caribbean, 59.9% for Central America, 64.5% for Temperate South America and 50.5% for Tropical South America from the 1950-55 statuses (UN, 1988).

The CMR (under-5 years) for Australia and New Zealand was 13, for Melanesia 88, for Micronesia/Polynesia 39 and for the whole Oceania 40, during 1980-85. The decline was 58.3% for Oceania, 56.7% for Australia/New Zealand, 65.5% for Melanesia and 75% for Micronesia/Polynesia (UN, 1988).

The CMR (1-4 years), per 1000 population, for selected developed countries during 1985 were 0.58 for males and 0.45 for females of USA. The CMR (1-4 years) for males and females of Federal Republic of Germany were, 0.47 and 0.42%; for France 0.49 and 0.41; for Netherlands 0.46 and 0.38; for England and Wales 0.50 and 0.41; for Sweden 0.30 and 0.28; for Canada 0.48 and 0.37; for Japan 0.56 and 0.42; and for Australia 0.57 and 0.45 per 1000 males and females, respectively (Lois, 1989). The lowest IMR in USA was found to be 9.7 per 1000 in 1989; the States rates varying from 6.8 in Vermont to 12.6 in Georgia. Worldwide, the US rate of 9.7 was bettered by 21 other countries, with Japan having the lowest of 4.8 (Wegman, 1990).

The estimated CMR (under 5 years) of USSR in 1980-85 was 31, showing a decline of 69.7% from 1950-55. The rate for the more developed regions during 1980-85 was 19 and for less developed regions 134. The CMR of the whole world was 118. The decline in 1980-85 from 1950-55 was 52.3% for the less developed, 74.0% for the more developed countries and 50.8% for the world as a whole (UN, 1988).

Another point observed was that the reductions in IMR and CMR were not as spectacular in countries having low rates from the beginning, compared to countries having high rates.

2.1.5. Status in Saudi Arabia

Limited information is available for the Kingdom of Saudi Arabia. During 1978, Rashid Ali et al reported that the Kingdom's IMR varied from 87 to 110 per 1000 (Ali et al, 1978). In 1980, Hammam et al reported that the IMR was only 40 per 1000 in Baraza Emirate near Jeddah (Hammam, 1980). Al-Sebai found in Turaba, during 1983, that the IMR was 134 per 1000. This was the finding of a small town on the western region of Saudi Arabia (Al-Sebai, 1983). In 1983 Abu Osba and group reported that the IMR of Saudi Arabia was 157 per 1000 during 1970 (Abu Osba, 1983). The Ministry of Finance and National Economy reported in 1984 that the IMR of Saudi Arabia for 1982 was 84.8 per 1000 live births (Ministry of Finance, KSA, 1984). In the same year, Obeidy Ibrahim concluded that, in Riyadh, the IMR was approximately 26% lower than the 1980-85 UN estimates and about one fourth of WHO report of 1963 (Obeidy, 1985). The Central Department of Statistics, Ministry of Finance and National Economy of KSA, reported in 1986, that the IMR in Saudi Arabia during 1983 was 69 per 1000 live births (Ministry of Finance, KSA, 1986). Conducting a survey at three different places during 1985, Nur reported in 1986, that the IMR of KSA which was 92.5 in 1973 had dropped to 56.7 in 1984 (Nur, 1986). Serenius and Hofvander claimed in 1988, that the Saudi IMR varied from 65 to 120 (Serenius & Hofvander, 1988). Al-Mazrou et al (1990), showed that the estimated sex combined IMR were 81, 70, 57, 46, 38 and 30 for the years 1976, 1979, 1982, 1984, 1987 and 1989, respectively. Recently, Al-Mazrou and Farid reported in 1991, that the estimated Saudi IMR for males was 108 in 1973, 95 in 1975, 69 in 1980 and 55 in 1985. For females, during the same years, the rates

were 98, 87, 60 and 50. The under-5 mortality for the same years were 158, 134, 88 and 69 for males and 149, 127, 78 and 58 for females, respectively. The IMR in urban areas in 1985 was 47, while in rural areas it was 68. The under-5 mortality in urban areas was 53 and in rural areas 91. The highest IMR (74) was in the southern region and lowest IMR (44) in the eastern region; the highest CMR (under-5) was also in the southern region (95) and lowest (51) in the eastern region. The Saudi IMR and CMR for 1985 were greatly influenced by maternal education. IMR was 59 among illiterate mothers and nearly half (32) among mothers with primary or higher education. Similarly, child mortality (under-5 years) among illiterate mothers was 80, and among mothers with primary or higher education was 40 per 1000 (Al-Mazrou & Farid, 1991). UNICEF estimated in 1992, that the Saudi IMR was 65 in 1990 and CMR (under-5 years) was 91 (UNICEF, 1992, p. 72).

However, all these isolated reports of Saudi Arabia show that there was no systematic scientific countrywide survey in the Kingdom of Saudi Arabia to establish the level of infant and child mortality before the 1987 Saudi National Child Health Survey (Al-Mazrou & Farid, 1991), the results of which are utilized in this study.

2.2. Factors affecting infant and child mortality

A literature search has been undertaken with regard to the various variables that might influence levels, trends and differentials in infant and child mortality. In this section, four major groups of variables will be examined. These include aspects of accessibility and affordability of health services; family resources, particularly educational background; household variables; and area characteristics.

2.2.1. Health services: Accessibility and affordability

The sharp decline in IMR in Mexico from a level of 250 per 1000 in 1929-31 to less than 50 per 1000 in 1982-87 (Population Council, 1990) was not explained by the improvements in living conditions alone but mainly by the early introduction of sanitation campaigns, and more recently of immunization, antibiotics and other modern health techniques. However, significant rural and semi-urban populations were under served, thus leading to inequalities in the health status

of the population with less access to the services. In addition to financial resources, the need for integration and coordination of the fragmented services to serve the needy population was emphasized.

A study of mortality in 17 developed countries by Buck and Bull in 1986 stated that, infant mortality was more highly correlated with the health service variables and less highly correlated with per capita income.

In Gambia, Greenwood et al (1990) compared the decline in infant and child mortality rates before and after introducing a primary health centre (PHC) program. Both IMR and CMR rates fell during the post intervention period, but the decline was similar in PHC and non-PHC villages, suggesting that the changes might have been due to upgrading of health facilities and improvements in transport. There was, however, a decrease in the prevalence of diarrhoea, vomiting and severe cough following the PHC program.

An Australian community attempted to improve its socio-economic and health status. Harris and Kamien in 1990 showed that markers of nutrition in early childhood, housing conditions and access to health care, all improved inspite of deterioration in employment opportunities and adult health. On the other hand, child admissions for many problems, mainly diarrhoea, decreased.

A comparative study by Wallace and Goldstein (1975) involving Sweden and the USA discussed data on time births and low birth weight; the rates for USA were almost twice as much as those for Sweden. The findings for the USA were discussed in the light of the quantity, quality and delivery of health care services, as well as, of other factors in Sweden.

The influence of basic health services on mortality in the first five years of life in north-east Nigeria was studied by Hornstrup et al (1991) where the difference between the area without organized health service and other areas was found to be highly significant.

In Liberia, Ahmed et al (1991) examined the effects of maternal socio-demographic characteristics and the quality of the environment on child survival through two intervening variables, breast-feeding and prenatal care. The findings confirmed the results of previous studies.

Dugdale (1980), reporting on the situation in a settlement in Australia, found that the factors leading to improvement in infant mortality were a changed attitude to small infants and an ability to use health services appropriately.

A Nicaraguan study (Sandiford et al, 1991) that examined a multiplicity of factors that might have led to a rapid decline in infant mortality concluded that improved access to health services rendered at the PHC facilities was the most important factor in the decline of IMR. A comparative study by Dowling and Fisher (1987) involving white and black American, demonstrated an incidence of low birth weight of 16.6% for blacks and 5.9% for whites, low birth weight being a predictor of infant mortality. In addition to life style, maternal behaviour, lack of access to medical care and poor nutrition were blamed in the case of the black population. Another American study by Joyce in 1987 considered inadequate access to medical care and high birth rates as primary reasons why the black neonatal mortality rate was almost double that of the whites. A third study by Davis et al in 1987 attributed improvements, both absolute and relative, in the health of black Americans over the past two decades, to major gains in the access to health care services. Another good example of the importance of affordable and accessible care was demonstrated by the Nicaraguan national health system (Lawton, 1988). Prior to 1979, health services were inaccessible to the majority of the population, with high incidence of infectious diseases and IMR. Then following the institution of the unified national health system, 80% had access to regular health care, and IMR declined from 120 to 76 with eradication of polio and great reduction of other infectious diseases.

A recent review of mortality data for young people in the USA by Hoekelman and Pless (1988), showed a decline of IMR from 1 in 6 in 1900 to 1 in 100 in 1986. Between 1900 and 1984, child mortality (1-4 years) declined from 1 in 50 to 1 in 2,000. It was stated that further improvements in death rates would require

better access to health care by those in need, together with reduction in environmental stress.

In Sierra Leone, foster children were found to be more at risk, because of discrimination in food allocation and access to medical treatment than other children (Bhedsoe et al, 1988).

In South Africa, black children continued to die from preventable diseases - about 10 times the rate of their white counterparts (Anderson and Marks, 1988). Black children in Cape Town in 1984, were 205 times more likely to have tuberculosis than their white counterparts, this being the result of a denial of access to health services for black children.

Following independence, and inspite of weather and economic problems, there was evidence of a sharp decline in infant and child mortality in Zimbabwe (Sanders and Davies, 1988), due to the reorientation of the health care system and the greatly improved access to immunization and oral rehydration therapy. Mortality has declined as a result of effective health care provision, inspite of the fact that there was little change in socio-economic conditions.

The role of women in self-help programs, one way of community participation, was demonstrated by a project in India (Antia, 1988). A publication from Saudi Arabia (Serenius and Hofvander, 1988) described the expansion of health care services within 15 years preceding 1988, with an increase in numbers of nurses from 3,261 to 29,896, physicians from 1,172 to 14,335, PHC centers from 591 to 1,821 and hospital beds from 9,036 to 30,707; the development and rapid expansion of the PHC system was mentioned as one of the key issues in improving survival prospects among children.

A study from Bangladesh (Amin et al, 1989) concluded that the persons responsible for health program planning and implementation need to ensure that the access to basic public health care services be made broad enough to cover the majority of the rural population through a system of decentralized curative and preventive services, with adequate trained staff.

Even among the most highly developed countries, with the highest per capita GNP, substantial social inequities in health were reported by Lehmann et al (1990), suggesting that the average wealth of a community does not necessarily determine health.

A study from USA (Wood et al, 1990) that evaluated access to health care for American children and teenagers revealed that the poor, uninsured, low income and non-white children had less access to care compared with children from more affluent or white families.

In Bangladesh, it was shown that, the distance of a diarrhoea clinic from home was positively associated with the prevalence of diarrhoeal morbidity and mortality among young children (Rahaman et al, 1982).

Considering the problem of distance from medical care, a study from Fiji (Andy, 1990) found out that most of those who attended were mostly from around the center. It appeared necessary to provide care to those in distant villages, either by opening satellite clinics, to be visited by medical assistants several times a month and/or by training local residents to provide appropriate first aid.

2.2.2 Family resources: Its impact on child survival

Family resources is one of the most powerful variables associated with IMR and CMR in developing countries. Adequate family resources are, however, lacking in most developing countries where there are unproportionately high IMR and CMR compared to developed countries.

Three variables have been utilized as proxies for family resources on the one hand and its position in the social pyramid on the other. These are: mother's education, father's education and husband's occupation.

2.2.2.1 Mother's education

Maternal education is strongly associated with child survival. Kibet found in Kenya that the strongest determinant of infant mortality was maternal education. Association of other variables such as beliefs, breast-feeding, nutrition, birth

spacing and socio-economic conditions were also influenced by education (Kibet, 1987). In Sri Lanka, Trussell and Hammerslough (1983) have found strong association of child mortality with mother's and father's education.

In Korea, Kim (1986) found that the most important determinant of infant mortality was maternal education. The two other important variables he suggested were crowding and maternal age. Along with other variables, Pant (1991) also found that mother's education was an important variable in Nepal's urban areas. He suggested that maternal education was complementary to household resources. In Burundi, O'Toole and Wright (1991) found that both maternal and paternal education had strong relationship with child mortality. Mother's education was found to have stronger association than father's education.

Lindenbaum and group found in Bangladesh that mother's education was protective for child survival. Mother's education exerted its effect through various mechanisms (Lindenbaum et al, 1985). The Westighouse research development group concluded that uneducated mothers were risk factors for child survival, in addition to other risk factors (Westinghouse, 1989). A study conducted by Adlakha and Suchindran on WFS data obtained from Jordan, Yemen, Egypt and Tunisia arrived at similar conclusions. Aksit and Aksit (1989), by using multivariate analysis, suggested that, in Turkey, mother's and father's education, along with some other socio-economic variables, were associated with IMR and CMR.

Employing Trussell's marriage duration model on Ghana Fertility Survey data, Tawiah concluded that mother's and father's education were the most significant variables, followed by father's and mother's occupation, for child mortality (Tawiah, 1989). In Mozambique, Lijestrand and Bergstrom (1984), found that child survival was significantly higher when the women had received some education, possessed radios, or had paid employment. In Colombia and Thailand, Bicego and Boerma (1991), found that children of women having no education fared worst, while children of women having secondary education experienced lowest probability of neonatal mortality. Contrary to the advantage

of mother's education, they found in Toga, Ghana and Senegal that the children of uneducated mothers were at lowest risk of neonatal deaths, possibly due to under-reporting of mortality among uneducated mothers.

Florez and Hogan found that, in Colombia sharp decline in IMR was less related to improved status of women than to reduction in fertility that enhanced infant's survivorship and also to public health interventions (Florez & Hogan, 1990). From results in Malaysia, DaVanzo also showed that mother's education, improvements in water and sanitation were inversely associated with IMR (DaVanzo, 1988). Cleland and Van Ginnekan had shown that in developing countries, each year of increment of maternal education corresponded with 7-9% decline in under-5 mortality. In assessing how mother's education influenced the health and survivorship of children, they suggested that economic advantages associated with education (income, water, latrine, housing, etc.) accounted for about one half of the overall education/mortality relationship (Cleland & Ginneken, 1988).

Esrey and Habicht inferred that educated mothers protected their children in unsanitary environment and they used piped water and sanitary toilet more effectively when those were introduced (Esrey & Habicht, 1988). Rizgalla found in Sudan that, the estimated proportions of children dying by two years of age were 0.195 for non-educated mothers, 0.134 for women with primary education, and 0.077 for women with post-primary education (Rizgalla, 1977). Identical effects of education were also found in many other societies. It was suggested that mother's education undermined the traditional practices and established authority of the mother in family affairs and thereby ensured the provision of better child care.

2.2.2.2 Father's education

A husband has an important role in determining the family's welfare and health status. His education operates through improving the family income, in addition to changing his knowledge, attitudes and practice. The UN studies suggested that, in Jordan, both maternal and paternal education had association with IMR and CMR (UN, 1991, p. 103). The results of a multivariate analysis, done by Aksit and Aksit (1989) on data from Turkey, revealed that mother's and

father's education was an important determinant of child mortality. They suggested the existence of linkages between parental education and other socio-economic, cultural and biomedical variables at community, household and individual levels. From Ghana fertility survey data, Tawiah (1989) established that both father's and mother's education were associated with IMR and CMR.

A study by the UN based on data from 15 developing countries revealed that, at univariate level, child mortality varies inversely with father's education. In almost all these countries, the ratio of reported to expected children deaths declined as the educational attainment of the father increased. But the mortality ratio decreased less sharply with father's education than with mother's education in most of these countries. In Sierra Leone, father's education was positively related to child mortality, while mother's education showed greater impact on child survival. Father's education had greater influence on IMR in urban areas, while mother's education had greater influence in rural areas (UN, 1985, p. 27-62). But in some countries where mothers had no or very little education, and fathers only had somewhat more education, the IMR was at its peak (UN, 1985, p.60). Perhaps the women had very little power to control family affairs. One year of increase in father's education, after certain level, could decrease IMR by 5%, as against 7-9% in the case of mother's education. Among the educated groups, father's occupation had comparatively minor effect on IMR. In a number of studies based on multivariate analysis, when other variables were controlled, father's education effect remained significant although not as effective as that of the mother. When other variables were included, the effect of father's education was reduced by 75%, i.e. from 5% to 1.2%, and that of mother's education was lowered by 50%, i,e, from 7-9% to about 3.4%. It was suggested that father's education worked through other socio-economic statuses to a far greater extent (UN, 1985, p. 61).

2.2.2.3 Father's occupation

The family income and the socio-economic activities are mostly dependent on husband's income in most of the developing countries. The health of children and their well being are directly related to family income. In Brazil, Victora, Smith and Vangan (1986), found through the application of multivariate analysis that child mortality was associated with low income, lower employment status of the

family head, place of residence and other factors. Tawiah (1989), found that in Ghana, father's and mother's occupation were significant variables for child mortality. In Egypt, income was found to be associated with child mortality, but not with infant mortality (Casterline, 1989). Jain (1985) using multivariate analysis techniques, showed that, in India, poverty and non-use of trained birth attendants were important determinants of neonatal mortality.

However, malnourished children had nine times greater risk of dying in Bangladesh than the well nourished ones (Bhuiya et al, 1989). Malnourishment is usually the outcome of prolonged poverty. On the other hand, higher income was found to be associated with lower mortality in developed countries. In Canada, higher income was associated with lower mortality and longer life expectancy (Wilkins et al, 1989). A study in Maine, USA, showed that the children of low income families, thriving on social welfare program, had an overall death rate tree times greater than the children who were not on social welfare program. Children from low income families were at higher risk of disease related deaths (3.5:1), accidental deaths (2.6:1) and homicidal deaths (5.0:1) (Nersesian et al, 1985). A child who was not breast-fed had a 25 times greater risk of dying of diarrhoea than those who were exclusively breast-fed (Huffman & Combest, 1990). The infancy-mortality risk factors, identified by Louis et al (1988) in a study on Djibuti were joblessness, lack of fecal hygiene, bottle-feeding and non-coverage by vaccination. A study by the United Nations during 1969-71, revealed that the IMR varied depending on the occupation of heads of families. In Algeria, the IMR varied between 106 and 125 when the family head was engaged in professional, technical, clerical, or service occupations, while it was 134 when the family head was engaged in manual occupations, and 160 when the head was involved in agricultural activities (UN, 1982, p. 89). In France also, variation in IMR was observed in different occupational groups. During 1966-70, the IMR was 12.2 in the professional and managerial group, 17.7 in the shopkeepers group, 28.8 in miners group and 30.3 in the manual workers group (UN, 1982, p. 63).

The results of a study by the United Nations of data from 15 countries were also consistent with the generalization that child mortality varies with socio-

economic status, for which the father's occupation is a common proxy. This relation persisted in 14 countries studied. Professional occupations were associated with lowest levels of child mortality in 10 of 14 countries.

Children of agricultural and production workers had higher IMR than national average mortality in 11 out of 14 countries. Professionals had the highest benefit when they worked in urban areas. At multivariate level, however, this benefit disappeared when all other variables were controlled.

2.2.3 Household infrastructure: Its impact on child survival

For ensuring child survival, the target of WHO-UNICEF was for 80% immunization coverage for the children of developing world. Despite all the difficulties of the last decade, the 80% goal is expected to have been reached. That extraordinary effort has saved over 12 million young lives and prevented over one and a half million children from being crippled by polio (UNICEF, 1991). In addition to vaccine preventable illnesses, there are many other factors or variables which take colossal toll of young lives acting behind the scene. The infrastructure of households constitutes an unseen and neglected, but important variable responsible for child mortality and survival. Many scientists have unearthed the effects of household characteristics on child survival.

The effects of household characteristics are measured at the household level by three important variables, namely: flooring material, source of drinking water and sanitation facilities.

2.2.3.2 Flooring material

Specific citations about flooring material are rare. However, there are other references on the housing conditions as a whole. Examining the relationship of child mortality with housing characteristics, Brennan and Lancashire found in England and Wales that, there were significant associations between mortality of children and high density housing, inadequate housing amenities and unemployment. Housing variables remained significant when the effects of socio-economic status and employment were kept constant (Brennan & Lancashire, 1978). Ericson et al (1990), found in Sweden that there were significant associations between housing conditions and perinatal and infant mortality. The

mortality rate was lower in the privileged than in the underprivileged group. Robinson and Pinch (1987), found in Southampton, England a strong relationship between high rates of early childhood deaths and cluster types of poor housing, single parenthood and unemployment. Richardson and Bac (1987), found in Gelukspan, Bophuthatswana, that the neonatal mortality rates were higher among home births than among children delivered in clinics. Stern et al (1990), found that the improvements in living conditions, introduction of sanitation, immunization, antibiotics and other modern health techniques had been instrumental in reducing IMR and CMR in Mexico. Penna and Duchiade (1991), concluded that air quality of houses, had an association, by causing pneumonia in metropolitan area of Rio de Janeiro, with high infant mortality. Sawyere al (1991), using multivariate analysis of data from Brazil, found that IMR was indirectly related with healthy conditions of the household, health related behaviour of the household members and the demographic composition. The UN studies of 15 developing countries, revealed that the results were not uniform in all the countries. Mortality disadvantages of traditional and intermediate housing materials, in relations to modern materials were reduced, between univariate and multivariate stages for some countries and retained for others. Regression co-efficient for rural and urban areas did not show clear and consistent pattern of rural/urban differentials in the impact of housing variables.

2.2.3.2 Source of drinking water

Studies have shown that CMR was lower in households having piped water supply within premises than in houses using traditional sources of water (Lindskog, 1988). Multivariate analysis, done by Victora, Smith and Vangan in Brazil, revealed that child mortality was associated with housing conditions, particularly source of water and type of toilet facility, in addition to low income, lower employment status of head of the household, place of residence and mother's education (Victora et al, 1986). Presence of piped water inside the house was found to be associated with lesser morbidity in family members. Victora et al observed significant relationship between infant mortality from diarrhoea and non-availability of piped water, flush latrine, poorly built houses and over crowding (Victora et al, 1988). Studies in Malaysia suggested that improvements in water and sanitation, in addition to mother's education, inversely affected IMR. Also, continuing breast-feeding in poorer sections could

reduce IMR gap with the groups having better education and sanitation facilities (DaVanzo, 1988).

While assessing the effects of toilet, piped water and maternal literacy together in Malaysia, Esrey and Habicht (1988), observed that the literate mothers protected their infants, specially in unsanitary environments lacking toilets, and that when piped water was introduced, they used it more effectively to practice better hygiene for their infants.

Khan and Mosley found that people using hand pump tube well water had significantly lower rates of cholera than people using canal and stream water (Khan et al, 1981).

It is, therefore, evident that quality of drinking water is significantly associated with child survival, especially in developing countries.

2.2.3.3 Type of toilet facilities

Type of toilet used is usually referred to or studied together with the source of drinking water. In Sri Lanka, the IMR was low since World War II, and the overall rate was 44. But the rate varied between socio-economic groups, ranging from 21 to 100 per 1000. Lack of sanitary facilities, in addition to poverty and minority group, was associated with higher IMR. The most significant variables associated with low IMR were nutrition, supervised child birth and immunization irrespective of having sanitary latrine or not (Waxler et al, 1985). In Nepal, urban areas having access to toilet was found to be significantly associated with lower IMR and CMR, in addition to other variables (Pant, 1991).

In Malaysia, children who lived in houses without toilet and piped water and who did not breast-fed were five times more likely to die after one week of delivery than did the group enjoying these facilities (Habicht et al, 1988). Khan found significant relationship between hand washing after using toilet and before eating or feeding with shigella morbidity (Khan, 1982). He also found significant effects of having sanitary latrine in reducing cholera and diarrhoea incidence in Bangladesh (Khan & Shahidullah, 1982).

UNICEF rightly observed that "the poorest fifth of humanity still lacks clean water and safe sanitation". "Access to safe water and hygienic sanitation is therefore, an aim, a means and a measure of development" (UNICEF, 1991, p. 30).

2.2.4 Area characteristics

2.2.4.1 Regional variations

Regional variations in morality were described by Chan and Portnoy (1986), who examined the maternal mortality and age-specific mortality rates for the under 25 years old in six border regions of the US side of the US-Mexico border and compared them with those of adjoining regions in Mexico. On the US side of the border, the improvement in the general mortality status of maternal and child health from 1970 to 1980 was equal to or better than that of the nation as a whole. Despite that improvement, in 1980 five of the six border regions showed higher mortality rates due to external causes for 1-4 age group. On the US side, maternal and child mortality was lower in the border region than in other parts of the Mexico but much higher than in the US.

Wilson (1990), found that the 1987 infant mortality in South Dakota returned was lower than that of the nation as a whole. Comparisons of South Dakota with the US data showed that, for both whites and non-whites, the neonatal mortality rates were below those of the nation. However, the South Dakota post-natal mortality rate was slightly higher than that of the nation and the non-white post-neonatal mortality rate was more than three times higher than that of the US. Comparison of the causes of post-neonatal deaths showed that the relative risk of death from potentially preventable causes was four times higher among South Dakota non-whites as whites.

Again from the US, Wegman in 1990 stated that the US infant mortality continued to decline slowly and the provisional 1989 rate of 9.7 per 1000 live births was the lowest ever recorded. Final 1988 data showed that the state rates varied from 6.8 in Vermont to 12.6 in Georgia. Worldwide, the US rate of 10.0 was bettered by 21 other countries with Japan having the lowest rate at 4.8.

2.2.4.2 Urban/Rural differentials

Urban/Rural residence was a common variable cited by many authors. Gaisie (1975), found out that in Ghana the estimated infant mortality rates ranged from 56 per 1000 live births in Accra to 192 in the upper region during the late 1960s. The urban rates was lower than the rural rate, 161 as against 198 per 1000 live births. Results on the determinants of regional variation in infant mortality in rural India (Jain, 1985), showed a substantial urban/rural variation in infant mortality rate; urban areas tended to have lower infant mortality. An examination of the determinants of infant and child mortality variations in four Arab countries: Jordan, Yemen, Egypt and Tunisia (Adlakha and Suchindran, 1985) showed that maternal education and rural/urban residence were the most important factors affecting child survival. From Kenya, Kibet in 1987 also found out that regional variations could be associated with ecological and cultural variables such as altitude, climate and beliefs concerning hygiene and urbanization.

As previously mentioned, Kim (1986), found that birth order was a significant determinant in urban areas and mother's education in rural areas. Demographic factors were relatively more important for infant mortality in rural areas, while socio-economic factors played a role for infant mortality in urban areas and for child mortality in rural areas.

Considering the health policy of Canada to reduce socio-economic inequalities in health, a study by Wilkins et al (1989), examined the changes in mortality by income in urban Canada from 1971 to 1986. The reduction of socio-economic inequalities in health was then considered as an explicit objective of the health policy of Canada.

The Zimbabwe demographic and health survey found out that the urban child mortality rates were much lower than rural rates at 55 and 99 per 1000, respectively (Harare Central Statistical Office, 1989).

2.2.5 Maternal and child health variables

2.2.5.1 Maternal factors

These cover maternal age, fertility and personal factors. Trussell and Pebley (1984), examined the potential impact of changes in fertility on infant, child and maternal mortality; their results indicated that if childbearing was confined to the "Prime" reproductive ages of 20-34 then infant and child mortality rates would fall by about 5%. Similarly, limiting childbearing to ages 20-39 would also reduce the maternal mortality ratio by about 11%. Universal adoption of an ideal spacing pattern in which all births subsequent to the first were spaced by at least two years apart, would reduce infant mortality by about 10% and child mortality by about 21%.

On examination of a number of demographic determinants of infant and early child mortality using information from 39 WFS countries (Bhuiya et al, 1989), age of the mother, birth order and spacing of births were identified, among other correlates, as important factors affecting survival of children below five years of age. Similarly, the Guatemalan study by Pebley and Stupp (1989), showed that child mortality rates were highest for very young mothers, older mothers and higher parity mothers even when birth interval length was controlled. Although higher maternal education and longer breast-feeding had strong beneficial effects on child survival, neither maternal education nor the length of beast-feeding weakened the association between reproductive variables and mortality. Moreover, on examining World Fertility Survey (WFS) findings for 40 developing countries Acsadi et al (1985), found that mother's age at first marriage, at birth of the first child, spacing and birth order among other factors, had a strong bearing upon child chances of surviving.

The historical experience of a developed country with regard to factors influencing infant mortality were demonstrated by Kintner (1988), who investigated the socio-demographic, economic, medical and public health factors that influenced infant mortality in Germany during the period 1871-1933. Marital fertility had the largest impact on infant mortality, followed by illegitimacy, medical care, urbanization and infant welfare centers, while breast-feeding patterns varied by region. The analysis found no evidence that advances in medical

technology affected infant mortality or that the influence of economic development changed over time.

Babies born to mothers under 20 years or over 39 at the time of birth, had poorer chances of surviving the first five years, than those whose mothers were between 20-39 years of age. Infant mortality was exceptionally high among babies whose mothers were under 15 years of age at the time of their birth (Acsadi et al, 1985). In many countries primarily the Indian sub-continent and sub-saharan Africa, where women marry and have their first birth at an early age, the first born child is the least likely to survive infancy and early childhood.

Furthermore, Fernandez and Castella (1989), in a paper presented at the international population conference in Delhi, showed strong evidence that relatively high fertility at very young ages of the woman produced a combination of short intervals between births and young maternal ages, that impaired dramatically the children's chances of survival. The effects of birth concentration, birth order and maternal age were extensive.

2.2.5.2 Child health factors

a) GESTATIONAL AGE: regarding gestational age and low birth weight (LBW), several authors referred to LBW as a factor related to infant mortality. Downes et al (1991) more recently concluded that LBW was a strong risk factor for infant mortality, while Chowdhury and Jayaswal (1989), ranked LBW and perinatal infection, as the major causes of infant mortality, followed by diarrhoea. But with regard to the major causes of mortality among children 1-6 years old, diarrhoea was the major cause, followed by respiratory infection, and accidents and burns. Wallace et al (1975), describing the patterns of infant and early childhood mortality in the California project, reported that 77.7% of neonatal fatalities and 85.6% of those dying in the first day of life, weighed 2500 gms or less at birth. Moreover, the vast majority of babies that were born to young mothers and died during the first day of life had very low birth weights, then they concluded that young mothers ran a high risk of having LBW babies prone to dying in the first day of life.

b) SEX OF THE CHILD: The sex of the child was cited as a significant variable of infant deaths in Korea (Kim, 1986). On examining the World Fertility Survey results of Jordan, Yemen and Tunisia, Adlakha and Suchindran (1985), found a persistent pattern of higher child mortality for females than males, suggesting preferential care and treatment for male offspring.

On investigating the levels, trends and differentials of infant and child mortality in Yemen, using data of the 1979 Yemeni fertility survey results for the birth cohort immediately preceding the survey (1976-78), Suchindran and Adlakha 91985), estimated the IMR to be 157 per 1000, being higher for females than for males, 163 versus 145 per 1000. The childhood mortality for the cohort 1971-75 was 95 per 1000, but with lesser magnitude for males (78 per 1000) than females (112 per 1000). Again, a persistent pattern of mortality differentials by sex were found in the data. It was further documented that for all birth cohorts between 1961 and 1978, male neonatal and post-neonatal mortality exceeded female neonatal mortality, but the childhood mortality was less than the corresponding female mortality. The pattern suggested preferential care and treatment of male offsprings.

More evidence on the issue of higher female than male mortality during childhood was reported from Bangladesh by Koenig and D'Souza in 1986. The paper affirmed that the centrality of gender as a determining factor in child survival in rural Bangladesh seemed unquestionable. To explain the sex differences in mortality on the basis of culture alone was not adequate; it was seen primarily as a result of the interaction of economic and cultural forces. Cultural factors related to some preference came into play, largely in response to economic pressure,which necessitated the selective distribution of the familial resources.

Similarly, a report dated 1974 using the Korean national fertility survey data emphasized a strong and uniform preference for sons and stated that Korean infant and child mortality rates were higher for girls than for boys (Choe, 1985). The author concluded that high female mortality rates were partly due to unequal

care for males and females by parents,although the excessive female mortality rates remained unexplained by the report.

Information from Egypt by Makinson in 1989 also supported that females were disadvantaged, as it was reported that post-neonatal mortality was 12% higher and second year mortality was 60% higher for females regardless of other variables such as socio-economic status, demographic variables or sex of older siblings. Culturally, it is believed that boys are weaker and need more nurturing, while social status and marital security for women is measured by bearing surviving sons. The literature suggests that this view was prevalent in the Middle East, as well as parts of Asia and Latin America.

c) CONSANGUINITY: Consanguinity was investigated by several authors. An example is a study from India (Rami and Padi, 1978), where a survey was carried out to determine the prevalence and patterns of consanguinity and its effect on fertility, morbidity and mortality. Out of a total of 106 marriages investigated, 54.7 were consanguinous with predominance of marriage between first cousins. Another retrospective study from Pakistan (Shami, et al, 1989), investigating prenatal and postnatal mortality in seven cities of the Punjab, a highly significant relationship between the level of mortality and inbreeding was reported, with most consanguinity related deaths reported in the neonatal, infantile and childhood periods. The authors suggested that consanguinity might play a major role in the high rates of postnatal mortality observed in the Pakistani community resident in the UK.

As regards the situation in Saudi Arabia, and with respect to marriage between relatives, Serenius and Hofvander (1988) reported infant mortality estimates ranging from 65-120 per 1000, and observed that the preferred marriage partner was a close relative; thus genetic disorders such as hemoglobin disorders were common in certain areas. Similarly, data from Algeria (Benallegue and Kedji, 1984) demonstrated that consanguinity was very frequent (22-25%), predominantly first cousin marriages with adverse consequences on infant mortality with unexpected polymalformations or neural tube

malformations, hematologic diseases, Juvenile diabetes and recessively inherited diseases.

d) BIRTH ORDER: Birth order was considered by a number of authors among whom Singhi et al (1989) who reported that an increased risk of infant and child mortality was linked with several factors, with birth order ranking as second to age of mother. On examining data for 39 world fertility survey countries, birth order was listed among the correlates of chances of survival below the age of 5, including sex of the child, mother's age, etc. (Hobcraft et al, 1985). The result of a study on reproductive patterns and child mortality in Guatemala indicated that birth order was again second to maternal age as a factor that had a significant impact on the risk of child mortality (Pebley and Stupp, 1985). It was noted that first births were disadvantaged relative to all other births, except those occurring after a very short birth interval. Findings of the WFS from 40 countries (Acsadi et al, 1985) rated birth order as third to mother's age at first marriage and at the birth of the first child and intervals between consecutive births. Castilla (1989) proposed a model to describe the basic pattern of infant and child mortality by maternal age, birth order and birth spacing. The effects were realized to be extensive. Kim (1984-89) further identified birth order as a significant determinants of child mortality in urban areas.

e) CHILD SPACING: A study from Bangladesh identified the length of the preceding birth interval and the survival status and sex of the immediately preceding sibling as a significant predictors of child mortality between age 1-5 years (Majumder, 1990). A publication of the Population Institute, Peking University, reported the effects of subsequent birth intervals to be statistically significant with regard to child survival in Shanxie area but not in Shanghai (Tu, 1989). A comparative analysis of the demographic determinants of infant and early child mortality, using information from 39 World Fertility Survey countries arrived at the conclusion that close child spacing was clearly linked to decreased survival chances (Hobcraft et al, 1985). Also referring to the WFS results of Jordan, Yemen, Egypt and Tunisia,among the demographic factors examined,only birth interval showed a significant effect on mortality (Adlakha

and Suchindran, 1985). Furthermore, Maine and McNamara in 1985, while reviewing WFS data, reached the conclusion that short birth intervals endangered the lives of the child born at the start of the interval and the child born at the end of the interval. Again referring to the Guatemalan study on reproductive patterns and child mortality (Pebley and Stupp, 1985), the length of the previous and following birth interval was among the factors that had a significant impact on child mortality.

A family health international study (1989) postulated that if mothers in the 29 nations included in the study spaced their pregnancies by an average at least 2 years, then the total of 2.6 million deaths of children under one year, could fall by at least 20%, resulting in a saving of about 500,000 lives each year. Roughly 33,000 infant deaths could be prevented in Africa each year, 80,000 in the Americas and 390,000 in Asia.

A report by Inayatullah in 1986 described the important risk factors related to child spacing and child survival as an interval of less than 2 years, maternal age less than 20 or over 35 and a birth order greater than 4. A research study on the determinants of infant and child mortality in korea (1955-1973) by Kim in 1986 found out that previous birth interval affected child mortality in both urban and rural areas.

f) VACCINATION: On assessing the importance of immunization in child survival, the Indian council of medical research (Ramalingaswami, 1989) estimates that four million children die each year of vaccine-preventable diseases and that another four million are permanently disabled. Again an analysis of the determinants of regional variations in infant mortality in rural India, identified that the availability of village level medical services and the extent of triple vaccination, were two important determinants of post-neonatal mortality (Jain, 1985). Similarly, immunization was identified among other individual and household variables as a determinant of infant and child mortality in rural Haryana, India (Singhi et al, 1989).

g) DIARRHOEA: National estimates of the rates of morbidity and mortality from diarrhoeal diseases in American Children (Glass et al, 1991), showed that diarrhoeal deaths were few, representing about 10% of the preventable post-neonatal deaths in the US. In comparison, the results of a prospective study carried out in twelve centers in India (Choudhury and Jayaswal, 1989), identified diarrhoea as a less important cause of infant mortality of 8.8% than of child mortality (37.5%). Furthermore, addressing the question of whether acute diarrhoea was an important cause of mortality among rural Bangladeshi children, Chowdhury et al (1991) found that the infant mortality was 1.7 times higher for acute diarrhoea than for the rest of diarrhoeas, and child mortality was three times lower for acute watery diarrhoea. Again from rural Bangladesh, the results of a Longitudinal surveillance program on the epidemiology and cause of deaths in children under five, Chen et al (1980) revealed that the most significant causes of deaths were diarrhoea, tetanus, measles, fever, respiratory disease and others. The major causes of infant mortality were neonatal tetanus (37.4 per 1000), diarrhoea (19.6 per 1000) and respiratory disease (10.4 per 1000). As for child mortality, diarrhoea took the lead, followed by measles, then the rest. Diarrhoeal mortality in Saudi Arabia is rare. However, Al-Mazrou et al observed that an average child, under 5 years of age annually suffers from 2.07 episodes of diarrhoea all of which are not necessarily reported to health facilities (Al-Mazrou et al, 1991).

2.2.6 Nutritional factors

2.2.6.1 Breast-feeding

From Bangladesh (Bhuiya et al, 1989), malnourished children ran a risk of death nine times as much as that of their well nourished counterparts. Breast-feeding and birth spacing were shown to have significant effects on child survival in a Chinese locality (Tu, 1989). The association between breast-feeding, fertility decline and lowering of mortality was mentioned before (Ramalingaswami, 1989).

In Yemen (Suchindran and Adlakha, 1987) breast-feeding children aged 1-5 experienced lower mortality rates than non-breastfed. Similarly, from the WFS results of four countries (Jordan, Yemen, Egypt and Tunisia) Adlakha and

Suchindran in 1985 clearly showed the beneficial effects of breast-feeding on infant's survival. For all countries, the mortality rate for non-breast-feeding children was substantially higher than for the breastfed, even when controlling for the other covariates.

Recently, the Center to Prevent Childhood Malnutrition, Bethesda, USA (1990), reporting on a study from Brazil, showed that infants who were not breastfed ran a 25 times greater risk of dying from diarrhoea.

WHO identified breast-feeding as an important factor in preventing diarrhoea (Hogan and Martinz, 1990). Control of Diarrhoeal Disease (CDD) programme is studying the protective effects of exclusive breast-feeding and the morbidity and mortality risks for infants. Kim et al (1990) emphasized that immunization and breast-feeding promotion were important interventions of child survival programs. They affirmed that the maximum reduction of mortality and morbidity would be achieved when all child survival interventions were applied in a balanced complementary manner as envisaged in the concept of PHC.

A prospective community study conducted in Bangladesh by Briend et al in 1988 found out that roughly one third of the deaths in the age group 18-36 months was attributable to the absence of breast-feeding.

A survey in Malaysia confirmed the synergistic effect between poor sanitation and non-breast-feeding. Infants of households without piped water or toilet facilities, who did not breastfed, were five times more likely to die after one week of age than those who were breastfed (Rand Corporation, 1988).

A similar study from Brazil by Victora et al (1986) showed that the type of milk in an infant's diet was an important risk factor for deaths from diarrhoeal and respiratory infections. Compared with infants who were breastfed with no milk supplements,and after adjusting for confounding variables, those completely weaned had 14.2 and 3.6 times the risk of death from diarrhoea and respiratory infections, respectively. Progressive weaning was associated with a corresponding relative risks of 4.2 and 1.6.

The results of a survey examining the risk-factors and risk mothers of infant mortality in Djibouti, Louis et al (1988) identified joblessness, lack of fecal hygiene, bottle feeding and inadequate vaccination coverage as risk factors to be combated through the PHC being progressively set-up.

A paper investigating the effects of maternal demographic characteristics and socio-economic status on infant mortality in rural Columbia (Florex and Hogan, 1990) found out that the overall differentials in infant mortality by measures of women's status were small and were in good part associated with the differing reproductive behaviours of the women and variations in breast-feeding practices.

From Malaysia, household data reflected that the continued prevalence of extended breast-feeding in the poorer states and narrowing of educational and sanitation differentials, helped close the infant mortality gap between the richer and poorer states (DaVanzo, 1988).

In the UK, while trying to answer why mortality was higher in the poorer areas of Britain, Barker and Osmond (1987) identified past differences in maternal health and physique, in the postnatal environment, particularly in infant feeding, housing and overcrowding, as possible explanations.

2.3 Applications of multivariate analysis to the study of determinants of mortality

Victora et al (1986) used multivariate logistics regression analysis of data from census files to study social and environmental determinants of child mortality in Brazil. The effects of correlated factors were distinguished after adjustment of maternal age and parity. Adlakha and Suchindran (1985) analyzed WFS data from Jordan, Yemen, Egypt and Tunisia to examine the determinants of infant mortality.

Jain (1985) used multiple regression analysis and demonstrated both medical and non-medical factors explaining the regional differences in IMR in India. Hobcraft et al (1985) used data from 39 WFS surveys to examine the demographic determinants of infant and child mortality.

Brennar and Lancashire (1978), used Kendall's correlation technique to explore association of child mortality with a variety of socio-economic factors in England and Wales. Pebley and Stupp (1985) used multivariate form of life table analysis (Hazard Model) in Guatemala. Using Indonesian WFS data, Hull and Gubhaji (1986) examined the variables distinguishing urban from rural status.

Choe analyzed Korean National Fertility Survey data using hazard model to find association of 12 coefficient for socio-economic variables with sexes of infants and children (Choe, 1985).

Diana and Case used multivariate analysis for data generated for "Healthy household and child survival in Brazil" study (Sawyer et al, 1991). Akinrinola and David (1991) used multivariate analysis to examine the effects of breast-feeding on infant and child mortality in Kenya.

Cleland et al (1991) used multivariate analysis for comparison of infant and child mortality socio-economic differentials in fifteen countries.

Magali (1991) used the same technique for examining the effects of different socio-economic and cultural settings on infant and child mortality in nine sub-Saharan countries. Using multivariate logistic and hazards regression, Bicego and Boerma examined the DHS of 17 developing countries to explore statistical association between maternal education and child health and survival.

Trussell and Hammerslough (1983) used hazard model analysis of the covariates of infant and child mortality in Sri Lanka. Shin (1975) used multiple regression analysis to analyze the cross-sectional and longitudinal interrelations between infant mortality and economic, social and public health variables of 63 selected countries.

Child mortality differentials in Sudan was studied by Farah and Preston (1982) using multivariate analysis of Sudanese census data. Linda and others used hazard models to examine the covariates of child mortality in the

Philippines, Indonesia and Pakistan. They showed the effects of univariate and multivariate analysis (Martin et al, 1983).

The World Bank analyzed data, generated from large body of literature, utilizing multivariate analysis to examine the effects of education on health. The main purposes of the World Bank study were to investigate the effects of education on health and the causes of mortality slowdown in developing countries (World Bank, 1985). The UN's Mexico City meeting (1979), on socio-economic determinants and consequences of mortality, provided groundwork for an international comparative research in mortality differentials involving 15 selected countries from Africa, Asia and Latin America. To accommodate many differentials they used multivariate analytical methods to exactly specify the magnitudes and relationships of the differentials of mortality. Trussell and Preston's method had been employed in analyzing the data of this study (UN, 1985, pp. 6-11). Using multivariate analysis, they examined whether the coefficient for mother's schooling remained large at the multivariate levels (UN, 1985, p. 25).

By multivariate analysis in Sri Lanka, Nepal and India socio-economic factors, influence of religion and ethnicity were considered (UN, 1985, p. 86). Effects of the childhood residence of the mother were also examined for Nepalese mothers who were born in rural areas (UN, 1985, p. 118).

The effects of mother's occupation, effects of region, wealth and income on IMR and CMR were also tested by multivariate methods (UN, 1985, pp. 264-5).

As a follow-up of the above UN joint study, a second study was taken up in six selected developing countries to assess the trends in child mortality differentials and to explore the extent to which those trends were related to indicators of socio-economic development and to health policies in each country. For this study also the same analytical method of Trussell and Preston was applied. Multivariate methods and regression coefficients were used to assess the variables for comparison. Countries included were Kenya, Costa Rica, Honduras, Paraguay, Jordan and Thailand.

A few years ago it was widely believed that the availability of continually improving medical technology would lead, if not to the complete disappearance, at least to a sharp reduction of morality differentials among social groups. This expectation has proved to be optimistic, in all countries, illustrating the lack of understanding of the actual processes generating social inequalities (WHO, 1980). "The only immediate utility of all sciences is to teach us how to control and regulate future events by their causes. Our thoughts and enquiries are, therefore, every moment employed about this relation" (David Hume, 1977). "In investigating the differentials in mortality, we are probably uncovering something more than the tip, but certainly less than the totality of the iceberg of social inequalities and their consequences for the health conditions of population groups, (Palloni, 1984)".

Chapter 3

FRAMEWORK AND METHODOLOGY

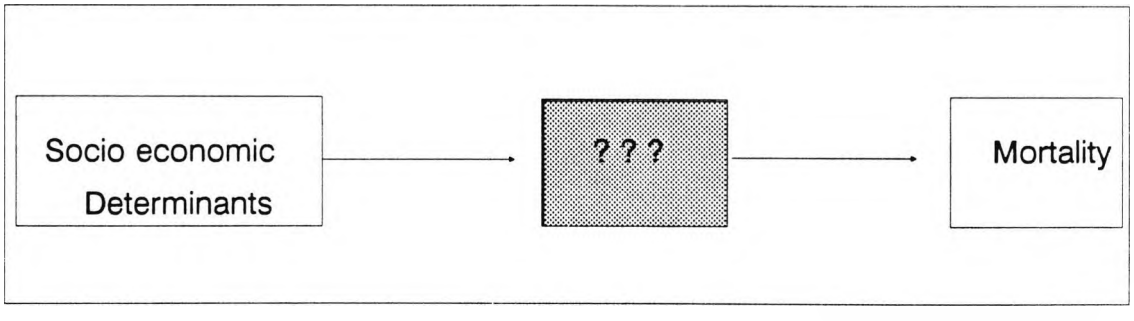
3.1 Framework

Since many attributes act through symbiosis or antibiosis on the survival or death of a child, examination of the effect of multiple factors is a complex issue. Many scientists have viewed the problems from different angles and examined the effects of the variables they thought appropriate. The methods and variables used to measure the effects varied according to requirements and background of the investigators or the condition of the society they are investigating.

Social science approach

Traditionally, social science research on child-mortality has focused on the association between socio-economic status and levels and patterns of mortality in the population. Correlations between mortality and socio-economic characteristics are used to generate causal inferences about the mortality determinants. Income and maternal education, for example, are two commonly measured correlates (and inferred causal determinants) of child mortality in developing countries populations. Specific medical causes of death are not generally addressed by social scientists.

The mechanisms by which socio-economic determinants operate to produce the observed mortality differentials remain largely an unexplained "black box". This is represented as follows (Mosley & Chen, 1984).



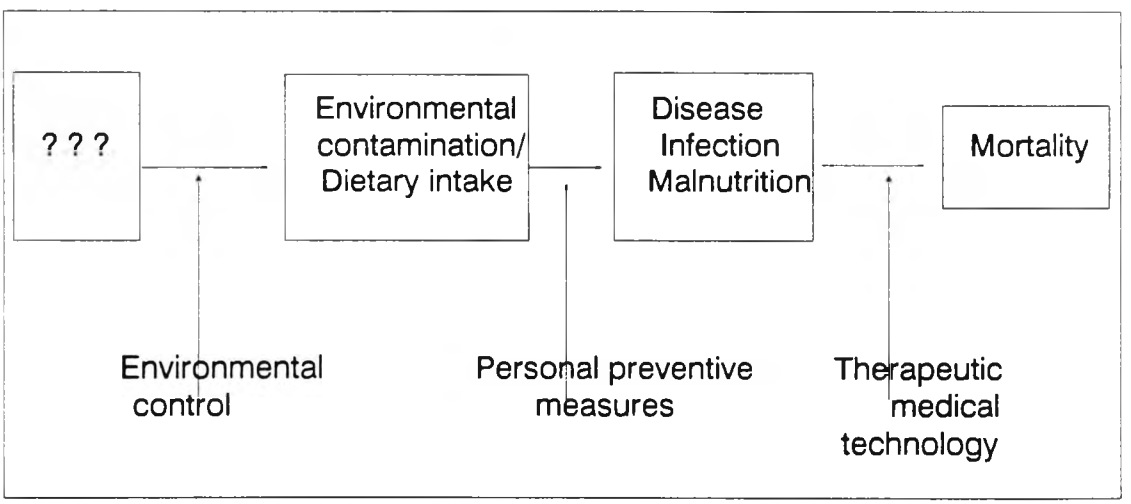
Since births and deaths are biological processes the above approach does not cover the biological attributes to survival or death. In many instances the causal factors in the black box remain unexplained.

Medical science approach

On the other hand frameworks and attributes used for medical research focused primarily on the biological processes of diseases, less frequently on mortality per se. Their assumptions are different from those of social scientists. Studies of cause of death attribute mortality to specific disease processes (such as infection and malnutrition), using information obtained from death reports or clinical case records; whereas clinical trials are usually limited to the assessment of the therapeutic effects of a particular medical technology.

Field evaluation studies measure the effectiveness of personal preventive measures on levels of morbidity and mortality in a population. Epidemiological studies define mechanisms of disease transmission in the environment, for example, the association between environmental contamination and disease. Intervention strategies are usually aimed at improving the environmental situation to reduce disease transmission. Nutrition research focuses on breast feeding, dietary practices, and food availability as they relate to nutritional status of the children.

The conceptual model of medical science approach to research on child survival may be presented as follows (Mosely and Chen, 1984).



The dependant variable measured by medical scientists is morbidity, i.e the manifestation of disease process among survivors (incidence & prevalence). The ultimate consequences of disease, viz: mortality, and socio-economic determinants are generally ignored.

Both the social and medical sciences have made major contribution to our understanding of child mortality. But the differing concerns and methodologies have constrained the development of more useful approaches. A new analytical approach incorporating both social and medical science methodologies into a coherent framework of child survival therefore is clearly needed.

3.1.1 Mosley and Chen framework

For the study of determinants of child survival in developing countries Mosley & Chen (1984) recommend a new approach. This approach incorporates both social and biological variables and integrates research methods employed by social and medical scientists. It also provides for the measurement of morbidity and mortality in a single variable. The framework is based on the premise that all social and economic determinants of child mortality necessarily operate through a common set of biological mechanisms or proximate determinants, to exert an impact on mortality. The framework is intended to advance research on social policy and medical interventions to improve child survival.

Mosley and Chen (1984) developed a useful classification using a multidisciplinary approach. They consider that the socio-economic determinants act both on family and individual member level. They also distinguish the proximate determinants, the intervening variables through which the socio-economic determinants affect the child's health status and disease process.Their approach is based on the following premises:

1. In an optimal setting, over 97 percent of newborn infants can be expected to survive through the first five years of life.

2. Reduction in survival probability in any society is due to the operation of social-economic, biological and environmental forces.

3. Socio-economic determinants (independent variables) must operate through more basic proximate determinants that in turn influence the risk of disease and the outcome of disease processes.

4. Special disease and nutrient deficiencies observed in a surviving population may be viewed as biological indicators of the operations of the proximate determinants.

5. Growth faltering and ultimate mortality in children (the dependent variable) are the cumulative consequences of multiple disease processes (including their bio-social interactions).Only infrequently a child's death is the result of a single isolated disease episode.

The key is to identify a set of proximate determinants, or intermediate variables, that directly influence the risk of morbidity and mortality. All social and economic determinants must operate through these variables to affect child survival.

Mosley and Chen (1984) suggested that the proximate determinants may be grouped into five categories :

1. Maternal factors: Age; parity; birth interval.

2. Environmental contamination: Air; food/water/fingers; skin/soil/inanimate objects; insect vectors.

3. Nutrient deficiency: Calories; protein; micronutrients (vitamins and minerals).

4. Injury: Accidental; Intentional.

5. Personal illness control: Personal preventive measures; medical treatment.

Relationship of the Proximate determinants to child survival:

The maternal factors are:

- Pregnancy outcomes affect maternal health through age, spacing, parity etc.

Environmental factors are:

- Transmission of infection through air, food, water, finger, skin, soil, objects and insect vectors.

Nutrient deficiency:

- Calories, proteins, micronutrients availability to child and mother, it affects health and breast-feeding.

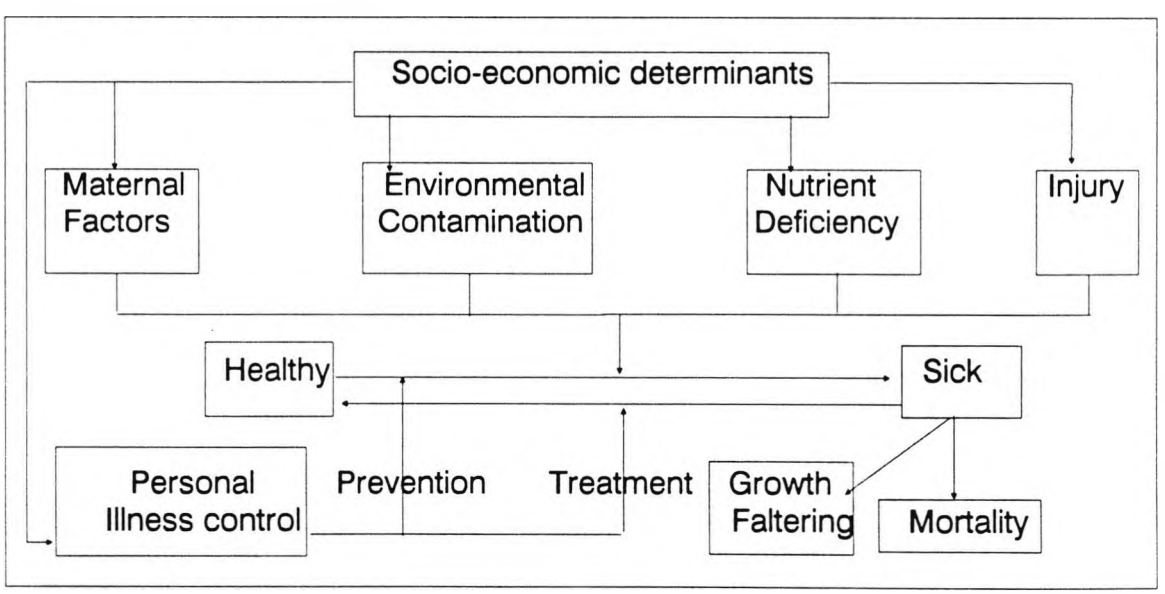
Injury:

- Physical, chemical, biological, or accidental, directly affect health.

Personal illness control:

- Vaccine, avoiding taboos; hygienic practice; pregnancy care; and treatment all prevent from disease.

Mosely and Chen's combined approach of operation of the five groups of proximate determinants on the health dynamics of a population (with socio-economic determinants) may be illustrated as follows:



The proximate determinants (or the intermediate variables) approach to child survival parallels developing an analytical framework for the study of fertility. But the mortality analysis is far more complex because the child's death is the ultimate consequence of a cumulative series of biological events.

The development of a conceptual framework for the study of child survival requires both a definition of the proximate determinants of mortality and a redefinition of the dependent and independent variables.

The dependent variable

Social scientists examine mortality as the dependent variable. This is wise since death is a definite event and can be easily measured and aggregated. But it has its handicaps, it is a rare event and requires a study of a large population or small population for a longer period. Social scientists rarely pay attention to health status of the survivors. In contrast medical scientists focus on disease or health status of the survivors. This approach permits intensive study of smaller population.

The shortcoming of this is that the past deaths among the birth cohort are often exempted. The model proposed by Mosley & Chen combines the level of growth faltering among survivors with the level of mortality of the birth cohort to create an index.

Growth faltering is considered as malnutrition following dietary deficiency. But it is due to many factors and it may be considered a non-specific indicator of health status. This indicator may thus be used for the social researches. The level of growth faltering is measured by using a standard method and comparing it with the weight of a standard growth chart for the same age. Typically, each child's weight is expressed as a percentage of the expected weight for age. Gomez's classification of malnutrition includes the following:

Grade I: 75-89 percent of standard weight for age,

Grade II: 60-74 percent of standard weight for age

Grade: III below 60 percent of standard weight for age.

The mortality rates of groups of cohorts were calculated by weight for age groups. There were consistent increase in death risk with lower weight for age. This was also true for early neonatal deaths. They suggested that the mortality risk among survivors by weight for age be incorporated as a grade IV health status index. A variable so constructed can be a useful measure. Since this measure reflects cumulative past morbidity experience, it may be suitable for single-round retrospective surveys searching for determinants of child survival. However, it will not serve as a valid index to relate specific absolute levels of mortality across populations. This is because the probability of dying at a given level of growth faltering varies greatly according to the prevalence of certain diseases and availability of medical services.

Proximate determinants

To achieve maximum analytical value the proximate determinants should serve as indicators of the various mechanisms producing growth faltering and death and also they should be measured in population research. The proximate determinants are directly measured in some and indirectly in others as illustrated below.

1. Maternal factors

The proximate maternal factors such as age, age at marriage, parity, birth interval etc. are measured by direct interview.

2. Environmental contamination

The levels of environmental contamination and the routes of spread of disease may be measured by microbiological examination of samples of (i) air, (ii) water, (iii) food, (iv) skin washing and (v) vector washing.

For public health surveillance only a single indicator organism is selected for measurement. E. Coli bacteria of human faeces is measured in food or water. The relative intensity of environmental contamination can be measured by the number of recent episodes (incidence) of a group of acute infectious diseases in children under study. For example, common cold, influenza, pneumonia can

be used for airborne infections, diarrhoeal diseases for water,food or milk contamination and neonatal tetanus for disease spread by skin and soil. Chronic disease can be measured by skin test for tuberculoses, stool test for parasitic diseases (through faecal contamination of environment), clinical examination for scabies or trachoma and blood for malarial parasites.

All these are direct means of assessing the levels of contamination. Physical indexes may also correlate with the levels of contamination; for example air contamination and risks of respiratory infections ; water contamination by sources of supply; food contamination by cleaning, cooking, storage; faecal contamination by presence of latrine or toilets. More than one measure may be used to obtain a composite index. Care should be taken to avoid treating each measure as an isolated factor, specially in multivariate models.

3. Nutrient deficiency

Nutrition deficiency in mothers or children can be measured by weighing all foods before consumption, accompanied by biological analysis of food samples. Less precise measures are observation and recall of diet. These give relative levels of nutrient intake. Deficiency of specific food intake can be measured from low serum protein (protein), xerophthalmia (vit A) and anaemia (iron). Manifestations of deficiencies may also be related with recurrent infections.

4. Injury

The operation of this intermediate variable is measured by incidence of recent injuries, or the cumulative prevalence of injury-related disabilities (physical handicaps, scarring from burns etc).

5. Personal illness control

This variable is measured by use of immunization, malaria prophylaxis, or antenatal care. For curative measures, providers of care and types of therapy

instituted for specific conditions are assessed. Traditional practitioners/practice and treatment should also be specified in this group.

A variety of procedures can be used to measure and scale the proximate determinants of child survival. These may range from biological analysis of environmental and food specimens, to medical examination of individuals, to visual observations of the environment to simply asking questions. Some methods are better than others, but not suitable for population based research. Direct microbiological examination of a water sample may give precise result. But it may not be valid for the whole year. Hence, the observation that the water source is a canal used for bathing, cooking, and faecal waste disposal will be far more appropriate in this case.

Socio-economic determinants

Socio-economic determinants (independent variables) operate through the proximate determinants. To understand their operation in growth faltering or mortality the socio-economic determinants are grouped into three broad categories of variables that are commonly used in social science research.

(I) Individual level variables: Individual productivity (father, mother); traditional norms / attributes.

(II) Household level variables: Income/wealth.

(III) Community level variables: Ecological setting; political economy; health system.

Individual level variables

(a) Individual productivity:

Three factors determine the productivity of household members. These are skill (education), health and time. If the "product" of interest is a healthy surviving child, the childbearing and childrearing adult (mother) needs to be separately considered from others (father). Father's educational level in urban areas usually correlates with income, household's assets, and the commodities the household

consumes. Thus the education of father enables him to earn more money that reflects its effects on health of the members.

Father's education often influences the attitudes and choices of consumption goods and child care services. This effect is most significant for child survival when more educated fathers are married to less educated mothers. Father's education thus operates on the proximate determinants through the income effects.

In case of mother, her skill, time and health operate directly on the proximate determinants. Her biological links with the foetus during pregnancy, and with the infant during lactation, her health and nutritional status, and her reproductive pattern, all influence the child's health and survival. Mother's education increases her sense of responsibility and skill in taking care of her own health, foetal health during pregnancy and child's health during the most vulnerable stages of its life. Her educational status gives her authority to choose, spend on health matters of her child, participate in child's and her own immunization and avail health care facilities in times of need. Additionally, her education undermines traditions which affect health. Higher education establishes her authority in family matters. The proximate determinants may thus be radically altered by mother's education in favour of child's survival.

For promoting the health of her child, mother's time for attending antenatal, post-natal and well baby clinic is needed, she has to devote time for breast-feeding, in preparing food, cleaning the child and his linen, cleaning the house and for sickness care, in addition she may have to spare her time for her husband to facilitate family matters. Some of them have to spend their time for income-generation, which in turn help the child survival. If the mother consumes her time in activities other than child care, specially in poor socio-economic situations the chances of survival of child is jeopardized.

(b) Traditions / norms / attitudes:

These are the factors that shape and modify the economic choices and health related practices according to the traditions and norms of the society. The important cultural determinants of child health and survival are :

1. *Power relationship within the household* : In traditional societies, although the mother has full responsibilities for child care, she may have very little control over distribution of food for herself or for her child (Safilios et al, 1980). The mother in law or husband may reverse the decision and they may stick to harmful traditional care. Education of child's mother may, however, shift the power relationship in favour for the child.

2. Value of Children : This is an important variable for child survival (Scrimshaw and Susan, 1978). In some cases, a family's investment in child care is conditional on expected returns. Where girls are valued for the bride price they bring, child survival rate is better for females than males. In places where female dowry is a burden during marriage, the reverse is true. Better feeding and medical care for male child operate through this proximate mechanism to create differential child survival rates in some societies.

3. Beliefs about Disease Causation : Society's wrong beliefs about disease causation shape behaviour affecting proximate determinants of child survival. These are ritualistic disease prevention practices, choice of therapies, choice of practitioners, sexual taboos and obstinacy to prevent illness in the suckling child. These are manifested by under utilization of modern health facilities when these are introduced in traditional societies. Formal education transmits concept of modern scientific medicine. When mothers are exposed to such information they may prefer to utilize modern medicine so as to significantly improve child survival without additional economic involvements.

4. Food Preferences : Choice of food and intake is deeply culturally conditioned. This is also prevalent in developed societies. This is confirmed by dietary heterogenecity in developed countries. Maternal diet during breast-

feeding and supplementation are important determinants of child survival. Food preferences, lactation, weaning of the child and restriction during illness of both the mother and the child, will all affect the child survival rates. Withholding of food and fluids during diarrhoea may accelerate malnutrition in already malnourished children, leading either to weight faltering or mortality.

Household level variables

Income/wealth/effects : A variety of goods, services, and assets at the household level operate on child mortality/survival through these proximate determinants. Effects of income may be stated as follows:

- Food: Availability of a basic minimum amount of food supply to ensure adequate nutrition is very critical. Wholesomeness and sanitary quality of food, (clean, fresh, free from contamination and adulteration) are also very essential for preventing transmission of pathogens which may affect child survival.

- Water: Both quality and quantity of water are important determinants of exposure to disease. Adequate quantity of water is essential for bathing, washing and cleaning. Potable water is needed for drinking and food preparation.

- Clothing/Bedding : This is needed for protection from adverse effects of climate and dust. Adequate clothes also help in reducing skin infections and infestations.

- Housing : Both space and facilities are needed. Crowding and poor ventilation predisposes to respiratory and skin infection. Houses should have vermin-proof window screens, bath and sanitary toilet. Water and food storage facilities and adequate number of rooms for sleeping and separate dwelling for live-stocks with proper sewer and plumbing connections are needed for hygienic living.

- Fuel/Energy : Adequate fuel is essential for cooking of food, boiling of milk and water, sterilization of feeding utensils including feeding bottles. Energy is needed for refrigeration, warming and cooling the houses.

- Transportation : It is needed for access to medical, preventive and maternity care, to market and income generating places.

- Sickness Care : Money should be reserved and made available in time of need to meet the expenses of hospitalization, physician, and maternity care and for purchasing drugs.
- Information: Households can obtain information through radio, television, newspapers, magazines and books about proper nutrition, hygiene, contraception, immunization, outbreak of disease and methods of protection.

The above list illustrates how income can mediate as powerful determinant of child mortality. In some cases 80 percent of the family income is spent on food. Increase in food price in such cases means increase in mortality specially of the vulnerable child. In poor countries even a marginal disparity in family income and cost and availability of food may increase child mortality seasonally.

Community level variables

(a) Ecological Setting: Climate, soil, rainfall, temperature, altitude, season etc. In subsistence societies, these variables may influence the production of crops, availability of adequate and potable water, vectorborne disease transmission, bacterial growth in food, survival of eggs and larvae of parasites on soil, and the drainage of sewage. These may affect the income generating work and access to medical facilities. All these would influence the child survival in adverse situation.

(b) Political Economy : A lack of political will may affect the determinants of child survival. These include stabilizing food supply using rail roads, road networks, irrigation, markets and political security. Important politico-economic factors are:

- Organization of Production: The production and distribution of benefits depends on whether it is by individuals or by community organizations. Distribution of food or resources needs to be stable.
- Physical Infrastructure: Railways, roads, electricity, water, sewage, telephone are some of the structures which have an impact on distribution, circulation of information on cost, availability of medical facilities, drugs and reminding people to take preventive measures in time.

- Political Institution: Stable political institutions can exert their influence in the stability of country affairs. They include organizations at distant outlying levels and their ties with central authority for policy guidance, program implementation, law enforcement, security systems, and control of labour unions, co-operatives and political activities. These institutions can shape the determinants of child survival.

Health system variables

It is presumed that modern medicine must improve the health of the population. But its mechanisms have not been spelled out. Within the proximate determinants model, the formal (Western) health system is viewed as operating in the following ways:

- Institutionalized (imposed) action: These are mandatory disease control measures. They have impact on mortality. These are financed either by the health system or private enterprises under government supervision . Examples of the latter are regulations governing sanitary quality of commercial food, milk, water, sewage, air, housing, restaurants, hospital and factories. There is however, economic constraints for preventive activities. Developing countries are overburdened by "enforced" but ineffective health laws.

- The other area of health system is cost subsidies for health related goods and services. These inputs operate through the "personal illness control" proximate determinants. This is mainly concerned with cure of illness which is dependent upon health beliefs and preferences. Cultural barriers may reduce the impact of this health system on child survival. The cost subsidies are also subject to economic constraints by many countries. Often there is considerable allocation of health resources in urban areas, resulting in helping the advantaged segment of the population. The rural health centres are often underutilized for non availability of physicians, drugs or for being located at a distance from their residences.

- The public information, education and motivation can operate in several levels. The public can influence the government politically to allocate

more funds or to modify general developmental policies in favour of people's health. The people can insist for upgraded medical staff or can upgrade traditional practitioners or health workers. Individually they can enhance their skills and change the practices of parents, specially mothers which will promote child survival.

- Improved medical technologies can favourably shape the determinants of child mortality. Examples are vaccines and antibiotics. These can be adopted either through institutional mandate (DPT, small pox vaccine, water and sewer system, refrigeration and sanitation in commercial food processing) or through subsidies (Vaccines, drugs, vitamins, ORS and contraceptives). However, the use of technology is guided by the following issues: (i) *What will be the contribution of a particular technology towards child survival when analyzed in proximate determinants model? (ii) To what proportion of people the technology will be available? and (iii) Will it be used effectively?*

Advantages of Mosley and Chen (1984) multidisciplinary framework:

This analytical framework will enhance our understanding of many factors involved in the study of child survival and family's production of healthy children. It will also provide a foundation for formulating health policies and strategies. The key advantage of the model lies in the organization of desperate measures of environmental conditions; of dietary, reproductive and health care practices; and of disease states into a coherent framework in which the former are linked to each other and to child survival and socio-economic factors. The proximate determinants have been limited to 14 specific factors grouped under five broad categories. Hence it is feasible to develop models which would enable integrated analysis of the biological and social determinants of mortality.

The model suggests that child mortality should be studied as a chronic disease process with multifactorial origins than as an acute, single cause phenomenon. The model will specify the interactions among socio-economic determinants.

In many situations multidisciplinary approach to the study of child survival could provide guidance for health policy makers in developing world. Large differences in infant and child mortality exist in developing countries between various regions, between mothers with different levels of education or social characteristics within a given area. An indepth analysis connecting the ecological and/or socio-economic factors to specify proximate determinants can enlighten the policy makers about the health related policies that could reduce the differentials.

Multidisciplinary research is rewarding in situations where social or health intervention are being introduced into large population. A rural or urban projects may change the ecological setting and/or may provide additional income generating opportunities for men and women which may improve health of the members. Those types of interventions may both assess the health impact of alternative strategies and concurrently enable to define sharply the specific factor/s which is/are amenable to change through revision of health policies, resulting in better infant and child survival chances.

3.1.2 Other frameworks

Behm Hugo (1987) has pointed out that there is no theory about the determinants of mortality and mechanisms of their operations. The conceptual frameworks so far developed reflect different disciplinary approaches and different thinking about society itself. However,they do agree on the following points : (a) Death is the final biological expression of a process which is determined by economic and social status of a country or region. The socio-economic conditions influence development of disease, one of the outcomes of which is death. (b) Structural determinants influence child's growth and development and generate biological risk factors which act directly on child's health.

The family must solve the needs of its members with the available resources and is to develop behavior consistent with its survival strategies. Although most of the decisions taken by family may affect the survival of the child, the family is an important mediating mechanism.

As discussed above, Mosley and Chen (1984) identified the intermediate variables as (i) maternal, (ii) environmental, (iii) nutritional, (v) injuries and (vi) sickness and health care practices . The survival strategies of families are controlled by the structure of the society in which they belong and factors of ecology, political economy and health care systems. Two other approaches to the analysis of the determinants of child survival have been suggested.

Economic model of Schultz

In the economic model of Schultz's (Schultz and Paul, 1985), child survival depends upon:

- The biologically determined heterogenecity of the child in terms of health status.
- The health input selected by family members to minimize losses of health and to achieve their other purposes.

These input items are determined by the economic situation of the household and by community restrictions, such as the availability of health services, regional wages and prices, and ecological conditions.

Framework of Breith and Granda

On the other hand Breith and Granda (1984), in their analytical framework maintained that, in a given social formation representing a combination of various modes of production, the position in the productive process distinguishes social classes by the nature of their work and patterns of consumption. The resulting living conditions affect child health positively or negatively. Each social class develops a set of favourable or unfavourable biological conditions which determine its health and sickness profile. In such situations, the family devices various methods to ensure the material and social survival of its members.

3.1.3 General problems in the analysis of determinants

It is clear from the foregoing summaries that the study of determinants of child survival is not an easy undertaking. Conclusions are often subject to limitation of interpretation of the results.

For any study a conceptual framework is needed to guide the analysis. This process includes several steps. The assessment of theoretical link between abstract concepts is followed by the experimentation of such relationships through indicators and the validity and reliability of indicators thus spelled. The analysis of these indicators through statistical models is subject to verification. These requirements, are lacking in most of the studies of determinants of mortality. The data used for this purpose are very often secondary (censuses, birth and death registers and surveys designed for other purposes). These are interpreted as indicators for the concepts under study. Often analysis consists of hypothizing about the nature of associations observed between the available independent variables and some function of mortality.

For any national study it is essential to determine the most important structural characteristics of the population. Some of the information is qualitative and cannot be statistically analyzed, but it should be included in the conceptual framework. With the traditional indicators of economic and social development, it is important to determine the following:

(a) The prevailing mode of production and the stage of development.

(b) The existing model of economic and social development.

(c) The degree of development of the forces of production.

(d) The type of dependance upon foreign markets and financial centres and the characteristics of the external debt.

(e) The degree of labour organization (a factor that affects the distribution of the product of social labour).

(f) The policies actually implemented concerning the distribution of wealth and social services, and the indicators of that distribution.

A frequent problem is the exclusion of factors from the analysis, for which no information is available. This may alter estimates of effects of the variables included in the analysis (say lack of information about the use of medical service). For example, Jain (1985) confirms the association between mother's education and the risks of dying in childhood. But when the variable "utilization of health care system" was introduced it was found that 86 percent of the effects of mother's education operates indirectly through health service utilization.

The analysis should also distinguish between the various levels at which the determinants operate and should adequately define the interrelationships between those levels. This is the purpose of multivariate studies. Problems, arising thereof, have been highlighted by Casterline (1981). Shultz (1985) provides a solution by estimating two functions. The first is a function of health production, which relates child mortality to health input used by the family. The second is an equation in which the demand for health input is presented as a function of family's human and economic resources and various regional indicators. Sometimes it is only possible to relate mortality directly to individual and community variables in the demand equation. Applying this method in Colombia, the mortality rate was found to be correlated with ecological factors, which remained after controlling for the effects of socio-economic variables and appears to have a larger impact on less educated women.

Bloch and others (1983) in a longitudinal cohort study of children from birth found that the social groups consisting of unskilled workers, or workers having unstable occupation, low education, poor housing, unstable personal relationship etc., had poor health status of mothers and most deficient children, pregnancies with higher risks and higher incidence of low birth weight etc. Children displayed retarded growth and development indices, and had higher mortality rates. Although frequency of visit for treatment of illness was similar to the other groups, this social group had less knowledge of standards of child care, and preventive medical care was less frequent and delayed resulting in higher child mortality rate in them.

In the USA, the mother's race and education are associated with mortality. Higher mortality rates of infant were observed both in white and black less educated mothers. But it was much less in Hispanic possibly due to better health practice in Hispanic culture. Low birthweight is an important variable. Ethnic groups are also said to be a factor for higher IMR and CMR.

For addressing the IMR and CMR in developing countries researchers should make use of all information available, of a multidisciplinary approach and a suitable analytical framework. Epidemiological case control studies may be employed to find the relative risks associated with biological and social factors in those who die and those who do not. Cultural characteristics, which is qualitative in nature, also need to be incorporated.

3.1.4 Implications for policies designed to reduce mortality

The goals of the study of child survival determinants are to point out the risk factors and finally to bring down the IMR and CMR sharply.

Policy implications depend upon many elements. Certain determinants, say religion and ethnicity cannot be changed. But ethnicity poses a higher risk which needs priority attention. The policy of extension of education and establishment of health services, specially their utilization deserve quick attention in many developing countries. But modification in housing quality involves adequate finance, time and motivation. Nevertheless, this is one of the important human rights. The health sector is responsible for extending preventive and curative facilities for improving child survival differentials.

There is a need for operational studies directed to give answers to the following questions:

- What is the magnitude of the child mortality differentials?
- How many of the children are exposed to those differential risks annually?
- What are the geographical locations of children at risk ?

- What are the social, economic and other characteristics which can identify the families at risk ?
- What progress is underway for changing these situations ?

3.2 Data sets and choice of variables

The main source of data utilized in this study is the National Child Health Survey which was carried out in Saudi Arabia during March - April 1987 with the objective of providing policy makers with reliable data necessary for evaluating and formulating maternal and child health policies. A nationally representative probability sample of households was selected and a total of 8,044 households were successfully contacted. A total of 8,482 ever-married women, less than fifty years of age, and 13,332 children under six years were interviewed.

Four questionnaires have been utilized in the survey:

- (a) the household schedule;
- (b) the household utilities module;
- (c) the maternal care questionnaire; and
- (d) the child health module.

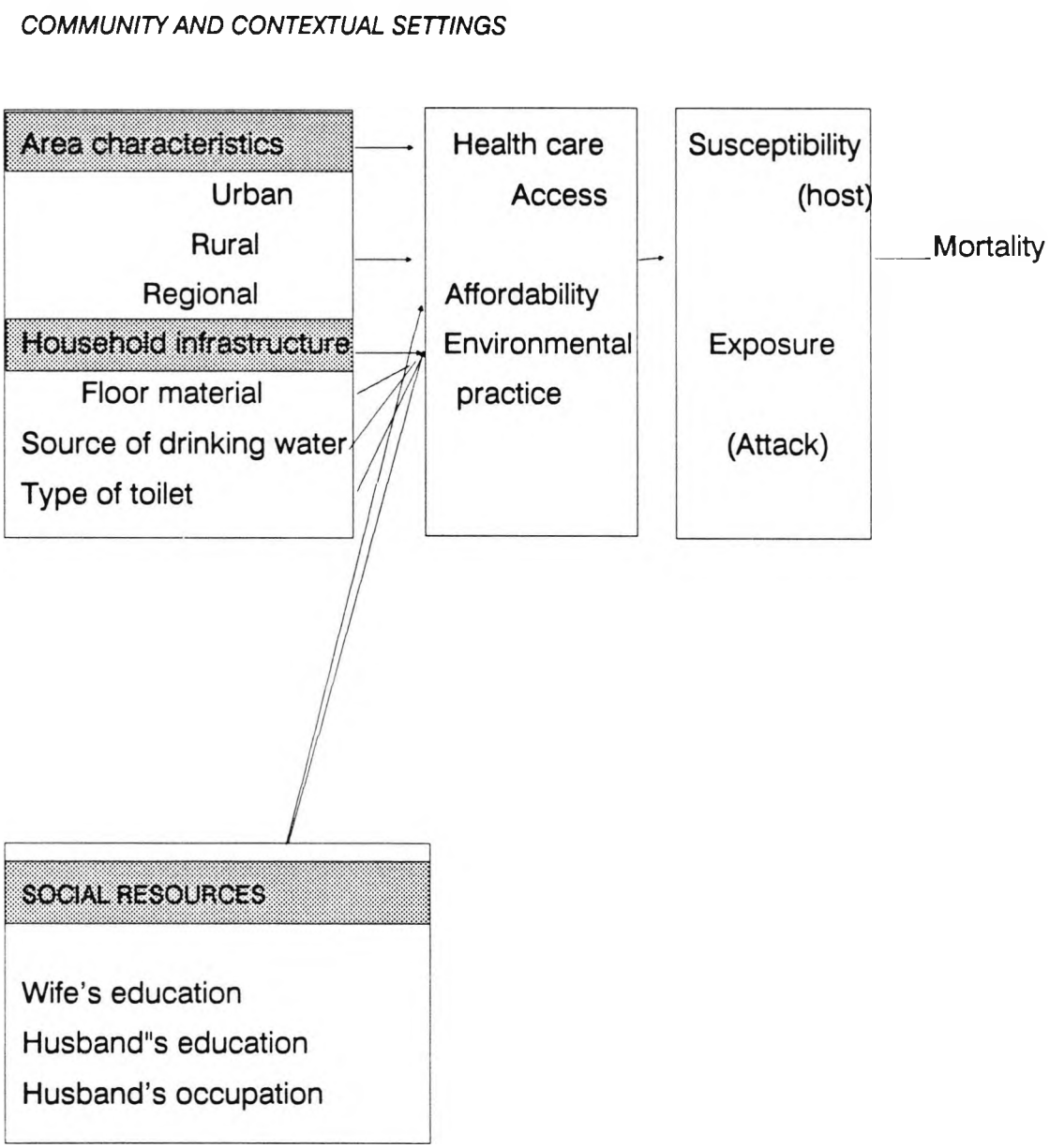
The individual maternal care questionnaire, which was administered to all ever-married women under the age of fifty, covered some background aspects of both respondent and her current (or last) husband (literacy, educational level etc), and the bio-demographic characteristics of the respondent such as : age, current marital status, age at first marriage, consanguinity, number of children ever born, children surviving and children dead by sex, pregnancy status and breast feeding patterns. For currently pregnant women as well as those who have had a birth less than five years ago, information concerning utilization of maternal and child care services was collected.

The child health module covered the areas of immunization, the prevalence of diarrhoea, the treatment offered and feeding patterns during illness.

However, in the NCHS (Al-Mazrou and Farid,1991) no attempt was made to directly measure norms, perceptions and awareness (through exposure to mass media for example). The survey did not include a community module.

Hence, four broad sets of variables are utilized in the present analysis. The first two capture structural factors, which relate to health services. The second relates to infrastructure setting of clean water, type of floor material and toilet facilities.

Figure 3.1 Summary picture of the adopted framework



The remaining two capture social resources. The third relates to the individual level social characteristics (such as wife's education) which influence the manipulation of community resources and constraints. The fourth deals with the area characteristics, such as prevailing norms regarding reproductive pattern, feeding and health care utilization etc.

The following summarizes the variables chosen for analysis:

1. As community level data on health services were not collected, two proxies were used to measure accessibility and affordability of health services:

- percent currently pregnant who did not have a check-up (among those who did not have a check-up) because facility was too far (accessibility).
- Percent currently pregnant who did not have a check-up (among those who did not have a check-up) because service was too costly (affordability),

2. The levels of infrastructure are measured at the household level by three variables:

- Floor material, a factor with two levels representing (i) households with earth floor and (ii) household with cement floor.
- Source of drinking water, a factor with three levels viz (i) well or pond, (ii) piped or bottled and (iii) other (unspecified).
- Type of toilet facility, a factor with three levels i.e. (i)Open field or other (unspecified), (ii) Pit and (iii) Flush (water seal).

3. Three variables are used as proxies for family resources on the one hand and its position in the social pyramid on the other. These variables are:

- Wife's education with two categories only, (i) less than primary certificate and (ii) with primary certificate or more.
- Husband's education, also with two categories of (i) less than preparatory certificate and (ii) with preparatory certificate or more.

- Husband's occupation. a factor with three levels; (i) farmer and other agriculture, (ii) service, skilled, semiskilled and unskilled, and (iii) clerical, sales, professionals.

4. Area characteristics are represented first by:

- Region and type of place of residence.

Then, an attempt was made to capture differences in region and place of residence through several aggregate measures. These measures and their interpretations are discussed later.

3.3 Data analysis

Trussell and Preston have developed and tested a method for analyzing mortality differentials from child survivorship data (1982). The procedure proposed by Trussell and Preston is applied to the data collected in the National Child Health Survey (NCHS) in order to estimate the co-variates of child mortality in Saudi Arabia. The procedure utilizes data obtained from Brass-type questions on children surviving and children ever born by standard categories of duration since first marriage or age. The main assumption underlying this technique is that, the age function of the cumulative probability of dying since birth, q(x), is proportional to a standard schedule $q^s(x)$. The proportionality factor is estimated as the ratio of actual to expected deaths within different categories of co-variates.

The essential feature of Trussell and Preston method is to construct an index of child mortality for women and compare the values of the index among different groups of women. This method has been adopted for this analysis.

3.3.1 Advantages of the Trussell and Preston method

This methodology permits the multivariate analysis of differentials in child mortality when the data are not available for individual children, but can be obtained for individual mothers. Census and surveys usually collect information on the total number of children ever born and surviving from each woman interviewed; the proportion of her children who have died, given her age, or duration of marriage, can then be related to life-table estimates of child mortality. Each woman's information on the mortality experience of her children can also

be related to her socio-economic characteristics and to characteristics of her household.

This method shows how to model such relationships using multivariate regression (Davis et al, 1956). The other advantages are that, even incomplete data collected in surveys and censuses, can yield estimates which are very close to those based on rich, detailed and expensive data. The method also provides more analytic flexibility and can accommodate continuous independent variables. Simple ordinary least squares (OLS) procedures can be employed to achieve results (Trussell and Preston, 1982).

Principles of Trussell and Preston Method

The principles of the index construction rests on the idea that the proportion of children who have died can be used as measure of the mortality of children of women after adjusting for the effect of marital duration or age of the women. Adjustment is necessary because, if mothers are old or have been married for a long time, their children are older and are thus exposed to the risk of dying for a longer period, resulting in a higher proportion of children who have died.

The child mortality index for a woman of certain marital duration or age is constructed as the ratio of the actual proportion of her children who have expired to the proportion expected for an average woman in the population of the same marital duration or age. For each woman an index of her children's mortality is created. The index is equal to the number of her dead children divided by the "expected" number of dead children. The "expected" number is derived by multiplying her number of births by the expected "proportion" of children dead. This expected "proportion" dead is based upon general mortality conditions in the population and also upon the exposure time of her children to the risk of mortality, as measured by mother's marital duration or age. When information on both marital duration or age are available, marital duration is used. Marital duration provides a more precise index of exposure.

3.3.3 Construction of the index of child mortality (UN, 1985)

The index of child mortality "M" for woman "i" having marital duration "j", "Mij" is thus:

$$Mij = Di / Ni \times EPDj$$

where, Di = number of dead children for woman i,
Ni = number of births to woman i,
EPDj = expected proportion dead for a woman of marital duration category j.

When marital duration categories are not available, j refers to a woman's age group. The marital duration categories used are: 0-4 years, 5-9 years, ... 30-34 years, and the age categories are: 15-19, 20-24, ... 45-49. Women above 49 and of marital duration above 34 are excluded from this analysis for their births and child deaths took place far in the past and were not included in the survey.

To derive EPDj the mortality estimation procedure originally developed by Brass is turned upside down. Brass developed a system of equations, based on simulation, for converting an observed proportion dead among women in category j into a life table measure of mortality. The equations are of the form:

$q(a) = d(j)\, G(j)$, where

q(a) = probability that a child will die before exact age-a.
d(j) = proportion dead among children ever born to women in marital duration category j.
G(j) = Multiplier suitable for women in marital duration category j.

The (a,j) correspondences suitable for mothers in marital duration category j are: (2, 0-4), (3, 5-9), (10, 15-19)'..... ' the (a,j) correspondences when j refers to age group of mother are (1, 15- 19), (2, 20-24), (3, 25-29), (5, 30-34), (10, 35-39).....

The multiplier G(j) is a function of the pattern of marital fertility in the population as indexed by ratios of cumulative parities for women in different marital duration groups. To put the above equation to work on the problem at hand, we impose a "standard" mortality function, "qs(a)" and convert that

standard into an expected proportion dead by rewriting the previous equation for q(a) as: EPDj = qs(a)/G(j)

A family of model life tables is chosen that is believed to be as accurate as possible for the country in question. The North and West model life table systems of Coale and Demeny are most frequently employed. A model life table with that system was found such that, for the population as a whole, actual child deaths were equal to expected child deaths. The qs(a) comes from this life table.

The final form of the child mortality index for women "i" of marital duration "j" is thus

$$Mji = Di / Ni \,.\, qs(a) / G(j)$$

The index of child mortality will be referred to as the child mortality ratio in this study, because it is the ratio of observed deaths to expected deaths. The index is a standardized mortality ratio, because it is standardized with respect to marital duration or age of mothers.

The analysis is performed using the statistical package GLIM (Generalized Linear Interactive Modeling) and a standard mortality schedule from Coale-Demeny regional life tables (UN, 1983) corresponding to West patterns, level 19.5. To facilitate the interpretation of parameter estimates, the dependent variable, the ratio of actual to expected deaths for each woman, is divided by 1.027 representing the average ratio in the sample under investigation. The grand mean for the new dependent variable is equal to 1.0. Thus, the deviation of the estimated ratio for a woman with the x-vector or attributes from 1.0, measures the positive or negative effect of those co-variates (in percentage points) compared to the average experience in the sample.

3.3.4 Methods of analysis

A two step multivariate analysis is adopted. In stage one, child mortality is regressed on all variables whose values are established during the parent's, childhood. In stage two, all other variables are added to those included in stage one. The coefficient of the parental childhood variables in stage two represent

the "direct" effects of the parental childhood variables on the mortality of next generation of children. Some of the parental childhood variables "work through" other socio-economic variables established later in life. The urban and rural samples are partitioned into separate rural and urban sub-samples and the stage II estimation is done for both samples. Because of the possibility that the structure of relations between mortality and the independent variables differs between rural and urban areas, the sample is partitioned into separate rural and urban sub-samples and the stage II estimation is done for both the sub-samples. Several of the determinants of mortality are shown to have systematically different effects in two areas, a result which sheds considerable light on the mechanisms through which these determinants operate.

The form of regression equation is:

$$M_{ij} = A + k\, {}^{B}k\, {}^{X}ik + E, \text{ where}$$

Xik = value of Kth variable for woman i.
Bk = coefficient of variable k
A = constant term.
E = error term, assumed normally distributed (after weighing by number of births) with mean of zero.

The variables ${}^{X}ik$, are members of a set of dummy variables. Within a set (say father's occupation), one category is assigned the value zero and a separate variable is constructed for each of the other occupations. The variable "sales" takes on the value of one if the father is a sales worker and in other cases zero. Zeroes on occupational variables indicate that the father is professional. This is termed a reference category. The value of ${}^{B}k$ for sales occupation indicates by how much the index of child mortality is raised for offsprings of sales workers relative to offsprings of professional workers. If ${}^{B}k = + .10$, it implies that children of sales workers have 10 percent higher mortality than children of professional workers controlling all other variables. The significance level of a coefficient refers to the significance of the difference in child mortality between the category to which the coefficient pertains and the reference category. Had another reference category been chosen, the coefficient and significance level of a particular category would almost certainly have been different, although differences among coefficients of categories would remain the same.

Chapter 4

RESULTS (I): Aggregate Analysis of Determinants of Infant and Child Mortality

4.1. Infant and child mortality

4.1.1 Introduction

This section examines the level and recent trends in infant and child mortality in Saudi Arabia. It looks at the mortality decline among children nationally and among subgroups of the population, defined mainly by place of residence and level of education.

Table 4.1.1 Mean number of children ever-born, surviving and dead per ever-married woman by age of mother, according to place of residence, region and literacy

	Mean no. of children	Age of mother							Total
		15-19	20-24	25-29	30-34	35-39	40-44	45-49	
Region									
Central	ever-born	0.69	1.98	3.54	5.43	7.39	8.53	9.43	4.99
	surviving	0.65	1.87	3.36	5.00	6.82	7.57	7.71	4.49
	dead	0.04	0.11	0.18	0.43	0.57	0.96	1.72	0.50
North	ever-born	0.76	2.36	4.10	5.86	7.62	8.60	9.66	5.27
	surviving	0.73	2.23	3.78	5.46	7.04	7.55	7.87	4.71
	dead	0.03	0.13	0.32	0.40	0.58	1.05	1.79	0.56
South	ever-born	0.74	2.37	4.43	6.11	7.54	8.19	8.67	5.53
	surviving	0.70	2.18	4.08	5.37	6.53	6.69	6.77	4.73
	dead	0.04	0.19	0.35	0.74	1.01	1.50	1.90	0.80
East	ever-born	0.77	2.32	4.35	6.13	7.72	8.16	8.42	5.26
	surviving	0.77	2.21	4.20	5.83	7.32	7.30	7.32	4.90
	dead	-	0.11	0.15	0.30	0.40	0.86	1.10	0.36
West	ever-born	0.78	2.10	3.80	5.29	6.66	8.11	8.07	5.29
	surviving	0.76	2.00	3.53	4.92	6.07	7.10	6.73	4.74
	dead	0.02	0.10	0.17	0.37	0.59	1.01	1.34	0.55

Table 4.1.1 Continued,

Residence									
Urban	ever-born	0.73	2.09	3.81	5.42	6.96	8.10	8.56	5.07
	surviving	0.71	1.98	3.61	5.08	6.46	7.27	7.12	4.62
	dead	0.02	0.11	0.20	0.34	0.50	0.83	1.44	0.45
Rural	ever-born	0.79	2.40	4.25	6.10	7.67	8.60	8.73	5.67
	surviving	0.75	2.23	3.89	5.41	6.76	7.00	7.02	4.88
	dead	0.04	0.17	0.36	0.69	0.91	1.60	1.71	0.79
Literacy									
Illiterate	ever-born	0.79	2.71	4.49	6.12	7.53	8.50	8.72	6.29
	surviving	0.75	2.52	4.15	5.57	6.82	7.37	7.16	5.54
	dead	0.04	0.19	0.34	0.55	0.71	1.13	1.56	0.75
Literate	ever-born	0.72	1.78	3.29	4.54	5.82	6.46	7.08	3.23
	surviving	0.69	1.70	3.16	4.32	5.54	5.90	6.00	3.06
	dead	0.03	0.08	0.13	0.22	0.28	0.56	1.08	0.17
Total	ever-born	0.75	2.18	3.92	5.62	7.18	8.25	8.62	5.25
	surviving	0.72	2.05	3.70	5.18	6.55	7.19	7.09	4.69
	dead	0.03	0.13	0.22	0.44	0.63	1.06	1.53	0.56

The reported mean numbers of children ever born, surviving and dead, by age of mother, according to type of place of residence, region of residence and literacy, are presented in Table 4.1.1.

The percentages of children who have died by age of mother and selected background characteristics are shown in Table 4.1.2. The accuracy of these data is usually affected by under reporting of dead children, especially by older women. As may be seen, about one in ten children (10.6%) born to ever-married women aged 15-45 years has died, indicating that infant and child mortality levels have generally been high during the period in which these women have been bearing children. The proportion of ever- born children who have died increases steadily with age of mother. This pattern reflects the shorter period during which children born to younger mothers have been exposed to the risk of dying and the fact that younger women have fewer live births as well as the effect of declining mortality levels over time.

The high lifetime fertility among Saudi women is seen to be translated through the effects of mortality into a smaller family size. Women aged 30-34

years reported an average of 5.6 live births and 5.2 living children, while those in the oldest age groups reported that out of 8.6 live births there were only 7.1 children still alive. Around 7% of all children born to women under thirty-five years of age by the time of the survey and nearly 13% of those born to women aged 35 and above have died as well.

Table 4.1.2 Percentage of children who have died among the ever-born, by age of mother, according to selected background characteristics

Background characteristics	Age of mother							Total
	15-19	20-24	25-29	30-34	35-39	40-44	45-49	
Residence								
Urban	3.3	5.1	5.2	6.3	7.2	10.2	16.8	9.0
Rural	6.1	7.3	8.5	11.4	11.8	18.6	19.6	14.0
Region								
Central	6.2	5.8	5.3	7.9	7.6	11.2	18.3	10.1
North	4.4	6.1	7.9	6.8	7.7	12.2	18.6	10.7
South	5.9	8.1	8.0	12.1	13.3	18.3	21.8	14.5
East	-	4.8	3.4	4.9	5.4	10.5	13.1	6.9
West	3.5	4.8	6.9	6.9	8.9	12.4	16.7	10.3
Literacy								
Illiterate	4.8	7.0	7.7	8.9	9.5	13.3	17.9	11.9
Literate	4.4	4.4	3.9	4.8	4.8	8.7	15.4	5.4
Total	3.5	5.8	6.2	7.9	8.7	12.9	17.7	10.6

While Table 4.1.1 demonstrated the effect of mortality on average family size, it gives no indication of the extent to which the loss of a child is a common experience. This becomes a little clearer in Table 4.1.3, which presents child survivalship data by parity according to type of place of residence. Around one-third of ever-married women have experienced the death of at least one child, and seven percent of these women have lost three or more children through death. This experience is more common among rural than urban women; the proportion who lost at least one child is 27% for urban women but as much at 42% for rural women. Ever-married women who have experienced the death of three or more children are twice as much in rural than in urban areas.

The percentage of women whose children have all survived declines with parity. More than 98% of women with only one live birth reported the child to be still alive; 75% of women with five live births reported a family size of five living children, and 52% of women with eight live births have not lost a child through death. Only 31% of women with nine or more live births reported all of the children to be still alive.

Table 4.1.3 Percentage distribution of ever-married women in the individual maternal care survey, by number of diseased children and parity, according to place of residence

No. of diseased children	Children ever-born									Total
	1	2	3	4	5	6	7	8	9+	
Urban										
0	98.7	94.9	90.9	86.8	78.5	67.6	68.1	55.3	35.3	72.7
1	1.3	4.6	8.1	10.8	16.5	23.1	23.2	26.7	24.2	15.5
2	-	0.5	0.8	1.8	4.4	7.5	4.7	10.3	17.7	6.2
3 & >	-	-	-	0.5	0.6	1.9	4.0	7.6	22.7	5.6
All	100	100	100	100	100	100	100	100	100	100
Rural										
0	97.1	90.2	82.0	73.5	67.4	61.1	54.2	43.3	23.4	58.4
1	2.9	8.6	15.7	17.6	24.0	25.1	26.6	28.8	24.6	20.4
2	-	1.3	1.8	7.0	5.7	8.9	11.2	16.1	19.8	10.0
3 & >	-	-	0.5	1.8	2.9	5.0	8.1	11.8	32.2	11.2
All	100	100	100	100	100	100	100	100	100	100
Total										
0	98.3	93.7	88.6	83.4	75.5	65.6	63.7	51.7	30.8	68.5
1	1.7	5.6	10.1	12.6	18.5	23.7	24.3	27.3	24.1	17.0
2	-	0.7	1.1	3.2	4.8	7.9	6.7	12.0	18.4	7.3
3 & >	-	-	0.3	0.8	1.2	2.8	5.4	9.0	26.6	7.2
All	100	100	100	100	100	100	100	100	100	100

Up to parity seven, the majority of mothers who have lost a child through death, reported that they have lost only one child, while women of higher parities are more likely to have lost two children or more. In fact, 32% of rural women who have had nine or more live births have experienced the death of three or more children.

The picture that emerges from these data is one in which infant and child mortality still plays an important role in the family building process. There is a sizable group of women whose children all survive, though it is still the case that about 54% of all ever-married in the sample had five or more live births and that upwards of 60% of those women had lost at least one child through death.

4.1.3.1 Definition of infant and child mortality

Infant mortality, ($_1q_0$), is defined as the probability that a live-born child will die before reaching its first birthday. Here it usually takes the form of a rate per 1000 live births. In contrast to 'infant mortality', the term child mortality lacks a uniform definition. It has been used to refer variously to the probability of dying between birth and the exact age 5 - usually known as "under age-5 mortality' or to mortality at ages 1-4, and sometimes to the probability that a child will die in its first two years of life. The measure of child mortality used in this chapter is the probability of dying between birth and exact age 5 (the under-5 mortality rate).

4.1.3.2 Estimation of infant and child mortality

The NCHS collected information on the date of occurrence of last live birth, whether the child is still alive and, if dead, age at death. Using this information of those 'last live births' born within the year preceding the survey, it is possible to derive an estimate of infant mortality prevailing during that year. The calculation of this estimate requires the application of life table techniques for censored information to calculate conditional monthly probability of dying, since those born within one year preceding the survey are not all subjected to a full year of exposure to risk of dying.

Direct estimates of mortality from this type of information are subject to large sampling variation especially when calculating conditional probabilities of dying within the second half of the first year of life. Further, omission of dead children and misdating of events greatly underestimate the level of mortality. The direct estimate of infant mortality derived from the survey data reflected a very low level of mortality that was inconsistent with other pieces of information available on infant and neonatal mortality. Direct estimation of infant mortality was, therefore, disregarded and more reliability was placed on estimate derived indirectly.

Indirect estimates of infant and child mortality can be inferred from information on the proportion of children dead among those ever born to women of different age groups. In the NCHS, ever-married women were asked about their number of children who were living at home, living elsewhere, or who had died. From the proportions of children dead and under certain fertility and mortality assumptions, indirect estimates of the level and trends in infant and child mortality over the 13-15 years prior to the survey may be obtained.

4.1.4 Levels and Trends in Mortality

Until recently, both infant and child mortality in Saudi Arabia were fairly high and the death of a child was a common feature of the family building process, with the result that there was a sizable disparity between the number of children who were born and the number who survived to adulthood. The large scale socio-economic development and the great expansion of health services, particularly in the areas of maternal and child care, have enabled Saudi Arabia to achieve impressive declines in its infant and child mortality rates during the past 15 years or so. This may be seen from Table 4.1.4 which shows the indirect estimates of infant and under-5 mortality rates by sex of child. The rates describes a fairly steep decline in mortality from the early 1970's to the early 1980's, followed by a gentler decline thereafter. Infant mortality declined from around 105 per 1000 live births in 1973, to 66 in 1980 and 52 in 1985.

Table 4.1.4 Indirect estimates of infant and under-five mortality (per 1000 live births), by sex of child, using the age model

Rates	1973	1975	1980	1985
A. Infant Mortality Rate				
Both sexes	105	93	66	52
Male	108	95	69	55
Female	98	87	60	50
B. Under-five Mortality Rate				
Both sexes	155	131	86	63
Male	158	134	88	69
Female	149	127	78	58

An even steeper decline is shown for child mortality. The table shows a reduction in the under-5 mortality rate of more than 90 deaths per 1000 live births, from 155 in 1973, to 86 in 1980 and 63 in 1985.

Thus, mortality between ages one and five declined faster than mortality in infancy during the 1970's and the early 1980's. Since then, the decline in child mortality has slowed down and is now more or less equal to that of infant mortality. In the early 1970's, about one-third of deaths under age 5 are estimated to have occurred between ages 1 and 5. By 1980, the proportion of deaths under age 5 which occur between ages 1 and 5 declined to 24% and by 1985 it has further declined to 18%.

The rates in Table 4.1.4 also indicate a noticeable mortality differential by sex of child. As a general rule, mortality in infancy and childhood is higher among boys than girls at all ages, except where maternal mortality is important. Detailed results show excess male infant mortality in both urban and rural areas. At the national level, infant mortality is some 11% higher among males than females. There is, however, no relationship between the level of mortality and the infant mortality differential by sex. The sex ratio of mortality tends to be more balanced in later childhood where, in general, neither sex enjoys a notable advantage between the ages of one and five. The figures in Table 4.1.4, however, imply a much higher probability of dying between ages one and five among males than females. This may be due to omission of female deaths.

4.1.5 Socio-economic differentials in mortality

The demography of Saudi Arabia is characterized by a wide regional diversity. As will be shown in section 4.7 the total fertility rate of 6.5 live births per woman, for example, observed for the whole country during the year preceding the survey, includes regional variation ranging from 5.6 births per woman in the West region to 7.6 in the North region; and from 6.1 births for women living in urban areas to 7.8 births for those living in rural areas. The results of the survey also reveal significant residential differentials in various indicators of maternal care and child health. Similar variations in infant and child mortality may be anticipated. They are inspected in this section.

4.1.5.1 Urban-rural differentials in mortality

Indirect estimates of infant and child mortality according to type of place of residence are shown in Table 4.1.5. An estimated 101 children per 1000 born alive in urban areas in the early 1970's died in infancy, compared with only 47 per 1000 live births in 1985. There were roughly 11% more rural than urban deaths per 1000 live births in the early 1970s and rural infant mortality was reduced from nearly 111 deaths per 1000 live births in 1973 to 68 per 1000 live births in 1985.

Table 4.1.5 Indirect estimates of infant and under-five mortality rates, (per 1000 live births) by place of residence and region, using the age model

	Infant Mortality Rate				Child Mortality Rate			
	1973	1975	1980	1985	1973	1975	1980	1985
Total	105	93	66	52	155	131	86	63
Residence								
Urban	101	85	57	47	148	117	71	53
Rural	111	107	83	68	168	148	115	91
Region								
Central	108	91	63	52	161	137	89	63
North	100	85	58	52	147	117	74	63
South	114	107	88	74	174	159	123	95
East	85	79	45	44	116	105	54	51
West	101	92	67	45	147	119	85	60

There were also large reductions in the mortality between ages 1 and 5 years in both urban and rural areas. The number out of every 1000 survivors to age one year who died before reaching age 5 years fell from 52 to 6 in urban areas, and from 64 to 25 in rural areas. It should be noted that the above figures represent lower bands for the early 1970's mortality, particularly for rural areas.

Thus, the decline in child mortality was much faster in urban than in rural areas. In the early 1970's, about two-thirds of all deaths occurring under age five years were accounted for by mortality in infancy in both urban and rural areas. During the period of transition to lower mortality, survival chances in the childhood years have become much higher in urban than rural areas. In urban

areas, the proportion of deaths under age 5 years which occur between ages 1 and 5 decreased to 20% in 1980 and to only 11% in 1985. The corresponding decline in rural areas was to 28% in 1980 and 26% in 1985. It may be of interest to note that in the developed countries, on average, more than 80% of deaths under age 5 occur before age 1, and less than 20% at ages 1-4 years.

The urban-rural differential in infant and child mortality can be attributed to differences in living standards and health conditions in general, and differential availability and access to public health facilities in particular. It should be noted, however, that residential differentials in mortality may subsume other important behavioral determinants of child mortality such as parental education.

4.1.5.2 Regional differentials in mortality

Indirect estimates of infant and under-5 mortality rates, shown in Table 4.1.5, reveal that past and present survival chances are higher in the East region than among those born in other regions. The East region has the lowest levels of mortality in infancy and at ages 1-4. Infant mortality is higher in the West and North regions, followed by the Central region, and highest of all in the South region. The regional differentials seem to have narrowed considerably since the mid-1970's particularly between the Central, North and West regions.

All regions, however, have shared in the long term decline in infant and child mortality, but the pace of the transition to lower mortality in the South region has been much slower than that observed for other regions. In the South region, infant mortality decreased from 114 per 1000 live births in 1973, to 74 per 1000 births in 1985, a drop of nearly 35%. In the remaining four regions, infant mortality has been halved over the same period.

The momentum of the mortality decline during the 1970's in comparison with the 1980's varied between the regions. Thus, the percentage of the total decrease in infant mortality during the period 1973-85 that took place during the period 1973-80 was almost 98% in the East region; about 80% in the Central, North and West regions, and only 66% in the South region.

4.1.5.3 Educational differentials in mortality

Indirect estimates in infant and child mortality according to mother's educational level are shown in Table 4.1.6. These estimates were derived using the marital duration model. They therefore, differ from the mortlaity estimates discussed in the previous sections which were derived using the age model. In estimating mortality by educational level, it was not possible to use the age model because it requires data on the distribution of 'all' women - regardless of marital status- according to educational level. In the NCHS, educational status was ascertained only of ever-married women interviewed in the individual maternal care survey.

Table 4.1.6 Indirect estimates of infant and under-five mortality, according to mother's educational level (using the duration model, model west and the Trussel method)

	1973	1975	1980	1985
A. Infant Mortality Rate				
Illiterate	73	67	65	59
Incomplete Primary	58	51	44	37
Primary & >	47	43	34	32
Total	72	66	54	50
B. Under-Five Mortality Rate				
Illiterate	101	92	88	80
Incomplete Primary	78	67	57	51
Primary & >	62	55	43	40
Total	100	91	77	58

The table shows the expected inverse relationship between mortality and mother's education level in the past and the present. In 1985, the infant mortality rate was highest among children to illiterate mothers, at around 59 per 1000 live births, and gradually declined to 37 for mothers with incomplete primary education and to 32 women with primary education or more. A similar inverse relationship is also shown for the under-5 mortality rate. Children born to women who are illiterate have the lowest chances of surviving. About one in twelve of them had died in the first five years of life according to the 1985 mortality rates. The chances of child survival improves progressively with increasing mother's

education; thus, among those with at least primary education, the odds of dying in the first five years of life falls to just one in twenty-five.

Thus, the pattern of educational differential in infant and child mortality suggests that the mother's attainment of primary schooling had a significant impact on child survival, but more critical than the step from literacy to primary education is that from illiterate to literacy.

The effect of mother's education on mortality is largely an urban phenomenon. Since the better-educated tend to be concentrated in the urban areas, we would expect the effect of education on infant and child mortality to play an unseen part in maintaining urban-rural differentials, and in many cases this is infact true. For younger women, urbanization and education appear to act independently to depress infant and child mortality.

The mechanism through which possession of an education results in lower child mortality is generally assumed to be associated with the greater autonomy of the educated woman in an urban setting. She has more control within the household over decisions affecting the welfare of her children; and, outside the household, is able to manipulate resources to their advantage. As education is universalized and mortality is reduced to low levels, the educational advantage in child survival becomes more associated with the level of education attained, though it is still through the privileged awareness and knowledge of, and access to the means of child survival that education has its effect.

4.2. Diarrhoeal diseases

4.2.1 Introduction

Diarrhoeal disease in Saudi Arabia is rivalled in importance only by Respiratory Infections as a cause of under-five morbidity. Though it still remains a recognized Public Health problem, its contribution to infant and under-five mortality has become less significant in recent years.

4.2.2 Diarrhoeal period prevalence

The NCHS data allow the estimation of two-week period prevalence, i.e. the percentage of children who had diarrhoea in the two weeks preceding the survey date, the denominator being the total number of children surveyed.

There were 7.5% of children under six years of age who were reported to have had at least one diarrhoeal episode, the prevalence rate varied markedly by age (Table 4.2.1). Among children under two years of age, it was lowest among those aged under six months, 6.7% more than doubling to 14.4% and 14.7%, respectively, in the aga groups 6 - 11 and 12 - 17 months; falling slightly to 11.8% of children aged between 18 and 23 months. The figure steadily declined among children aged two years or more, 8.2% of those aged two years falling to 4.9% of those aged three years, 4.1% of those aged four years,and

Table 4.2.1 Percentage of children under six years of age reported to have had diarrhoea in the last two weeks according to age and sex

Age	Male	Female	All	No. of children
0-5 months	7.4	6.0	6.7	1075
6-11 months	15.1	13.5	14.4	1244
12-17 months	14.8	14.7	14.7	1163
18-23 months	9.8	14.2	11.8	967
2 years	9.8	6.7	8.2	2191
3years	5.0	4.9	4.9	2193
4 years	4.1	4.2	4.1	2213
5 years	4.3	2.8	3.6	2094
All <6 years	7.9	7.1	7.5	13141

3.6% of children who were five years of age. The highest prevalence rate of 14.5% was observed in the age group of 6-17 months. Continuing into the age group of eighteen months to two years, period prevalence remained high, 11.8%.

Differentials in reported diarrhoeal prevalence by age according to place and region of residence may be seen in Table 4.2.2. It was higher among rural than urban children under six years of age, 9.2% compared with 6.7%. Rural prevalence exceeded urban prevalence at all ages.

Table 4.2.2 Percentage of children who had diarrhoea in the two weeks prior to survey, according to age and residence

	Months				Years				All
	0 - 5	6 - 11	12 - 17	18 - 23	2	3	4	5	
Residence									
Urban	6.0	12.5	14.4	10.7	7.3	4.0	3.6	3.0	6.7
Rural	8.2	8.8	15.5	14.4	10.1	6.8	5.2	4.9	9.2
Central	5.2	15.1	13.4	14.8	7.7	4.1	3.8	5.2	7.7
North	4.8	10.7	17.0	15.2	7.1	2.4	4.9	1.1	6.8
South	14.2	23.3	21.2	17.8	12.5	9.9	7.3	6.9	12.4
East	3.4	13.3	9.5	5.7	5.3	3.4	2.4	1.8	4.9
West	5.9	12.4	14.2	7.6	7.9	4.1	3.2	2.9	6.1
All	6.7	14.4	14.7	11.8	8.2	4.9	4.1	3.6	7.5

There were distinct regional patterns also in reported diarrhoeal prevalence among children under six years of age. It was notably higher in the South than elsewhere, 12.4% or one in eight children, compared with 7.7% in the Central, 6.8 in the North, 6.1% in the West and 4.9% or one in twenty children who were living in the East.

4.2.3 Environmental factors and diarrhoeal prevalence

There were marked differentials in diarrhoeal prevalence according to living conditions (Table 4.2.3). The small minority (7%) of children who lived in a dwelling with an earth floor featured the highest prevalence, 15.3% of children under six years of age reported to have had at least one diarrhoeal episode in the two weeks preceding the survey. This figure was twice as high as among children who lived in a dwelling with cement floor (7.5%).

Water supply and toilet facilities each denoted differentials in diarrhoeal prevalence also. A reported 11.5% of the very small minority of children whose source of water supply was a spring, and 10.5% of those who obtained their water from a well, had diarrhoea in the two weeks before the survey, falling to around 7.2% of those whose household used piped or bottled water. Toilet type signified a larger differential than water supply, falling from 13.5% of the small

Table 4.2.3 Percentage of children under six years of age reported to have had diarrhoea in the last two weeks, according to age and environmental factors

Environmental factors	Age (years)							No.of children
	0	1	2	3	4	5	all <6	
Floor								
Cement	11.1	13.2	8.3	4.9	3.9	3.5	7.5	12118
Earth	19.4	27.1	12.7	11.3	12.4	7.1	15.3	752
Water source								
Piped	10.0	13.7	7.2	4.4	3.6	3.4	7.1	9389
Bottled	14.0	8.9	6.6	7.2	2.3	4.8	7.3	845
Well	14.0	16.4	13.2	8.6	7.1	4.6	10.5	2470
Pond	(18.4)	(27.0)	(6.8)	(7.9)	(7.5)	(4.4)	11.5	170
Others	(16.6)	(13.4)	(16.5)	(1.5)	(6.0)	(1.7)	9.4	409
Toilet								
Flush	10.8	13.2	8.4	4.8	3.8	3.6	7.4	11201
Pit	13.8	16.7	7.9	6.2	4.6	3.0	8.7	1286
Open ground	17.0	21.6	15.0	10.0	11.5	6.9	13.5	683
Household size								
1-4	12.2	17.6	13.8	9.3	2.5	(11.8)	12.4	1021
5-9	11.1	13.4	8.0	4.8	4.9	3.8	7.5	7316
10 +	11.4	13.7	8.1	5.3	3.8	3.0	7.4	4995
Persons / room								
< 3	11.2	13.9	8.5	5.1	3.7	3.8	7.7	10858
3 & >	11.5	14.9	9.1	6.2	7.3	3.5	8.5	2454
Persons/bedroom								
< 3	11.8	14.8	6.0	4.5	2.9	3.8	7.5	2976
3 & >	11.2	13.8	9.4	5.5	4.8	3.7	8.0	10308
Total	11.3	14.0	8.5	5.3	4.4	3.7	7.9	13332

Note: Figures in parantheses were based on less than 100 children

minority who used open field to 8.7% of those who had a pit latrins and 7.4% of the large majority who had a water-seal type toilet, indicating dooryard pollution as the most provable associated environmental factor.

Measures of household size and household density are included in Table 4.2.3 also. The highest prevalence was to be found among the minority of children who were living in small households of less than five members, 12.4% compared with around 7.5% of children living in larger households.

Table 4.2.4 shows the reported diarrhoeal prevalence by age according to the current feeding pattern expressed in terms of (i) exclusive breast- feeding,(ii) bottle feeding only or(iii) both. With the exception of age three years highest prevalence was observed in the third group, lowest among those who were exclusive bottle fed; while the reverse was true for the children age three years or more.

Table 4.2.4 Percentage of children under six years of age reported to have had diarrhoea inthe last two weeks, according to age and most recent feeding patternof last child

Feeding pattern	Age (years)							No. of children
	0	1	2	3	4	5	6	
Breast only	10.6	12.4	7.8	4.2	3.0	2.2	6.8	4132
Breast + bottle	11.6	14.9	9.1	5.5	5.2	4.5	8.5	6541
Bottle only	10.1	11.3	5.1	6.3	3.3	2.8	6.6	1497
All children	11.3	14.0	8.5	5.3	4.4	3.7	7.9	13332

4.2.4 Duration of diarrhoeal episodes

The percentage distribution of the reported duration (in days) of the diarrhoeal episode, and the mean duration are shown according to the child's age in Table 4.2.5. Two, three and four days were most commonly quoted as the duration of diarrhoea, accounting respectively for 18%, 20% and 15% of episodes. Also commonly quoted, in 17% of cases, was seven days, or one week.

The mean duration of diarrhoea fell very gradually with age, among those aged three and four and five years of age. The distribution of diarrhoeal episodes duration (in days) may be seen according to residence in Table 4.2.6. Rural

Table 4.2.5 Duration (in days) of diarrhoeal episode during last two weeks by age and residence

Age of child	Duration in days									Total	Mean
	0	1	2	3	4	5	6	7	8+		
Months											
6 - 11	9	5	13	21	11	9	3	18	11	100	4.7
12 - 17	1	7	15	21	19	9	3	18	7	100	4.6
18 - 23	6	5	13	17	21	8	2	23	5	100	4.4
Years											
2	8	8	23	16	13	8	1	12	11	100	4.3
3	7	9	22	23	9	6	3	14	7	100	3.9
4	8	5	23	22	14	5	1	12	10	100	4.0
5	4	12	26	13	25	2	-	14	4	100	3.5
all < 6	6	7	18	20	15	7	2	17	8	100	4.3

episodes were reported to have been a little longer than urban episodes, with mean durations, respectively of 4.7 and 4.1 days. Episodes among children living in the South were reported to have lasted 4.7 days on average also, compared with 4.1 days in the West and 3.6 days in the Central. Longer durations were reported in the East, 5.1 days, and the North, 4.8 days.

Table 4.2.6 Duration (in days) of diarrhoeal episode during last two weeks according to residence

	Duration in days							Total	Mean	Median
	0 - 1	2	3	4	5 - 6	7	8 +			
Residence										
Urban	16	18	18	17	9	15	7	100	4.1	3.9
Rural	9	18	22	12	9	19	11	100	4.7	4.1
Region										
Central	25	19	13	12	9	16	5	100	3.6	3.4
North	6	21	11	24	15	15	8	100	4.8	4.5
South	8	7	23	12	9	22	10	100	4.7	4.2
East	15	10	21	17	6	17	14	100	5.1	4.2
West	10	22	23	8	8	12	7	100	4.1	3.8
Total	13	18	20	15	9	17	8	100	4.3	4.0

4.3 Personal preventive measures: Immunization

4.3.1 Introduction

The percentage of children immunized against major preventable communicable diseases of infancy and childhood is one of the key indicators of PHC service coverage and a reliable measurement of child health status. A single dose each of BCG and measles vaccine and three doses of DPT and OPV would establish immunity to prevent the respective diseases. In this study, each child under six years of age was asked whether they had a health card. If the answer was yes, the interviewer asked to seethe health card and copied from it the child's immunization record. If the health card was not available at the interview or if the child does not pocess a health card, the only question that was asked was whether the child had ever been given any injections or drops in the mouth to prevent him/her getting the disease.

4.3.2 Health card coverage and availability

The vast majority, 95%, of children under six years of age were reported to have a health card. But only 55% of the health cards were available at the interview. Detailed immunization records were collected therefore in respect of just over a half, 53%, of children. For the remainder of children only minimal information could be collected. The majority of these, 43% out of 47%, were reported to have a health card which were not available at the interview, leaving almost 5% who had no health card. There were very slight variations by age in health card coverage, (Table 4.3.1). There was a greater variation by age in health card availability than there was in health card coverage. The proportion of health cards that were available at the interview rose from 57% for infants under six months of age to 61% of those aged between six months and one year, fell slightly to 59% of those aged one year and declined steadily, thereafter, to 48% in respect of children aged four years.

Table 4.3.1 Percent distribution of children aged under six years according to health card status by age and sex of child

Age	Health card status			Total
	Seen	Not seen	None	
0-5 months	57.4	36.2	6.4	100
6-11 months	61.3	34.4	4.3	100
12-17 months	59.4	37.0	3.6	100
18-23 months	60.2	36.7	3.1	100
2 Years	54.1	42.4	3.5	100
3 years	51.3	43.9	4.8	100
4 Years	47.5	47.5	5.0	100
5 Years	45.5	49.1	5.4	100
Male	52.5	43.1	4.4	100
Female	53.2	42.0	4.8	100
All	52.8	42.6	4.6	100

4.3.3 . Residence and parents' education differentials in health card coverage and availability

Possession of a health card varied by residence, reflecting differential Primary Health Care coverage, (Table 4.3.2). Urban children were more likely than rural children to have a health card. Children living in the North were most likely to have been reported to have a health card, 99%, followed closely by those living in the Central and East Regions, each 98%, slightly less, 95%, of children living in the West, and in the South a much lower figure, 88%, was reported.

Mother's and father's education were associated with variations in health card possession and availability also, though they were smaller than were those observed in respect of residence. Least likely to have a health card were children either of whose parents was illiterate. In contrast with residence, parents education denoted little variation in the likelihood of a health card being available.

Table 4.3.2 Percent distribution of children aged under six years according to health card status by place of residence and parents' education

Residence & education	Health card status			Total
	Seen	Not seen	None	
Place of Residence				
Urban	54.1	43.5	2.4	100
Rural	50.1	40.8	9.1	100
Region of Residence				
Central	56.9	41.0	2.1	100
North	69.9	28.9	1.2	100
South	44.9	43.1	12.0	100
East	51.6	46.3	2.1	100
West	49.1	46.1	4.8	100
Mother's Education				
Illiterate	51.5	42.7	5.8	100
Literate, No.schooling	58.2	37.4	4.4	100
Incomplete Primary	60.0	37.5	2.5	100
Primary/Preparatory	57.4	41.6	1.1	100
Secondary & >	55.5	43.2	1.3	100
Father's Education				
Illiterate	54.3	39.1	6.5	100
Literate, No Schooling	56.2	40.1	3.6	100
Incomplete Primary	53.0	40.5	6.4	100
Primary	52.1	44.2	3.7	100
Preparatory	51.1	45.4	3.5	100
Secondary & >	54.4	43.8	1.8	100
All	52.8	42.6	4.6	100

The proportion of health cards available at the interview was roughly the same between urban and rural residence. Region of residence, however, signified differentials in health cardavailability. In particular a much higher proportion of health cards were available in the North than elsewhere. Regional differences in health card availability which were in the same direction as differentials in health card possession, resulted in larger regional differences in the proportion of children whose health cards were seen than there were in the proportion who were reported to have a health card.

4.3.4 Proportion of children with at least one vaccination

Virtually all, 99.5% of children whose health cards were seen werereported to have had some form of immunization. A slightly lower figure, 97.3%, of children who had a health card that was not available at the interview were reported to have been given an injection or drops. These figures contrast with only 16% of children who had no health card who were reported to have had some form of immunization, (Table 4.3.3). The possession of a health card was practically synonymous with at least embarking on an immunization schedule.

The combined set of figures indicate that there were 94.7% of children under six years of age who had been given at least one vaccination. There were slight variations with age in the proportion of immunised among children who possessed a health card, as shown in Table (4.3.3.).

Table 4.3.3 Percentage of childern under six years of age who have any immunization according to health card status and age of child

Age	Health card status			All
	Seen	Not seen	None	
0 - 5 months	96.9	94.7	14.4	90.4
6 - 11 months	99.3	98.3	20.3	95.6
12 - 17 months	99.9	96.2	22.5	95.6
18 - 23 months	99.9	97.9	11.0	96.4
Two years	99.8	97.1	14.1	95.7
Three years	99.7	98.0	13.6	94.7
Four years	99.9	98.2	12.5	94.7
Five years	99.8	96.9	18.0	93.7
All	99.5	97.3	15.5	94.7

Together the figures indicate that there were 90% of infants under six months who had been given at least one immunization, rising to around 96% of those aged between six months and three years, 95% of those aged three and four years and 94% of children aged five years.

4.3.6 Disease- specific immunization coverage and full immunization levels

The results on immunization presented so far have been inadequate on account of their not being vaccine-specific. This has precluded an assessment of full protection against specific infectious diseases, especially against diphtheria, pertussis and tetanus (DPT) and polio, each of which require three doses to be effective.

In Table 4.3.4 are presented, separately by age, the percentages immunized by type of vaccine for children whose health cards were available. Also shown are the percentages given an injection or drops to prevent them catching an infectious disease, separately for children whose health cards were not available and those who had no health card.

The BCG vaccination against tuberculosis is carried out soon after birth and the age pattern conforms with this. The triple vaccine, which protects the child against diphtheria, pertussis (whopping cough) and tetanus, and the polio vaccine are each, as noted, administered in three doses. Ages recommended are ones which preclude an interval of susceptibility after the period of maternally derived immunity and which also ensure prolonged effectiveness. Recommended age for the first dose of DPT and polio vaccines is three months, the second and third doses following at monthly intervals, so that the full course should be completed before the child's first birthday.

The percentages of children who had been given DPT and polio vaccine were almost identical, not surprising since they would usually be given at the same time. The age pattern of the first dose tends to conform with the recommended age of three months; there were around 60% of infants under six months with health cardavailable who had received their first DPT and polio vaccination, which allowing for slippage between birth and the issue of a health card, would approximate the percentage who were aged three months or more. Just over a half of infants under six months whose health cards were available had received the second dose, and around 45%, the third doses of DPT and polio vaccines, representing a high, and by implication, speedy completion

Table 4.3.4 Percentage of Children under six years of Age according to Immunization status, type of Vaccination and Age

Immunizaon status	Months		Years					All < 6
	0 - 5	6 - 11	1	2	3	4	5	
Health card seen								
BCG	97	99	99	99	99	99	98	99
DPT 1	61	98	100	99	99	100	99	96
DPT 2	52	96	99	99	99	100	99	95
DPT 3	46	91	98	99	98	99	98	94
Completion, DPT	75	93	98	100	99	99	99	98
Polio 1	59	97	99	99	99	100	99	96
Polio 2	52	95	99	99	99	100	99	95
Polio 3	44	90	98	99	98	99	98	93
Completion, polio	75	93	99	100	99	99	99	97
Measles	-	73	96	98	97	99	97	91
Percent All	37	68	95	98	95	98	95	88
Health card not seen								
Injection	93	98	97	97	97	98	97	97
Drops	81	97	96	97	98	98	96	96
No Health card								
Injection	15	21	18	14	13	13	17	15
Drops	11	18	17	14	11	9	15	13
% of all children estimated fully immunized *	34	66	90	94	90	93	89	83

Completion is the percentage of children given first dose and who have completed the course with third dose.

* Estimate of % fully immunized = % Fully immunized (Health card seen) / % Any immunization (Health card seen) X % Any immunization (all)

rate of 75%.The figures display a sharp rise in the second half of infancy and the figures for all infants thus confirm a relatively high and speedy completion, well within the recommended ages.

Children aged one to five years whose health cards were available display almost universal and universally complete protection against DPT and polio. Measles vaccination is recommended at the end of infancy and not before age nine months. The percentage immunised against measles, of children whose health cards were seen, indicate that 73% in the age group 6months to one year and between 96 and 99 percent thereafter showed measles vaccination in their immunization record.

The figures presented so far portray high immunization levels. They represent, however, only those children whose health cards were seen, which is just over half of all children. Most of the remainder, 43 out of 47% were children reported tohave a health card which was not available at the interview. The two sets of information collected in respect of these children, namely whether they had been administered an injection or oral drops may be roughly compared with figures collected about children whose health cards were seen. The percentage given an injection includes those who had been immunized against tuberculosis, those given the first dose of DPT vaccine and those who had been immunized against measles. In this case it is probably best compared with the health card figures for the first immunization administered, BCG. The percentage of children given drops to prevent them from catching an infectious disease may be compared with the percentage of children with health cards available who had been given the first dose of the polio vaccine.

4.3.8 Differentials in immunization coverage among children aged 12 - 23 months

Immunization coverage amongst one year olds according to their residence and also their mother's and father's education are shown in table 4.3.5. There were effectively no urban/rural differences in immunization levels among children who possessed a health card, whether available or not. Rural children without a health card were less likely than urban children to have been given an injection or drops, 10% compared with 36%. Taking differences in health card coverage in to account, then an urban rural differential in immunization levels may be observed; 98% of urban compared with 92% of rural children were reported to have had any immunization, and the upper estimates of those completely protected were respetively 93 and 87%.

Some regional differentials were apparent among children with health cards. those living in the central and north were less likely to have been immunized against measles. Full immunization levels for children with available health cards

Table 4.3.5 Percentage immunized of children aged 12-23 months according to health card status and type of vaccine by residence and parents' education

	Health card										All	
	Seen						Not seen		None			
	BCG	Polio			Meas-les	All	Inj	Drop	Inj	Drop	Any	All
		1	2	3								
Residence												
Urban	99	99	99	98	96	95	96	96	(36)	(36)	98	93
Rural	99	99	98	97	96	95	97	97	11	10	92	87
Region												
Central	98	99	99	99	93	92	98	94	(0)	(0)	97	89
North	100	99	99	97	94	94	97	97	-	-	99	93
South	99	99	99	98	97	96	97	97	(15)	(14)	88	85
East	99	99	99	98	98	97	98	98	(0)	(0)	99	96
West	100	99	98	98	98	97	95	96	(30)	(30)	96	93
Mother"s education												
Illiterate	99	99	99	98	96	94	96	97	13	12	95	89
Incomp.prim	100	100	99	99	95	95	93	88	(0)	(0)	97	92
Prim/prep	99	100	99	99	98	98	97	96	(51)	(51)	98	96
Secondary +	100	100	100	99	99	98	97	97	(100)	(100)	99	97
Father's education												
Illiterate	99	99	99	98	98	97	99	98	(13)	(13)	95	92
Incomp.prim	98	99	99	99	96	95	99	99	(16)	(16)	95	90
Primary	99	99	98	98	94	93	96	97	(20)	(20)	96	90
Preparatory	100	99	98	99	95	95	95	97	(31)	(31)	97	92
Secondary +	99	100	100	99	97	96	94	93	(24)	(16)	96	92
All	99	99	99	98	96	95	97	96	18	17	96	91

Figures in parentheses based on less than 50 children

ranged from 92% in the central to 94% in the north, 96% in the south and 97% in the east and west. After taking into account differentials in health card coverage, notably lower in the south than elsewhere, then the regional picture changes. Least likely to have had any immunization were children living in the south. The upper estimates of those fully immunized ranged from 85% in the South to 89% in the Central, 93% in the North and West and 95% in the East.

Maternal education differentials in immunization levels among those who pocess health card was seen were largely due to differences in measles vaccination. The likelihood of being immunized for all children irrespective of health card status rises gradually with mother's education. Differentials in immunization coverage by father's education were less consistent than mother's education differentials.

4.4 Breast-feeding and weaning practices

4.4.2 Prevalence and duration of breast-feeding

4.4.2.1 Prevalence of breast-feeding

Of the 6,131 most recent live births which had taken place five years or less before the survey, 90.1% were reported to have been breastfed. Thus, one in ten children were not breastfed. The figures display some variation with mother's age. In particular the youngest mothers, under twenty years of age, displayed the lowest likelihood, 85.2%, of having breastfed their last child. The figure rises thereafter, fluctuating between 89% and 92% for infants whose mothers were aged 20-49 years, (Table 4.4.1).

First-born infants were least likely (80%) and second and later-born infants are much more likely than first-born infants to have been breastfed; 90% of second births rising marginally to 92% of those of fifth and higher order.

Table 4.4.1 Percentage of last live birth in five years preceding survey, who were breast-fed according to mothers age.

	Mother's age							Total
	< 20	20-24	25-29	30-34	35-39	40-44	45-49	
% ever breast-fed	85.2	89.0	90.9	91.5	89.3	90.2	91.7	90.1
No. of live-births	278	1243	1696	1061	1078	511	265	6131

The birth order effect persists after taking into account mother's age, while the mother's age effect is in some cases almost reversed after taking into account birth order, (Table 4.4.2). Least likely to have been breastfed were first births to women aged 25-34 years, 74%. Most likely to have been breastfed were fifth and sixth order births to women under twenty-five years of age, 95%. With the exception of second births, women under twenty-five years were more likely than those aged 25-34 years to have breastfed their last child of the same order, and the latter were in turn consistently more likely to have breastfed their last birth of the same order than were women aged 35-44 years.

Women whose childbearing started early and progressed speedily appear to have been most likely to have breastfed their last child. A late start is associated with the lowest likelihood of breast-feeding.

Table 4.4.2 Percentage of last live-births in five years preceding survey who were breast-fed according to mother's age and birth order

Birth order	Mother's age				Total
	< 25	25 - 34	35 - 44	45 - 49	
1	81.8	74.0	*	*	80.1
2	88.5	91.9	89.8	*	89.8
3 - 4	93.7	90.7	85.0	*	91.2
5 - 6	95.3	93.2	85.8	*	91.6
7	*	92.3	91.1	91.8	91.6
Total	88.3	91.2	89.6	91.7	90.1

* Less than twenty live-births

4.4.2.2 Current status

The percentages of children still breast-feeding by age may be seen in Table 4.4.3 and 4.4.4. The percentages decline on the whole from 90% of those under two months of age to 70% of those aged five and six months, 60% of those aged nine and ten months, a little under 50% of those aged one year and just over 5% of children aged two years or more. Data such as this are often distorted by age mis-statement as displayed, for example, by heaping on preferred digits. In this case the fluctuations in the numbers of children by age in months do not seriously distort the current status figures.

Table 4.4.3 Percent distribution of current breast-feeding status and age distribution of last live births according to mother's age and birth order, in the last five years preceding the survey

	Breast-feeding status				Age (months)			Total
	Never breast-fed	Still breast-feeding	Stopped breast-feeding	Total	0-5	6-11	12+	
Mother's age								
< 20	15	54	31	100	39	29	32	100
20-29	10	43	47	100	20	23	57	100
30-39	10	42	48	100	16	17	67	100
40 & >	9	28	63	100	8	11	81	100
Birth order								
1	20	37	43	100	22	24	54	100
2	10	36	54	100	19	19	62	100
3-4	9	43	48	100	19	21	60	100
5-6	8	45	49	100	17	20	63	100
7+	8	42	50	100	15	18	67	100
Total	10	41	49	100	17	18	65	100

The current status data indicate that the younger the mother the more likely the infant is to be still breast-feeding; 54% of children whose mothers were aged under twenty years were still breast-feeding, falling to 28% of children whose mothers were aged forty or more.

Table 4.4.4 Percentage of last live births in five years preceding the survey who were still breast-feeding according to age of child

Age of child (months)	% Who were still breast-feeding	Number of children
0	90.2	120
1	90.1	194
2	87.4	187
3	81.8	153
4	78.2	199
5	70.5	203
6	69.2	212
7	64.0	217
8	65.3	178
9	60.8	203
10	61.5	226
11	53.9	169
12 - 23	44.2	1779
24 & above	5.7	2046
All ages	41.5	6086

Note: Restricted to children still alive or survived for twelve months

4.4.2.3 Early weaning

Among those who had stopped breast-feeding, the likelihood of having been weaned before age three months declines steadily with mother's age. The relationship is equally striking with respect to birth order, 44% of first-born infants weaned in the first three months falling to 19% of seventh or later born infants (Table 4.4.5).

4.4.2.4 Duration of breast-feeding

Table 4.4.5 Percentage of infants who stopped breast feeding under three months of age, among last live births, in last five years who have stopped breast-feeding, according to mother's age and birth order.

	Mother's age					Birth order					All births
	< 20	20-24	25-29	30-39	40-49	1	2	3-4	5-6	7 +	
% weaned under 3 months (among those weaned)	49	36	29	22	17	44	33	28	24	19	26

The estimates of breast-feeding duration are reasonably consistent; a median of 14.8 months according to current status data, and a prevalence/incidence estimate of 13 months. The duration of breast-feeding rises conspicuously with mother's age . The prevalence/incidence estimates display a steady increase, from ten months among children whose mothers were aged under twenty years, to twelve months among those whose mothers were in their twenties, and fourteen, fifteen and eighteen months, respectively among those whose mothers were aged 30-34, 35-39 and 40-49 years. The medians - derived from the proportions still breast-feeding - all exceed the prevalence/incidence estimates, the largest discrepancies being apparent among children whose mothers were aged 35 years or more.

4.4.2.5 Residence and literacy differentials

Residence and parent's literacy are associated with differentials in the likelihood and duration of breast-feeding, (Table 4.4.6).

Urban children were marginally less likely than rural children to have been breastfed, 90% compared with 92%. Prevalence/incidence estimates of the mean duration of breast-feeding indicate that rural children were weaned two months later on average than urban children, at 14.4 months of age compared with 12.3 months.

Table 4.4.6 Percentage of last live births in five years preceding survey who were ever breastfed and prevalence / incidence estimates of mean duration of breast-feeding according to residence and education

	% Who were ever breast-fed	Mean duration of breast-feeding
Place of Residence		
Urban	89.5	12.3
Rural	91.5	14.4
Region		
Central	90.2	11.5
North	90.8	13.9
South	91.8	13.4
East	91.5	13.0
West	88.3	13.4
Mother's Literacy		
Illiterate	90.8	14.3
Literate	88.8	10.7
Father's Literacy	-	
Illiterate	90.4	15.0
Literate	90.0	12.1
Total	90.1	13.0

Infants living in the South and East were most likely to have been breastfed, 92%, followed closely by those living in the North, 91%, those living in the Central Region, 90% and the lowest figure, 88%, was recorded among infants living in the West. Weaning was earliest in the Central, 11.5 months on average, followed by 13 months in the East, 13.4 months in the South and West, and it was latest in the North. Women who were illiterate were a little more likely than those who were literate to have breastfed their last child. The prevalence/incidence estimates indicate that children whose mothers were illiterate were weaned almost four months later on average than those whose mothers were literate.

While there was practically no difference in the likelihood of being breastfed according to father's literacy, women whose husbands were illiterate displayed the longest recorded duration of breast- feeding.

Thus, parent's literacy signifies the largest and most consistent variation in the age at weaning; it was latest among those children whose fathers were illiterate, followed in turn by those whose mothers were illiterate, and those whose fathers were literate and it was earliest among children whose mothers were literate.

4.4.3.1 Introduction of supplementary foods

A prevalence/incidence estimate of the mean duration of un-supplemented breast-feeding, or mean age at supplementation with solids, can be obtained. In this case the prevalence / incidence estimate of the mean age at supplementation with solids is 5.3 months, which indicates there to be an interval of 7.7 months on average between the introduction of solids and weaning.

Also included in Table 4.4.7 are the percentage distribution, for all children, of the pattern of breast and bottle feeding, currently for children not yet weaned and prior to weaning otherwise; those children who were never breastfed comprise the category "bottle only". The percentages of children still breast-feeding are indicated in the table to assist in evaluation.

Infants less than two months of age comprise 5% who were never breastfed and fed by bottle only, 56% who were breastfed only and 41% whose feeding included breast and bottle. Hence, around 42% of infants under two months of age who were breastfed had been bottle-fed also, rising to 61% of those aged two to three months. Thus, while the number of infants breastfed is fairly high, this would not appear to be equated with high rates of completely unsupplemented breast-feeding on demand in the first months of life.

Table 4.4.7 Percet distribution of last live births, in last five years, who were breastfed, by age at supplementation with solids, and pattern of feeding according to age of child

Age at Introduction of solids	Current age of child (months)							Total
	0-1	2-3	4-5	6-7	8-9	10-11	12+	
	99	98	71	40	13	13	9	
0-1	1	-	1	2	1	-	1	
2-3		2	5	6	4	7	3	
4-5			23	35	51	43	38	
6-7				17	25	26	27	
8-9					6	9	9	
10-11						2	1	
12+							12	
Total	100	100	100	100	100	100	100	100
Current/last pattern of feeding								
breast only	56	36	37	33	33	35	32	34
breast + bott.	41	56	54	55	57	54	58	56
bottle only	5	8	9	12	10	11	10	10
Total	100	100	100	100	100	100	100	100
% still breast feeding	90	85	74	67	63	58	24	42

Note: childre still alive or survived 12 months

Not surprisingly perhaps, as mean age at weaning increases with mother's age, so does the mean age at supplementation with solids.

4.4.3.2 Residence and literacy differentials

As in respect of mother's age, residence and maternal education differentials in mean ages at weaning are mirrored in respect of the mean age at supplementation with solids, (Table 4.4.8).

Supplementation was earlier on average among urban than rural infants, 4.8 months compared with 6.4 months post-partum. There was a slightly shorter period also between the introduction of solids and weaning among urban children, 7.5 months compared with 8 months among rural children.

Table 4.4.8 Mean age at supplementation with solids for last live births, in last five years, according to mother's age, residence and literacy

	Mean age at supplementation of solid food	Mean interval between supplementation & weaning
Mother's age		
< 20	5.2	4.7
20-29	5.0	6.9
30-39	5.7	8.9
40-49	5.8	11.9
All	5.3	7.7
Residence		
Urban	4.8	7.5
Rural	6.4	8.0
Region		
Central	4.3	7.2
North	6.4	9.6
South	6.4	7.0
East	4.7	8.3
West	5.4	8.0
Mothers' Literacy		
Illiterate	6.2	8.1
Literate	3.8	6.9
Father's literacy		
Illiterate	6.4	9.0
Literate	4.9	7.2
Total	5.3	7.7

Residence in the Central signified the earliest introduction of solids, at 4.3 months on average, rising to 4.7 months in the East, 5.4 months in the West and 6.4 months in the North and South Regions. In the Central and South the shortest intervals between supplementation and weaning were recorded, around 7 months. The longest interval was recorded in the region which shared the latest introduction of solids, the North, there being 9.6 months on average between supplementation and weaning. Infants whose mothers were illiterate were introduced to solids almost two and a half months later on average than those whose mothers were literate, at 6.2 months

compared with 3.8 months. The corresponding intervals between supplementation and weaning were 8.1 and 6.9 months. Infants whose fathers were illiterate shared the latest introduction of solids with rural, North and South children, 6.4 months. They also displayed the second longest interval between solids and weaning, 9 months compared with just under average, 7.2 months, among infants whose fathers were literate.

4.4.4 Reasons for breast-feeding behavior

4.4.4.1 Reasons for not breast-feeding

The most common single reason for non-initiation of breast-feeding was "lack of" or "insufficient" milk, (Table 4.4.9) followed by the infant's refusal as the second reason and aboutn one fifth of the responses mentioned poor health of mother.

4.4.4.2 Reasons for early weaning

Among those children who had stopped breast-feeding by the time of the survey, 26% were less than three months of age when they were weaned. Mothers were asked what was the most important reason for weaning most recent child before they were three months of age.

Table 4.4.9 Percent distribution of last live births, in five years preceding survey, who were not breast-fed, by reason given for not breast feeding.

Reasons for not breast feeding	Percent	No. of children
No milk	32	187
Child refused	23	138
Mother sick	21	123
Child sick	9	55
Nipple problems	4	25
Child died	2	12
Others	9	52
Total	100	592

About 43% of mothers said that the infant was weaned on account of there being "insufficient" milk (table 4.4.10). Without further questioning it is difficult to assess the extent to which this was involuntary. Poor health of mothers accounted for 11% of cases and nipple problem were mentioned in respect of 5% of cases. A further 6% referred to "child upset by breast milk" as the main reason for weaning within three months. Taking these reasons together, it would seem that 22% of infants were weaned within three months on account of physiological factors over which there was perceived to be no control. This figure could be as high as 65%, depending on the extent to which weaning on account of there being 'insufficient' milk was unintentional. Pregnancy was given as the reason for early weaning in 5% of cases and ten percent weaned their children in order to use the contraceptive pill.

In about 4% of cases, mothers reported that the infant was "old enough" to be weaned. This is the only category which appears to represent a voluntary weaning. Hence, according to the results, only 4% of infants weaned in the first three months post-partum were weaned completely out of choice.

Table 4.4.10 Percent distribution of last live births, in last five years, who have stopped breast-feeding by reason given for weaning, according to age at weaning

Reason for weaning	Age at weaning (months)					Total
	< 6	6-11	12-17	18-23	24 +	
No milk	40	27	15	12	2	23
Mother sick	9	6	8	5	1	6
Nipple problem	4	2	2	4	0	2
Milk upsets child	6	4	2	2	-	3
Mother pregnant	7	26	37	24	3	16
Wants another child	0	2	1	2	0	1
Child old enough	4	6	21	41	93	30
Pill	11	8	6	5	-	7
Others	19	19	8	5	1	12
Total	100	100	100	100	100	100
No. of children	1106	443	468	318	632	2968

Note: There were 28 children for whom reasons for weaning was not stated.

4.4.4.3 Reasons for weaning

The child being old enough was the most common reason given for weaning the last live birth, accounting for 30% of those who had stopped breast-feeding. It was not surprisingly a factor that became increasingly important as the age at weaning increased. Insufficient milk accounted for 23% of the responses. The importance of this reason declined as age at weaning increased. A new pregnancy was given as the reason for stopping breast-feeding in 16% of the responses. This reason was most prominent between ages six months and two years. The desire to use the contraceptive pill was given as the reason in 7% of cases. It was predictably a factor that was most prominent in infancy. It still, however, accounted for around one in twenty children weaned in the second year of life.

4.5 Maternal Care

4.5.1 Introduction

The NCHS provides information which can be used to examine the care a mother receives during pregnancy, at the time of delivery and in the post-natal period. Regular ante-natal examinations can mitigate the effects of, if not avoid altogether, those complications of pregnancy and delivery which may jeopardize both mother and infant's survival chances. Post-natal checks would ensure restoration of health of the mother; and with frequent inter-gestational examinations prepare the mother for subsequent child-bearing as well as to continue with the care of her living children.

A series of questions pertaining to ante-natal care were asked in relation to current pregnancy and the last live birth where this had occurred five years or less prior to the survey. The group of pregnant women comprised 13% who were in the second month, 39% in the third to fifth months and 48% in the sixth to ninth months of their pregnancy. Information about intranatal and postnatal care also were gathered for women whose last live birth had occurred five years or less prior to the survey.

4.5.2 Ante-natal care

4.5.2.1 Ante-natal care coverage

Seventy percent of currently pregnant women were reported to have had a pregnancy check; 63% of women who were in the second month, 67% in the third to fifth months and 75% of women who were in the sixth to ninth months of their pregnancy. These figures compare with 68% of women who had a pregnancy check before their last live birth, where this had occurred five years or less prior to the survey.

A higher proportion of women who were in their sixth to ninth months of pregnancy than of women whose most recent live birth had taken place five years or less prior to the survey who reported a pregnancy check, 75% compared with 68%, is indicative of an ongoing expansion in the service. There was a distinctive age pattern in the difference between the two sets of figures, largest at the extremes and smallest among women aged 25-29 years. These figures suggest the impact of contemporary expansion on most of younger and older women.

The distribution by pregnancy duration of the percentage who had a check indicates an early first check; of those women who would have a check, at leat 85% were estimated to have the first one in the first three months of pregnancy. At the same time though, an estimated 7% or more of women in receipt of ante-natal care, (5% of all women), would not have their first check until the last three months of pregnancy.

A prompt incorporation into the ante-natal care programme for the majority of women has been described. Nevertheless, between 20% and 25% of pregnant women are estimated to receive no ante-natal care at all, and an additional 5% do not have their first check until an advanced stage of their pregnancy

There appears to be some variation with age in the likelihood of a pregnancy check, though this is not entirely consistent between live births and current pregnancies, especially when the latter are broken down by pregnancy duration, (Table 4.5.1). The live birth figures display a steady decline with mother's age. Currently pregnant women also tend to feature a decline with age in the likelihood of a pregnancy check. Pregnant women under twenty years of age appeared less likely, however, at earlier durations than those over twenty years to have had a check, and both of these groups and women in their thirties appear to "catch up" by the sixth to ninth months. Though based on small numbers, these figures would seem to support an earlier first check among women in their twenties, whose advantages lessens with pregnancy duration.

Table 4.5.1 Percentage who had a pregnancy check among currently pregnant women by pregnancy duration and among women whose most recent live birth occured five years or less prior to the survey

Age	Currently pregnant women					Last live births	
	Duration of pregnancy (months)			All duration	No. of women	Percent	No.of women
	< 3	3-5	6-9				
< 20	77	62	83	73	134	74	278
20-24	81	73	80	78	355	73	1243
25-29	54	69	70	67	381	73	1696
30-34	58	64	71	66	240	66	1060
35-39	(48)	57	72	64	171	64	1075
40-44*	(56)	68	75	70	63	56	509
45-50						48	265
Total	63	67	75	70	1346	68	6125

* For Pregnant women, age group 40 & > .Figures in parenthesis were based on < 20 women

A pregnancy check was most likely in respect of first and second live births, the likelihood of a pregnancy check declines thereafter. Among current pregnancies it was those whose live birth outcome would correspond to the first, second and third live births which were most likely to have been checked.There was a decline thereafter by birth order in the likelihood of a pregnancy check.

There have been observed separately mother's age and birth order effects on the likelihood and timing of ante-natal care. The separate effects of the two can be appraised from Table 4.5.2, in which are presented the percentages of women who had a pregnancy check according to age and birth order, separately for most recent live births and current pregnancies.

Table 4.5.2 Percentage of currently pregnant women and of last live births which received ante-natal check by current age and birth order

Current Age	Birth order										Total
	1	2	3	4	5	6	7	8	9#	10+	
Pregnant Women											
< 20	73	73	*	*							73
20-24	79	83	76	74	*	*	*	*	*	*	78
25-39	*	*	72	71	63	65	*	*	*	*	68
30-34	*	*	*	*	*	*	59	*	*	*	66
35 & >	*	*	*	*	*	*	*	81	*	68	71
Total	75	80	76	72	66	64	62	71	67	60	70
Last Live Births											
< 20	77	70	*	*	*	*					74
20-24	82	78	67	66	60	*	*	*	*		73
25-29	87	82	76	74	67	67	67	*	*		73
30-34	*	*	80	74	70	61	60	65	63		66
35-39	*	*	*	84	73	68	63	63	58		64
40-44	*	*	*	*	*	*	*	51	56		56
45-50	*	*	*	*	*	*	*	*	50		48
Total	80	78	72	73	67	64	63	61	56		68

* Figures based on less than 50 women: #: Live births: 9+

On the whole, birth order effect persists when age is taken into account. It may be seen that the greater likelihood of a pregnancy check before the first than the second most recent live birth is accentuated after mother's age is taken into account. Among pregnant women, the higher likelihood of a pregnancy check for pregnancies which would correspond to the second than the first live births becomes confined to women aged 20-24 years.

Age differentials become, reversed when birth order is taken into account. Among first to fifth order live births, the likelihood of a pregnancy check rises systematically with age. Only among seventh and higher order births does the expected fall with age appear. Consistent with the live birth figures, currently pregnant women aged 20-24 years who were expecting their first or second live births were more likely than those under twenty years of age to have had a pregnancy check. Unlike the live birth figures, however, women aged 20-24 years who were expecting their third and fourth live births were more likely than those aged 25-29 years to have had a check.

Residence denotes differential access to ante-natal care. Seventy-six percent of urban pregnant women had a pregnancy check compared with only 56% of rural expectant mothers. The difference was smaller among women who were in their sixth to ninth months of pregnancy than among women at earlier durations. The live-birth figures, signify an even larger differential than the figures for pregnant women.

The likelihood of receiving ante-natal care was highest in the East, just higher than in the Central Region. A much lower level than either was recorded in the West and the North, and it was lowest in the South.

Congruence between the number of women in their sixth to ninth months of pregnancy who had a pregnancy check and the number who had a check prior to their most recent live birth was highest in the Centre, followed by the East. A bigger difference was reported by women living in the West, South, and the largest difference was reported by women living in the North.

Literate pregnant women were much more likely than illiterate pregnant women to have had a pregnancy check. Pregnant women whose husband were illiterate were marginally less likely than the group of all illiterate women to have had a pregnancy check.

4.5.2.2 Number of pregnancy checks

The number of women who have a pregnancy check and the date of their first check are key indicators of the level of ante-natal care. Next is the number of pregnancy checks, which is of course dependent on the date of the first one. While the number of pregnancy checks not surprisingly rises with pregnancy duration it is noteworthy that more than one in four women who were in the sixth to ninth months of their pregnancy had received only one or two checks, (Table 4.5.3). At the other extreme were just under one in four women in their third to fifth months who had received four checks or more.

Table 4.5.3 Percentage distribution of currently pregnant women by number of pregnancy checks, according to duration of pregnancy

Duration of pregnancy	Percent no check	Of those with a check percent by number of checks							Total
		1	2	3	4	5	6	7+	
< 3	37	65	23	6	1	2	1	2	100
3-5	33	29	27	22	10	7	1	4	100
6 & >	25	13	14	11	12	10	10	30	100
Total	30	26	20	14	10	8	5	17	100

The distribution of the number of checks among women in the sixth to ninth months of their pregnancy, though it fell with number of checks, was nevertheless fairly uniform, 10% or more reporting each number of checks. Women in their third to fifth months displayed a more distinctive decline in the percentage reporting a progressively larger number of checks.

4.5.2.3 Nature of ante-natal care

The vast majority of pregnancy checks were carried out by a doctor. Of 934 currently pregnant women who reported having had a pregnancy check, 97% saw a doctor and 3% saw a trained nurse. Almost identical results were reported in respect of 4,151 most recent live births, 98% having been checked during the pregnancy by a doctor, 2% by a trained nurse

Eighty-one percent of pregnant women went to a government health facility and 19% to a private health facility for their pregnancy check. Similar figures, 82% and 18%, were reported in respect of the last live birth. With the exception of women under 20 years of age, the likelihood of having a pregnancy check in a government health facility increased with age .

Thus, it would seem that ages associated with a lower likelihood of a pregnancy check are the ones associated with a greater likelihood of using government health facilities also. The figures on location of the check would seem to imply an earlier start to childbearing to be associated with use of government health facilities, while a later start was associated with a slightly greater tendency to use private facilities.

The greater likelihood of a pregnancy check that was observed among urban than rural women also denotes a much lower likelihood of using a government health facility. A similar relationship between the two was observed in the East, in South and the North; in the East a high likeli- hood of receiving ante-natal care was associated with a lower likelihood of using a government health centre, and in the South and North the lowest likelihood of ante-natal care were associated with the greatest likelihood of using a government health facility. Parent's literacy associated with a lower liklihood of a pregnancy check denoted greater likelihood of its taking place in a government health facility.

4.5.3 Intra-natal care

4.5.3.1 Place of delivery

Women whose last child was born five years or less preceding the survey were asked about where the child was born and who attended the birth. Three in four women had a hospital or clinic birth and one in four a home birth. Government facilities accounted for the majority of all hospital or clinic births. The likelihood of the most recent live birth's being delivered in a government hospital falls, and of its being delivered at home rises, with mother's age and between first, second and third and higher order births, (Table 4.5.4). The likelihood of a birth in a private hospital or clinic meanwhile

Table 4.5.4 Percentage distribution of births in last five-years by place of delivery, according to mother's age and birth order

Mother's age	Goverment health facility	Private health facilty	Home	Other	Total	No.of births
< 20	67	12	21	-	100	274
20 - 24	67	12	21	0	100	1239
25 - 29	62	14	24	0	100	1695
30 - 34	60	11	29	0	100	1057
35 - 39	60	13	27	0	100	1073
40 - 44	60	11	29	0	100	500
45 - 49	48	14	38	0	100	261
Birth Order						
1	70	16	14	-	100	187
2	65	16	19	0	100	719
3 & >	60	11	28	1	100	4742
Total	62	12	26	0	100	6109

displays no systematic variation with mother's age but it declines slightly between first, second and third and higher order births.

The oldest age group of women were much less likely than other women to have delivered their most recent child in a government hospital or clinic. They were correspondingly the most likely to have had a home birth. There were notable residence differentials in the place of delivery. Sixty-nine percent of urban women gave birth to their last child in a government health facility, 16% in a private one and 15% were home births, the figures for rural women being 44% in a government and 5% in a private hospital or clinic, and 51% at home. So, 85% of urbancompared with 49% of rural births were in a hospital or clinic, and 15% compared with 51% were at home.

There were two distinct combinations of government and private health care, similar to those recorded in respect of ante-natal care. In the Centre, the North and South around 95% of hospital or clinic births were in government facilities, while in the East, which had the highest proportion of hospital births, 91%, and in the West, which had the second lowest proportion

of hospital births, 69%, there were respectively only 74% and 71% of hospital births which were in government facilities.

Distinctive regional patterns of care may be inferred under the crude assumption that those women who received ante-natal care did so in the same health centre as they gave birth to their most recent child. The Central Region stands out as the one with the most comprehensive system of government health care, there being an estimated 73% of women who received ante-natal care before, and also delivered, their most recent live birth in a government hospital or clinic. The figure was much lower, around 50% elsewhere. In the East and in the West relatively large numbers of women are estimated to have received private care during pregnancy and delivery, 23% and 20%, respectively compared with 6% or less elsewhere. Thus, a similar level of ante-natal care and care at the delivery in the Centre and East Regions appears to have been achieved with a very different combination of government and private facilities.

Not only were literate women more likely than illiterate women to have had a hospital birth, 89% compared with 66%, a greater proportion of them were in private facilities, 24% of hospital births to literate women and 11% of hospital births to illiterate women. The distribution of places of delivery among women whose husbands were illiterate was more or less the same as it was for all illiterate women, there being perhaps a marginally higher proportion of home and lower proportion of government hospital births associated with husband's illiteracy.

4.5.3.2 Attendance at delivery

Sixty-one percent of deliveries were attended by a doctor, 21% by a trained nurse, 13% by a relative, 1% by a traditional birth attendant (TBA / Daya), 3% by no one and there were 1% of deliveries with attendance described as "other".

Attendance at the delivery and place of delivery are quite closely inter-related. A hospital or clinic birth would usually be attended by a doctor or trained nurse. Births attended by a TBA / daya, by a relative or by no-one would usually have taken place at home. The difference between the number of births attended by a doctor or trained nurse and the number that took place in a hospital or clinic approximates therefore the number of home births that were attended by a doctor or trained nurse. This being so, an estimated 74% of most recent live births were delivered in a hospital or clinic and attended by a doctor or trained nurse, 8% were delivered at home and attended by a doctor or trained nurse, 1% and 13% respectively, were delivered at home and delivered by a TBA / daya and a relative, and 3% were delivered at home with no one in attendance. Just over 30%, therefore, of home births are estimated to have been attended by a doctor or trained nurse, just under 5% by a TBA / daya, 50% by a relative, and just over 10% by no-one.

Presuming again that all hospital or clinic births, that is 85% of urban and 49% of rural births, were attended by a doctor or trained nurse, then 6% of urban and 12% of rural births were delivered at home attended by a doctor or trained nurse, and 9% and 37%, respectively were attended by a relative, a TBA / daya or by none; in other words, 40% of urban home births and 24% of rural home births were attended by a doctor or trained nurse. It was shown earlier that rural women were over three times as likely as urban women to have given birth to their most recent child at home. These figures denote an even bigger differential after taking into account attendance at the delivery, rural women being more than four times as likely as urban women to have given birth at home without a doctor or trained nurse in attendance.

Women living in the Centre were most likely to have been attended by a doctor during their most recent live birth, falling in case of those living in the East, West, North and of those living in the South.

A larger proportion of home births to women living in the East were attended by a doctor or nurse than elsewhere, followed by the West, the South and Central and the lowest proportion was to be found in the North. Literate women were more likely than illiterate women to have been attended by a doctor during their most recent live birth and around 20% were attended in each case by a trained nurse.

Almost half of home births to literate women were thus attended by a doctor or nurse, compared with under a quarter of home births to illiterate women. As it was for urban compared with rural residence, a large differential in the likelihood of a home birth becomes even more pronounced when it is restricted to home births unattended by a doctor or trained nurse.

The association between husband's literacy and attendance at the delivery, as it was for place of delivery, appears to be negligible therefore in comparison with that for woman's literacy.

4.5.4 Post-natal care

About 58% of women whose last child was born five years or less prior to the survey had a post-natal check-up, which may be compared with 68% of them who had an ante-natal check. Ninety-three percent of post-natal examinations were carried out bya doctor compared with 98% of antenatal checks. Fifty-four percent of all women, therefore, had a post-natal check carried out by a doctor, and 67% an antenatal check, and 3% and 1% respectively, had post and ante-natal checks carried out by a trained nurse.

A post-natal check was most likely in respect of first births, falling in case of second, third and fourth births, (Table 4.5.5). Other than between first and second births, the likelihood of an antenatal check displayed amore systematic fall with parity than the likelihood of a postnatal check. As a consequence, sixth and higher order births featured a smaller difference between the proportions with antenatal and post-natal checks than did lower order births.

Table 4.5.5 Percentage of last live births whose mothers received ante-natal checks and post-natal checks, according to birth order

Birth Order	% who had antenatal check	% who had post-natal check
1	80	71
2	78	63
3	72	60
4	73	59
5	67	52
6	64	53
7	63	52
8	61	52
9 & >	56	55
Total	68	58

Urban/rural differentials in post-natal care resemble those observed in respect of ante-natal care; urban women were more likely than rural women to have had a post-natal check. With the exception of the South, the regional differential in post-natal care coverage was much smaller than it was in respect of ante-natal care.

The North and the Central featured, as they did for ante-natal checks, the highest likelihood of a doctor's having carried out the post-natal check, falling slightly in the East, South and the West.

Women who were illiterate were much less likely than literate women to have had a post-natal check though again the differential is not as marked as it was in respect of ante-natal care. As in respect of residence, the least advantaged in respect of overall care levels received the most coherent maternal care package. Thus, illiterate women featured similar figures for ante-natal care, post-natal care and hospital deliveries, while there was a significant number of literate women who appear to have had a pregnancy check and delivered in hospital without benefitting from a post-natal check.

Just as in relation to ante-natal care, slightly fewer women whose husbands were illiterate than of all illiterate women had a post-natal check and slightly fewer of them were performed by a doctor.

4.6 Marriage patterns

4.6.1 Introduction

In Saudi Arabia, the basic features of the family are taken for granted and treated as sacred. Information on date of marriage refers to the date when marriage was consummated, *Zawaj,* and not the earlier date on which the marriage contract was signed, *Milkah.*

4.6.2 Current marital status

Table 4.6.1 shows the distribution of the population enumerated in the household survey by current age and sex, according to marital status. As may be seen, very few women under age 15 are married. The proportion of the population that is single declines very rapidly with increasing age. By ages 25-29, only about about 13 percent of the women are single, compared with 29 percent of men. By about age 50, the percentage remaining single is two percent for women and just over one percent for men. These very low proportions show that marriage is almost universal in Saudi Arabia.

As the proportion of single persons declines with increasing age, the proportion of the population that is ever-married rises by corresponding amount. The proportion of currently married women increases rapidly upto ages 35-39 and then starts to decline due to the effect of widowhood and divorce. Between age s 25 and 50, the proportion divorced among women ranges between two and four percent. The percentage of women who are widowed climbs steadily with age but it is not substantial until about ages 50-54, where it reaches 19 percent. Among women in the age range, about one-third have never been married, 62 percent are currently married, while the remaining five percent are either widowed or divorced.

Table 4.6.1 Percentage distribution of the population enumerated in the NCHS (1987) household survey by age, sex and marital status

Age	Single	Married	Widowed	Divorced	Total
A. Males					
10 - 14	99.6	0.2	0.2	-	100
15 - 19	99.0	1.0	0.0	-	100
20 - 24	76.0	23.7	0.1	0.2	100
25 - 29	29.0	70.3	0.2	0.5	100
30 - 34	7.4	90.7	0.4	1.5	100
35 - 39	3.4	96.1	0.3	0.2	100
40 - 44	2.4	96.8	0.4	0.4	100
45 - 49	1.4	97.8	0.7	0.1	100
50 - 54	1.1	98.3	0.5	0.1	100
55 - 59	0.7	97.8	1.0	0.5	100
60 - 64	1.2	96.3	2.2	0.3	100
65 - 69	2.5	94.6	2.9	0.0	100
70 +	5.6	83.8	9.4	1.2	100
B. Females					
10 - 14	99.5	0.4	0.0	0.0	100
15 - 19	83.9	15.4	0.2	0.5	100
20 - 24	38.9	58.2	1.0	1.9	100
25 - 29	12.5	82.6	1.7	3.2	100
30 - 34	10.1	83.2	2.9	3.8	100
35 - 39	4.7	89.8	3.2	2.2	100
40 - 44	3.0	86.6	8.1	2.3	100
45 - 49	1.9	84.4	11.6	2.1	100
50 - 54	5.7	71.7	19.1	3.5	100
55 - 59	3.8	66.2	25.9	4.1	100
60 - 64	10.7	44.2	39.8	5.2	100
65 - 69	11.3	36.9	47.5	4.3	100
70 +	18.2	24.1	53.7	4.0	100

The net effect of the three factors of first marriage, dissolution of marriage and remarriage on the current marital status of the female population is shown in Table 4.6.2. As may be seen, at the time of the survey, 94.9 percent of all ever-married women at ages 15-49 were married, about 2.6 percent widowed and 2.5 percent divorced. The proportion currently married decreases from over 95 percent among women less than 40 years of age, to 90 percent for those aged 40-44 and to 86 percent for women aged 45-49 years, mainly due to the higher incidence of widowhood at older ages.

Table 4.6.2 Percent distribution of all ever-married women according to current marital status by current age

Age	Current marital status			Total
	Married	Widowed	Divorced	
15 - 19	96.6	0.8	2.6	100
20 - 24	96.0	1.4	2.6	100
25 - 29	95.3	1.7	3.0	100
30 - 34	94.7	2.5	2.8	100
35 - 39	95.5	2.9	1.6	100
40 - 44	90.0	7.6	2.4	100
45 - 49	85.9	12.1	2.0	100
Total	94.9	2.6	2.5	100

4.6.3 Age patterns of first marriage

In this section, recent trends in the tempo and level of female nuptiality will be analyzed by linking data on date of first marriage obtained in the individual maternal care survey with data on current marital status from the household survey. Any analysis of age patterns of first marriage must take into account the fact that the data on age at marriage are censored, i.e. the data are incomplete since information on the age at marriage is available only for women who have ever been married.

Table 4.6.3 shows the distribution of 'all' women in the sample by marital status and age at first marriage, according to current age. About 17 percent of all Saudi women aged 15-49 married for the first time before age 15, more than 43 percent before age 18 and about 60 percent married before age 22 years.

Table 4.6.3 Percentage distribution of all women by marital status and age at first marriage according to current age

Age	Never married	Age at first marriage						Total
		< 15	15 - 17	18 - 19	20 - 21	22 - 24	25 - 49	
15 - 19	83.9	3.6	9.7	2.8	-	-	-	100
20 - 24	38.9	10.8	25.5	15.4	7.3	2.1		100
25 - 29	12.5	18.6	33.9	16.1	9.7	7.7	1.5	100
30 - 34	10.1	22.2	34.6	14.4	7.9	4.8	6.0	100
35 - 39	4.7	25.0	39.0	10.7	8.2	4.5	7.9	100
40 - 44	3.0	31.7	35.5	12.0	7.2	3.5	7.1	100
45 - 49	1.9	33.1	31.2	11.2	8.1	5.3	9.2	100
Total	33.0	16.7	26.6	11.0	6.1	3.4	3.2	100

Cohort trends in age at marriage can be examined by comparing the distribution of the proportion of women ever-married by age for successive age cohorts. The figures in Table 4.6.4 show a clear trend towards later marriage, and a concomitant tendency for first marriage to become spread over a wider age group, as evidenced by the substantial decreases in the proportions of young marriages. Thus, the proportion ever married before reaching age 25 has decreased from 94 percent among women currently at ages 35-44, to 89 percent for women currently 30-34 years, and to 80 percent for women currently at ages 25-29 years. Likewise,the proportion has declined - but more reapidly - for those marrying before age 20; from about 79 percent among the cohorts of women currently at ages 35 and over, to 48 percent among the cohorts aged 20-24. The downward trend in teen-age marriages has been even more striking. About 65 percent of women currently at ages 35 and over had entered first marriage before reaching age 18,

Table 4.6.4 Cumulative proportion of women ever-married (per 1000) by age (exact years) for five-year age cohorts, as implied by NCHS (1987)

Current age of cohort (as of 1987)	Age (exact years)											
	15	16	17	18	19	20	22	25	30	35	40	45
15 - 19	60											
20 - 24	113	186	266	345	419	484						
25 - 29	203	303	401	491	562	632	725	803				
30 - 34	254	371	483	581	661	726	816	887	928			
35 - 39	276	426	562	672	756	818	895	947	969	974		
40 - 44	330	448	558	650	726	785	871	938	979	985	990	
45 - 49	326	431	528	615	681	750	840	921	974	987	995	996

whereas the figure was 58 percent for women currently 30-34 years, 49 percent for women currently 25-29, and 35 percent for those aged 20-24.

There has also been a very sharp decline in the very early marriage. The proportion of women ever married by exact age 15 was about 33 percent among the women currently at ages 40-49. This proportion continued to decline gradually with every succeeding cohort until it reached a low of six percent among women currently aged 15-19.

This important transformation in the tempo of female nuptiality in Saudi Arabia reflects, of course, an upward trend in age at first marriage. This may be illustrated by an examination of trends in the ages at which certain proportions of successive age cohorts were married. In Table 4.6.5, figures are given showing the ages at which 10, 25, 50 and 75 percent of the initial size of each of the seven ages cohorts considered had been married for the first time. The table also shows the inter-quartile range which is obtained by subtracting the age at which the proportion ever married reached 25 percent from that age at which the proportion reached 75 percent.

Table 4.6.5 brings out in sharper focus the remarkable transformation in the age pattern of nuptiality which started with the cohorts of women born in the early 1960s, and shows that the two dimensions of the tempo of nuptiality, namely the early-late dimension and the rapid-slow dimension, have worked - with only few exceptions - in such a way as to reinforce each other. Thus, the age at which the proportion ever-married reached 25 percent was less than 15 for each of the cohorts currently aged 35-39, 40-44 and 45-49. This age has risen to 15.5 years for the cohort aged 25-29 and to almost 18 for the cohort aged 15-19. A similar upward shift amounting to more than two years is also shown for the ages at which 75 percent of the women in each cohort had entered first marriage.

Table 4.6.5 Estimated ages at which 10, 25, 50 and 75 percent of successive five-year age cohorts had ever-married as implied by the NCHS (1987)

Current age of cohort (as of 1987)	Percentage ever-married				Inter-quartile age range
	10	25	50	75	
15 - 19	15.8	18.0			
20 - 24	14.9	16.8	20.3		
25 - 29	13.8	15.5	18.1	22.3	6.8
30 - 34	13.5	15.0	17.2	20.3	5.3
35 - 39	13.5	14.8	16.5	18.9	4.1
40 - 44	12.8	14.3	16.5	19.4	5.1
45 - 49	12.6	14.3	16.6	20.0	5.7

A concomitant tendency for the effective nuptial span to be expanded into a wider age range is also shown by the increase in the inter-quartile range, from an average of 5 years for the older cohorts aged 35 and over, to 6.8 years for the cohort currently aged 25-29.

Of special interest, however, is the trend in the median age at first marriage, i.e. the age by which half of the women of any given cohort had entered into a first marriage. The figures in Table 4.6.5 show that the median age at first marriage has risen from less than 17 years for the cohort of women currently at ages 35 and over, to 17.2 for women at ages 30-34, 18.1 for

women at ages 25- 29, and to 20.3 for those currently at ages 20-24. Information on women in their late teens suggests that the upward shift in age at first marriage and the tendency for first marriages to be spread over a wider age range was continuing in the late 1980s.

Table 4.6.6 gives the values of the singulate mean age at marriage for men and for women according to type of place of residence and region of residence. As may be seen, women and men living in urban areas marry later, on average, than those living in rural areas. There are differences across geographic areas in the mean age at marriage. For example, the value of SMAM for females is lowest in the North and South regions (at 20.2 and 20.5 years, respectively); it increases to 21.0 years in the East region, 21.8 years in the Central region and to 22.9 years in the West region.

Table 4.6.6 Singulate mean age at marriage (SMAM) for males and for females, according to type of place of residence and region of residence

	Male	Female
Type of residence		
Urban	25.4	22.1
Rural	24.4	20.6
Region		
Central	26.3	21.8
North	23.9	20.2
South	24.5	20.5
East	24.5	21.0
West	26.0	22.9
All	25.2	21.8

4.6.4 Consanguinity

Marriage between first cousins and, in general, between men and women who have a blood relation is quite common in Saudi Arabia. Among ever-married women under 50 years of age, about 58 percent reported having a blood relationship with their husbands (36 percent "first cousins" and 22 percent "other relation").

Table 4.6.7 shows that consanguineous marriage is least common in the Central and the South regions and among women who are literate where nearly one-half of spouses are related, and most common in the North and the East regions and among women who are illiterate where more than two-thirds of spouses have a blood relation.

Table 4.6.7 Percent distribution of ever-married women by blood relation between spouses, according to selected background characteristics

	First cousin	Other relation	No relation	Total
Place of residence				
Urban	34	24	42	100
Rural	41	19	40	100
Region				
Central	36	17	47	100
North	36	34	30	100
South	34	18	48	100
East	36	31	32	100
West	36	22	42	100
Wife's literacy				
Illitertae	39	24	37	100
Literate	30	19	51	100
Total	36	22	42	100

4.7. Reproductive patterns

4.7.1 Introduction

Saudi Arabia also features many of the characteristics that have been associated in other societies with fertility reduction. These include a major increase in the proportion of children who survive to adulthood, continuing urbanization, and modernization in respect of education, health and housing, and the possession of consumer durables, as well as an upward shift in the age pattern of first marriage. The NCHS allows the fertility implications, if any, of these to be assessed.

The bulk of the analysis in this section is oriented around age cohorts and marriage cohorts. Age cohorts identify women who were in particular age range at the time of the survey. Marriage cohorts identify the women who occupy the same interval of years since first marriage. The term 'marital duration' will refer to years since first marriage, even if marital dissolution, remarriage, etc., has occurred since that initial event.

Age is pertinent to fertility, in particular, and especially in countries such as Saudi Arabia where there are large numbers of births to older women, because it is related to fecundity. Demographers have developed a large number of measures to describe different aspects of fertility. There are two fundamental dimensions to any individual woman's childbearing: how many children she has had (the 'quantity' or 'level') and how quickly she has had them (the 'tempo'), and by extension these apply to any aggregate or sub-group as well. The central problem of fertility analysis is that these two dimensions cannot be fully separated. It is for this reason that the results using one measure will not always seem to correspond to the results based on another measure.

4.7.2 Current parity

Current parity is a measure of achieved fertility at the time of the survey and is simply the accumulated number of live births that a woman has had to date. The data on current parity or the number of children ever-born from the NCHS is cross-sectional and do not refer to the reproductive behavior of a cohort of women as it grows older. Thus, for the younger women, current parity will reflect their fertility during a limited period only, while for the older women, this measure comes close to their life-time fertility.

First, however, consider the sample as a whole. Table 4.7.1 shows that the mean parity for all ever-married women is and for currently married women are identical (5.3), indicating that the effect of marriage dissolution on the fertility of the whole sample is negligible. The overall mean parity of 5.3 children per woman reflects a high level of fertility, since the sample includes women who still expect long reproductive lives.

Table 4.7.1 Percentage distribution of ever-married and currently married women, according to the number of children ever-born

No.of Children Ever-born	Ever-married Women		Currently Married Women	
	All Ages < 50	45 - 49	All Ages < 50	45 - 49
0	7.9	3.3	7.7	2.9
1	8.6	1.8	8.1	1.4
2	9.7	1.5	9.8	1.5
3	10.0	2.0	10.2	2.0
4	10.2	3.5	10.3	3.3
5	9.3	5.1	9.4	4.6
6	9.3	7.4	9.5	6.9
7	8.0	8.4	8.1	8.4
8	7.4	11.6	7.4	10.5
9	5.8	11.3	5.9	12.3
10 +	13.8	44.1	13.6	46.2
All	100.0	100.0	100.0	100.0
Mean parity	5.3	8.6	5.3	8.8
No.of women	8382	975	7858	838

The parity distributions for the whole sample shows considerable dispersion, with a skew toward the high parities. Thus, about 8% of all ever-married women are childless. Of the rest, 18% have had either one or two live births, 20% three or four, 18% five or six, 15% seven or eight and the remaining 21% nine or more.

The distribution of the sample according to age of the woman, age at first marriage and marriage duration will, however, have a profound effect on the mean parity. This is evident from the proportion of childless women, which reaches 8% for all evermarried in the sample but only about 3% for tose aged 45-49. Therefore, it is necessary to study parity in conjunction with controls for age and age at first marriage to gain further insight in the pattern of fertility.

4.7.3 Completed fertility

The cumulative fertility or mean number of children ever-born to women aged 45-49 can be taken as indicative of the level of completed fertility provided the data for these women are not subject to bias arising from misreporting of the age of women and from recall lapse that affects the reporting of the number of children.

As shown in Table 4.7.1, the average woman of age 45-49 at the date of the survey who had ever been married had almost nine (8.6) live births. However, the distribution of these women by parity still exhibits a great deal of dispersion. Roughly speaking, one-third of these women are within one child of this mean (i.e. 8, 9 or 10 children), one-third, are below this range (7 or fewer births), and one-third, are above (11 or more births). One woman in 15 has had a family below 'replacement' level (o, 1 or 2 live births), but at the other extreme, one woman in two had 9 or more children and one woman in three had 11 or more children.

The fertility of currently married women aged 45-49 is also shown in Table 4.7.1. As may be seen no significant differences exist between the distributions of ever-married and currently married women by the number of children ever-born.

One reason, however, for examining the group of currently married women aged 45-49 is that it gives an estimate of the level of primary sterility. Only 2.9% of these women had no children at all. This figure may be taken as the percentage of couples in which either the husband or the wife is incapable of having any children at all. It provides a clear indication of the low level of primary sterility, since, in Saudi Arabia, prevailing norms do not support voluntary childlessness. In international terms, this low level of primary sterility implies a level of general health in excess of the thresholds below which fertility is inhibited.

4.7.4 Parity within age groups

Having considered in some detail the level of completed fertility, attention now shifts to those women whose families are still being formed. A detailed picture of current parity by age groups as shown by the NCHS is given in Table 4.7.2. It should be noted that due to the cross-sectional nature of the survey, as mentioned earlier, there is a systematic exclusion of women who had not married by the time of the survey. As a result, there is an under-estimation in the mean age at marriage. This effect extends through the entire reproductive history of respondents and results in a downward bias in the age at entry into each parity. The amount of bias, however, decreases with age, but cannot be specified entirely.

Table 4.7.2 Percent distribution of ever-married women, according to the number of children ever-born

No.of children ever-born	Age							Total
	15 - 49	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	
0	47.3	15.1	4.5	2.8	1.8	1.2	3.3	7.9
1	36.1	21.8	6.7	3.9	0.9	1.2	1.8	8.6
2	12.3	25.5	12.7	5.9	2.5	2.1	1.5	9.7
3	3.5	19.7	18.2	7.2	4.5	3.1	2.0	10.0
4	0.2	10.9	21.5	10.8	6.9	4.0	3.5	10.2
5	0.2	3.4	15.5	15.5	10.3	6.1	5.1	9.3
6	0.4	2.5	11.2	16.9	13.2	8.0	7.4	9.3
7	-	0.5	5.8	14.1	14.5	11.2	8.4	8.0
8	-	0.3	2.6	10.9	14.1	14.0	11.6	7.4
9	-	0.1	0.6	6.6	11.1	13.4	11.3	5.8
10+	-	0.4	0.6	5.4	20.2	35.5	44.1	13.8
Total	100	100	100	100	100	100	100	100
Mean	0.8	2.2	3.9	5.6	7.2	8.3	8.6	5.3

As may be seen, the proportion of childless women declines rapidly between ages 15 and 25. Among ever-married women aged 25 or more years, less than 5% are childless. The data also show high level of fertility by women of all ages. Among women aged 20-24, themean number of children ever-born is 2.2 and 38% of these women have had three or more live births.

Among women aged 25-29, who have had on average four children, 36% have already had five or more children, and among women aged 35-39, 60% have had seven or more children. Thus, as age increases, the distribution of women by current parity becomes more spread and the modal parity tends to occur at a higher number with a lesser magnitude. These data indicate that fertility in Saudi Arabia must be considered very high.

Finally, one important goal of maternal and child care programmes is to prevent infant and maternal deaths by assisting women to avoid high risk pregnancies. Evidence suggests that pregnancies among women who have already had five or more births are associated with increased mortality and morbidity for both the mother and the child. The results in Table 4.7.3 show that many Saudi women, particularly those in the older age groups, are in this high parity risk category. Overall, about one in two Saudi women had five or more births. By age, the proportion with five or more births increases from about 20%, among women under 30% to as much as 70% in the 30-34 group. Among women at ages 35 and over, who already are at greater pregnancy risk because of their age, the proportion in the high parity risk group increases to nearly 83% in the 35-39 cohort and to 88% among women 45-49.

Table 4.7.3 Percentage of currently married women reporting a current pregnancy by current age and residence

	Current age							Total
	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	
Residence								
Urban	27.5	24.1	20.4	19.9	12.5	6.3	0.6	16.6
Rural	22.9	26.9	24.4	22.7	15.3	6.5	2.1	17.7
Region								
Central	31.0	26.0	20.6	19.1	12.8	9.5	1.2	18.1
North	19.7	30.5	27.0	22.7	14.0	6.2	0.0	19.6
South	26.3	29.4	28.7	30.3	16.4	7.0	2.2	21.0
East	27.8	20.5	17.8	17.3	15.4	4.0	4.4	16.0
West	22.4	21.2	19.4	18.2	11.9	5.4	0.6	14.0
Total	25.9	24.9	21.4	20.7	13.4	6.4	1.1	16.9

4.7.5 Current fertility

So far attention has been focused on completed fertility, and on cumulative fertility for certain segments of the women's reproductive period. In this section attention will be focused on the pattern and level of current fertility, i.e. fertility in the 12-month period preceding the survey. This information is perhaps of most practical importance and relevance for planning and policy-making through its impact on current and future population growth. Three measures of current fertility will be presented: the proportion of women currently pregnant, age-specific fertility rates and total fertility rates.

4.7.5.1 Proportion of women currently pregnant:

The proportion of women reporting a current pregnancy is, in a sense, the most 'current' measure of all since it actually anticipates the level of fertility during the next nine months or so. The percentage of currently married women reporting a current pregnancy is shown in Table 4.7.4 according to current age and residence. Overall, 17% of currently married women report a current pregnancy. The percentages decline monotonously and rapidly with age.

The distribution of current pregnancies according to the duration of pregnancy is shown in Table 4.7.4. Contrary to generally observed patterns, where few pregnancies are reported for the first trimester, a substantial number of pregnancies in Saudi Arabia, about 26%, are reported to be of two to three months duration. Nevertheless, the distribution, with peaks at two, four and seven months, s uggests some misreporting of duration of gestation. However, about 78% of all pregnancies are reported as of durations 2-7 months. If pregnancies at these durations are fully reported, then it may be calculated that the overall level of current pregnancies are under-reported by about 14% [1 - 6 / (9 x 0.78)]. This estimates of under-reporting would imply that around 19.3% of currently married women are currently pregnant. This percentage of pregnancies at any time implies (5 x 0.193 / 0.75) = 1.29 live births per married woman during five years, where 0.75 years or 9 months is the average gestation period. This value is very

Table 4.7.4 Percent distribution of current pregnancies, according to the duration of pregnancy

Duration of Pregnancy (in Months)	Percentage
2	13.3
3	12.8
4	14.3
5	12.1
6	11.8
7	13.3
8	12.5
9	9.9
All	100

close to the mean number of children ever-born to women with marital duration of less than five years.

4.7.5.2 Level of current fertility

Two measures of fertility in the 12-month period preceding the survey are employed in this section: age-specific fertility rates and total fertility rates. An age-specific fertility rate (ASFR) is the ratio of births occurring to a group of women of a particular age in a specified time period, usually a year, and the total number of woman-years spent in that age-group during the specified time interval. The total fertility rate (TFR) is the sum of age-specific fertility rates over the childbearing ages. The TFR represents the number of live births that would occur to a woman if she were to experience throughout her reproductive years the level of childbearing represented by the schedule of age-specific fertility rates of a given period. The estimation of these rates from a retrospective sample survey could be subject to sampling fluctuations as well as non-sampling errors resulting from omission of births or misstatement of ages and dates.

The estimation of ASFRs from the survey is based on a relatively simple procedure. First, the most recent births to the ever-married women who were enumerated in the survey were classified by the age of mother at maternity. These births constituted the numerators in the calculation of ASFRs. The number of births thus obtained for any given age-group was divided by the number of woman-years lived in the same age-group. This rate was then multiplied by the proportion of ever- married women in the same age-group, which was obtained from the household survey data, to give a rate for all women regardless of marital status.

The rates thus obtained from the CHS are shown in Table 4.7.5. As may be seen the NCHS data yield fertility rate of 6.46 live births per woman for 1986-87. The survey data also yield a crude birth rate equivalent to 42 live births per 1,000 persons for 1986-87.

Table 4.7.5 Age specific fertility rates and age specific marital fertility rates per 1000 women, for 12 months period preceding the survey

Age	Age-specific fertility rates	Age-specific marital fertility rates
15 - 19	55	349
20 - 24	236	398
25 - 29	328	391
30 - 34	273	326
35 - 39	251	278
40 - 44	111	127
45 - 49	37	45
	Total Fertility Rate (TFR)	Total Marital Fertility Rate (TMFR)
15 - 49	6.46	7.82

The curve of age-specific fertility rates begins with a minimum somewhere around age fifteen, the sweeps upward forming a very broad peak over the age range 20-39, with a maximum occuring at ages 25-29.

Both the total fertility rate and the age pattern of current fertility indicate that fertility in Saudi Arabia is very high. Nevertheless, current fertility as measured by the TFR is about 24% lower than the cumulative fertility of

women currently at the end of the childbearing ages, as represented by the mean number of children ever-born (CEB) to 'all' women aged 40-49 (Table 4.7.7). This difference could signify a reduction in fertility, or it may be due to reporting errors. Commonly, errors in dating of the last live birth result in either an under or over-estimate of current fertility according to whether the interval since the last live birth is over or under-stated.

Assuming that dating errors may well exists, and to resolve the discrepancy between completed and current fertility estimates and derive an adjusted estimate of current fertility, indirect techniques must be applied. A more detailed evaluation of the data, suggested that the reported total fertility rate of 6.5 should be taken as a minimum estimate of the current level of fertility, and that a total fertility rate of around 6.8 live births per woman is a more plausible estimate of the level of current fertility. A comparison of the revised TFR estimate of 6.8 births with the measure of completed family size (CEB) of 8.4 births per woman suggests that, although fertility remains high in Saudi Arabia, there is indication that it has declined significantly from the very high levels prevailing in the past.

4.7.6 Differentials in current fertility

The analysis of differentials in the current level of fertility will be based on age-specific fertility rates for the 12-month period preceding the survey, by type of place of residence and region of residence. These rates are shown in Tables 4.7.6.

In Saudi Arabia, urban fertility is significantly lower than rural fertility, with a difference of more than 1.7 children observed in the total fertility rate between urban women (6.1 births) and rural women (7.8 births). The magnitude of the fertility differential between urban and rural areas seems quite plausible. A yardstick for appraising this variation may be the urban/rural differential in current parity for women at ages 30-34 which is almost equal to one birth. This age group is chosen because it reflects the level of cumulative fertility up to an old enough age; its reporting is likely to be of a better quality than older ages and its experience relates to a relatively more recent past.

Table 4.7.6 Age- specific fertility rates per 1000 women, for the 12-month period preceding the survey by residence

Background characteristics	Age							Total fertlity rate
	15 19	20-24	25-29	30-34	35-39	40-44	45-49	
Residence								
Urban	52	213	314	264	249	99	24	6.07
Rural	66	315	375	316	269	144	79	7.81
Region								
Central	47	182	333	284	281	107	36	6.37
North	73	272	383	361	324	70	29	7.56
South	63	261	384	325	253	135	73	7.48
East	72	279	347	307	238	148	42	7.17
West	46	196	283	229	228	108	36	5.63
Total	55	236	328	273	251	111	37	6.46

Among urban women, the total fertility rate for the 12-month period prior to the survey is 25% lower than the mean number of children ever- born for women 40-49 years of age, while for rural women, the implied longterm decline in fertility is just over 9%, (Table 4.7.7). This suggests that urban women have been leading the initial transition to lower fertility in Saudi Arabia.

Tables 4.7.7 also shows that the level of current fertility is lowest in the West Region (5.6 births); this level rises to 6.4 in the Central Region, to 7.2 in the East Region and to about 7.5 in the South and North Regions. These figures suggest that the West and the Central Regions have experienced the fastest fertility decline as evidenced by the fact that the total fertility rate (TFR) for these two regions is more than one-quarter lower than the mean number of children ever-born (CEB) among women 40-49 years of age. In contrast, in the North Region, the difference between the TFR and the mean CEB is only 15%, while in the East and the South Regions, it is around 10%.

Table 4.7.7 Total fertility rate for 12-month period preceding the survey and mean number of children ever-born to " all " women 40-49 years of age by residence

Background Characteristics	Total Fertility Rate	Mean No.of Children to "All" Women aged 40-49	Implied Longterm Decline in Fertility (%)
Residence			
Urban	6.07	8.09	25
Rural	7.81	8.56	9
Region			
Central	6.37	8.67	27
North	7.56	8.90	15
South	7.48	8.20	9
East	7.17	7.99	10
West	5.63	7.91	29
Total	6.46	8.45	24

Chapter 5

RESULTS (II) Individual Level Analysis of Determinants of Infant and Child Mortality

5.1 Aggregate analysis of determinants of infant and child mortality

The marked regional-differentials in infant and child mortality calls for a comparative aggregate analysis of selected broad categories of determining factors. The regional aggregate reflections of these determining forces are also investigated. The unit of analysis in this part are geographic classifications. Whenever possible, with reference to sample size, rural and urban classifications are utilized.

Before further investigating regional differentials in infant and child mortality we should point out that in the total sample 70.4% of women reside in urban areas while 29.6% reside in rural areas which shows that the overall survival rate is influenced by the majority population and hence in regions where rural population predominates higher levels are to be expected. The regional overall sizes and this urban-rural composition are provided in table 5.1.

Table 5.1 Number of ever married in the sample women by region and their urban-rural composition

Residence / Region	Total		Urban		Rural	
	Number	% of total	Number	% of region	Number	% of region
Total	8482	100.0	5974	70.4	2508	29.6
Central	2103	24.8	1915	91.9	188	8.9
North	781	9.2	619	79.2	162	20.8
South	1325	15.6	279	21.0	1046	79.0
East	1169	13.8	943	80.7	226	19.3
West	3034	35.8	2212	72.9	822	27.1

Table 5.2 provides regional-differentials in the selected categories of determining forces. Table 5.3 arranges the regions according to the level of some of the determining forces. The forces indicated are those portray appreciable regional variations.

Table 5.2 Some aggregate indicators of the level of infant mortality, individual resources, household infrastructure and health service infrastructure by region of residence

total smple of evermarried women (8482) cases

Regions	Total	Central	North	South urb.	South rural	South total	East	West urb.	West rural	West total
$^{1}q^{0}$ * 1000 1	50	43	54	33	80	71	38	33	62	43
Individual resources										
% Evermarried women with at least primary certificate	24.5	30.5	21.1	20.0	8.4	10.8	26.5	34.8	5.4	26.8
% of Husbands with at least preparatory certificate	24.5	37.5	19.8	29.1	17.4	19.8	27.2	35.9	10.7	29.0
% of Husbands who are prof / tech /adm /clerk	33.6	40.1	35.1	33.9	25.4	27.2	36.9	36.1	15.1	30.3
Household infrastructure										
% Ever-married women in households with cement floor	91.1	94.4	85.3	97.6	79.7	83.4	92.3	95.1	87.7	93.0
% Ever-married wome using only piped or bottled water for drinking	78.3	95.5	86.9	87.2	41.9	51.3	97.2	86.6	18.4	67.0
% evermarried women who live in households with flush toilet	85.6	96.2	87.2	99.2	60.4	68.5	99.3	90.1	51.2	78.9

1 Estimates referring to (11/85) 1.2 years prior to the survey date

Table 5.2, Continued

Regions	Total	Central	North	South Urb	South Rural	South Total	East	West Urb	West Rural	West Total
1q0 * 1000	50	43	54	33	80	71	38	33	62	43
Health services (Infrastructure)										
% currently pregnant who did not have a checkup because facility is too far (among those who did not have a check)	3.2	1.2	4.2	- 0	2.7	2.7	-	4.4	5.1	4.7
% currently pregnant who did not have a checkup because service is too costly	- 0	- 0	- 0	- 0	- 0	- 0	- 0	- 0	- 0	- 0

Table 5.3 Order of region according to the level of social resources and infrastructure

(1 refers to worst conditions)

Region	Total	Central	North	South Urban	South Rural	South Total	East	West Urban	West Rural	West Total
$_1q^0$ * 1000	-	4	3	5	1	-	7	5	2	-
Individual resources										
% Evermarried women with at least primary certificate	-	5	4	3	2	-	6	7	1	-
% Of husbands with at least preparatory certificate	-	7	3	5	2	-	4	6	1	-
% Of husbands who are prof / tech / adm / clerk	-	7	4	3	2	-	6	5	1	-
Households infrastructure										
% Evermarried women using only piped/bottled water for drinking	-	6	4	5	2	-	7	3	1	-
% Evermarried wome who live in households with flush toilet	-	5	3	6	2	-	6	4	1	-

The overall level of infrastructure settings is quite favorable in Saudi Arabia. Health services in particular are impressive. They are uniformly accessible and affordable in all regions of the country. Nevertheless, there are marked regional variations in both the source of drinking water and in the existence of sanitary flush toilets. The two regions (rural West and rural South) with the least favorable infrastructure portray highest mortality.

Table 5.4 Some aggregate indicators of the level of infant mortality, individual resources, household infrastructure and health service infrastructure by region of residence

Subsample of evermarried women with parity greater than zero and years since first marriage less than 15

Region	Total	Cen-tral	North	South urban	South rural	South total	East	West urban	West rural	West total
$^1q^0$ * 1000		46	51	51	83	77	32	39	68	49
Individual resources										
% Evermarried women with at least primary certificate	38.3	47.0	32.0	31.6	14.0	18.0	40.0	55.2	9.0	42.0
% Of husbands with at least preparatory certificate	38.3	47.0	27.0	32.9	27.1	28.0	40.0	55.5	18.9	39.0
Household Infrastructure										
% Evermarried women in household with cement floor	91.0	94.0	85.5	97.5	81.0	84.9	93.5	94.5	86.4	92.1
% Evermarried using only piped /bottled drinkig water	78.5	95.3	90.4	87.5	44.6	54.5	97.3	85.9	19.5	66.6
% evermarried women who live in households with flush toilet	85.6	95.9	88.1	100.0	60.0	59.3	99.1	88.4	51.2	77.6

Table 5.4 is a repeat of table 5.2 but restricted to ever married women with parity greater than zero and duration since first marriage less than fifteen years. Table 5.4 reflects a more recent experience than table 4.4 and applies to the sample of women chosen for the subsequent detailed individual level analysis of the determinants of recent mortality differentials.

It is clear that the picture of infrastructure portrayed in table 5.2 is similar to that in table 5.4. Both tables in fact reflect the recent improvement in structural factors. The overall levels of female and male education improves significantly. The intervening mechanisms through which the determining forces are translated to survival differentials are health care utilization, reproductive behavior, feeding patterns as well as levels of environmental contamination.

The regional aggregate measures of some intermediate variable are provided in table 5.5. These measures are provided for the total sample of ever married women.

The differentials in child care indicators are minimal and the overall levels of utilization especially of preventive services are quite favorable. Around 95% of children have a birth certificate or a health card and the completion of all immunizations is almost universal among children 1-6 years old with a health card or a birth certificate seen by the interviewer. About 52% of birth certificates and health cards were presented and seen by the interviewers. Among children with health cards that were not presented, 99.9% of them were reported to have had either drops or injections and 99.3% were reported as having both. Levels of utilization of curative services are significantly lower than the levels of utilization of preventive services but still without marked regional differentials.

Maternal care utilization are less impressive than child care utilization and shows marked regional variations. Again the two regions with the least favorable maternal care practices have the highest infant mortality.

Table 5.5 Some indicators of reproductive behaviour, utilization of maternal care services, utilization of child care services (preventive-curative) by region

Total Sample of ever-married women (8482) cases

Region	Total	Cent-ral	North	South urban	South rural	South total	East	West urban	West rural	West total
$^1q^0$ * 1000	50	43	54	33	80	71	38	33	62	43
Reproductive behaviour Indicators										
% related to spouse	58.3	53.1	69.9	42.4	54.8	52.2	67.6	56.2	63.4	58.2
% with age at 1st marriage < 15	24.7	22.6	22.8	27.9	27.0	27.1	30.1	25.1	21.8	24.2
%currently pregnant, age < 20	10.0	11.9	8.0	10.8	8.8	9.3	12.9	7.3	9.8	8.0
% currently preg. age more than or equal 35	17.4	15.5	14.5	5.4	20.3	16.6	18.0	21.2	19.6	20.7
Mean parity per evermarried women	5.25	4.99	5.27	4.9	5.7	5.53	5.26	5.16	5.63	5.29
Mean length of birth interval for those with parity > 1	3.59	3.59	3.10	3.75	3.41	3.48	3.52	3.93	3.40	3.79
Mean length of birth interval for currently pregnant women with parity > 0	2.43	2.48	2.20	2.03	2.33	2.26	2.60	2.57	2.39	2.52
% Ever breast-feeding	90.1	90.2	90.8	92.1	91.8	91.8	91.5	86.9	91.7	88.3
Mean length of breast-feeding duration for currently nonpregnant	10.47	9.37	10.63	9.36	11.20	10.85	9.54	11.28	12..00	11.49

Table 5.5, Continued

Region	Total	Cent-ral	North	South urban	South rural	South total	East	West urban	West rural	West total
$^1q^0$ * 1000	50	43	54	33	80	71	38	33	62	43
Health service utilization Maternal Care										
% Currently pregnant seen by a professional among those currently pregnant	69.2	75.1	66.0	61.9	55.4	57.0	80.9	76.0	48.7	68.0
% Evermarried women with at last live birth <5 yrs who had preg.checkup by a professional	67.9	79.0	52.0	59.6	47.0	49.3	78.6	79.5	40.7	68.1
% Evermarried women with last live birth < 5 yrs who gave birth in a health establishment	74.7	86.6	78.5	58.5	46.7	49.1	91.3	81.1	37.6	68.5
% Evermarried women with last live birth < 5yrs who had postnatal check- up by a professional	57.3	57.7	58.7	48.2	41.1	42.2	55.2	71.0	35.1	60.4

Table 5.5, Continued

Region	Total	Cent-ral	North	South urban	South rural	South total	East	West urban	West rural	West total
$^1q^0$ * 1000	50	43	54	33	80	71	38	33	62	43
Child care (Preventive)										
% Of children < 6 yrs with a birth certificate or health card	94.9	97.6	98.7	93.3	86.8	88.1	97.7	95.8	89.9	93.8
% Of children 1-6 years old who completed all immunization	96.1	95.8	96.7	96.7	93.2	93.8	96.7	98.6	94.1	97.1
Child care (Curative)										
% Having any treatment among children < 3 yrs who had diarrhoea	75.1	77.1	65.3	81.1	70.1	72.0	75.7	81.5	76.8	80.2
% Having ORS among those having any treatment	67.0	76.3	77.6	63.3	62.6	63.2	64.3	60.4	62.8	60.7
% Seeking professional advice among those who had diarrhoea	68.0	67.6	59.6	66.7	66.1	66.2	69.4	73.3	73.2	71.0

Around 58% of Saudi ever married women are related to their husbands, quarter of women marry at an age less than 15 and around 27% of pregnant women are either less than 20 years old or older than 35. Mean parity reflect high level of fertility. A rough estimate of mean births-interval based on data of ever married women with parity greater than 1 is around 3.6 years.This estimate

is calculated by dividing number of children ever born a woman has ever had minus one by duration since first birth for that women and averaging the results.*

This presents an overestimate of mean births-interval since it assumes continuous exposure to the risk of concepcion since this first marriage for all women included in the calculations [some of these women are currently or (ever) widowed or divorced and hence, they were not continuously exposed]. Restricting the calculations to only closed births-interval for currently pregnant women gives an estimate for mean births-interval equal to 2.4 years (excluding the interval from marriage to first birth). This latter figure does not take into account pregnancies that did not end in a live birth. Breast-feeding is a common practice in Saudi Arabia and continues at least through infancy. Almost 90% of Saudi women ever breastfeed their children with a mean breast-feeding duration (10.47) that ranges between 9 and 12 months in all regions.

The preceding aggregate analysis reveals that the greatest regional-differentials in the determining forces are found principally in individual social resources, household infrastructure especially source of drinking water and type of toilet facility in addition to utilization of maternal care services which though undoubtedly represents an intervening mechanism, reflects in a way regional norms, perceptions and awareness of the importance of such utilization.

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* Duration since first birth is assumed equal to duration since first marriage minus one year standing for an assumed first birth interval

Although the rural West region portrays the lowest levels of social resources and household infrastructure, it managed to retain a better level of mortality than rural South. Considering the intervening mechanisms, the region fares better only for sick children. Otherwise, they show lower levels of utilization of maternal care services and similar reproductive patterns and use of preventive child health services as the other regions.

5.2 Multivariate individual level analysis of determinants of recent mortality differentials

The previous section has clearly demonstrated wide regional differentials in infant and childhood mortality. It has also brought forward the existing aggregate variations in the determinants of mortality between the different areas studied.

Determinants of mortality are usually interrelated and hence the gross effect of each factor need to be adjusted for the presence of other factors. This section performs the multivariate analysis for individual level data to disentangle the net effect of each variable.

Three main categories of variables are chosen: individual level social resources (education of mother, education of husband and occupation of husband), household infrastructure (floor material, source of drinking water, type of toilet facility) as well as area characteristics (region of residence).

The following section proceeds from an analysis of the net effect of each variable within the category of variables considered (social as well as infrastructure categories) to the measurement of all the other variables.

The analysis is performed at the individual level with the dependent variable defined as the ratio of actual to expected deaths for each woman compared to the average ratio in the sample under investigation. All the subsequent analysis and tabulations refer to ever married women with parity greater than zero and duration since first marriage less than fifteen years; thus confining the analysis to the study of determinants of recent mortality differential only. The methodology adopted is discussed in the relevant section and the categories of each variables are given in the section on choice of variables.

Table 5.6. Parameter estimate and associated standard error, individual characteristics

Individual Characteristics	Gross Effect	Net Effect	S.E of Net Effect
(1)		1.7520	0.1349
Education of woman Primary +	-0.5765 **	-0.3540**	0.0842
Education of husband, prep +	-0.4418**	-0.1949 *	0.0840
Occupation of husband (Service, Skilled)	-0.7452**	-0.6689 **	0.1471
Occupation of husband (Prof / Clerical /Sales)	-0.9278**	-0.6749 **	0.1486

* : Significant at 0.05 ** : Significant at 0.01 (1) : Estimated ratio in the reference cell, mothers with less than primary certificate whose husbands have less than a preparatory certificate and are occupied mainly in agricultural sector.

Table 5.6 shows the results of multivariate analysis of social indicated resources. It shows that all three variables are significant factors. At one extreme, the estimated mortality experience of children whose mothers have less than a primary certificate and whose fathers have less than a preparatory certificate and these are mainly occupied in the agricultural sector, is 75% higher than the average (overall) mortality experience in the sample under investigation. More favorable individual resources significantly improve child mortality. This is expressed in a child mortality experience that is 47% less than the average experience in the sample (almost half the overall mortality level) for mothers with at least primary certificate whose husbands have clerical, sales or professional occupation and of course have at least preparatory certificate (1.752 - .3540 - .1949 - .6741 = .529). The occupation of husband has a leading position, compared to other individual social resources, in manipulating child mortality with almost twofold the magnitude of the education of mother. The relatively small effect of education of mother may be attributed to the categorization chosen to represent the educational status which contrasts lack of primary education with movement to higher levels while the categorization of occupation of husband reflects greater differentials in educational status and material resources.

Introducing the region of residence as a factor with seven levels representing the seven areas under consideration, improves the model. Table 5.7 provides the parameter estimates of this new model and their significance. Region of residence remains a highly statistically significant term even after controlling for education of woman, her husband education and occupation. The magnitude exception is rural West where the lowest proportion of educated women were found. This suggests a positive gross effect for this region implying higher of gross effects of the seven regions follow the same order as the levels of women's education in those regions which explains partly the reductions observed in the net effects after controlling for individual resources. The only mortality than rural South (the reference region). Instead this region has a negative gross effect that increases in magnitude after controlling for individual resources, emphasizing the conclusions from the aggregate level of analysis that parents in this region seem to cope well with their environment (beating the odds with better utilization)

Table 5.7. Parameter estimates and associated standard errors the model including both individual resources and region of residence

Individual resources & Region	Gross effect	Net effect	S.E. of Net effect
(1)	-	2.1400	0.1533
Education of woman primary +	-0.5765 **	-0.2388 *	0.0858
Education of husband, prep +	-0.4418 **	-0.1903 *	0.0839
Occupation of husband (service, skilled)	-0.7452 **	-0.5434 **	0.1501
Occupation of husband (prof /clerical / sales)	-0.9278 **	-0.4841 **	0.1535
Rural west	-0.2928 *	-0.3641 *	0.1403
Central	-0.8346 **	-0.6959 **	0.1182
North	-0.5833 **	-0.4598 **	0.1392
East	-1.1250 **	-1.0010 **	0.1255
Urban south	-0.5822 **	-0.5192 **	0.1908
Urban west	-0.8787 **	-0.6811 **	0.1199

* : Significant at 0.05 ** : Significant at 0.01

(1) : Estimated ratio in the reference cell, mothers with less than a primary certificate whose husbands have less tha preparatory certificate and are mainly occupied in agriculture in rural south

The East region is far ahead for all other regions with respect to its positive impact on child survival compared to rural South. Next, are the two regions - Central and urban West with identical impact followed by urban South, the North region then rural West. Mortality experience of children in rural South with the least favorable individual resources for parents, is twice as high (114% higher) than the average in the sample. Comparable children in the East region experience only 14% higher mortality than the average. On the other hand, mortality of children of parents with most favorable individual resources in the East region is only one-fifth (22%) the average level in the sample. These results bring out the important role of region of residence even after controlling for social resources.

Table 5.8 Parameter estimates and associated standard errors, the model with the interaction term (education of woman - region of residence)

Region and education of woman	Parameter estimate	Standard error
1	2.150	0.1570
Rural West	-0.3714 *	0.1451
Central	-0.7305 **	0.1316
North	-0.4021 *	0.1526
East	-1.1740 **	0.1391
Urban South	-0.5450 *	0.2081
Urban West	-0.6108 **	0.1358
Education of woman, primary +	-0.4469	0.3304
Education of husband, preparatory +	-0.1865 *	0.0840
Occupation of husband (service, skilled)	-0.5390 **	0.1503
Occupation of husband (clerk/sales/prof)	-0.4736 **	0.1539
Rural West.Edw primary +	0.0532	0.5687
Central.Edw primary +	0.2474	0.3593
North.Edw primary +	-0.1233	0.4093
East.Edw primary +	0.7051	0.3746
Urban South.Edw primary +	0.2457	0.5415
Urban West.Edw primary +	0.0061	0.3584

* : P-vale < 0.05 ** : P-value < 0.01 (1) Estimated ratio in the reference cell, mothers with less than a primary certificate whose husbands have less than a preparatory certificate and are mainly occupied in agricultural in rural South.

At this point, we need to investigate whether the effects of individual resources (especially, education of mother) act independently from the region of residence or otherwise interact to induce distinct impact of these individual resources in every region. Adding the interaction term (education of wife/region of residence) to the additive model does not improve the fit and all parameter estimates associated with this term are not statistically significant (table 5.8).

Turning back to the determinants of child survival, (table 5.9 and 5.10) provide parameter estimates and their significance for the infrastructure variables alone and for the infrastructure variables controlling for region of residence.

Table 5.9 Parameter estimates and associated standard errors of household characteristics

Household characteristics	Gross effect	Net effect	S.E.of net effect
(1)	-	1.6450	0.1628
Cement floor	-0.2580	0.2251	0.1527
Drinking water source			
Piped/bottled	-0.5909**	-0.4342**	0.0925
other source	-0.3155	-0.1793	0.2057
Type of toilet			
Pit	-0.4388*	-0.3785*	0.1740
Flush	-0.8380**	-0.6340 **	0.1610

*: Significant at .05 **:Significant at .01

(1) : Estimated ratio in the reference cell, children in households with earth floor where the main source of drinking water is either well or pond and without toilet facility in the household (open ground).

Table 5.9 gives indications with respect to the role played by infrastructure variables in shaping mortality differentials. The insignificance of floor material is mainly due to obvious insufficient variation in this variable (as revealed by table 5.2). On the contrary, both type of toilet facility and the source of drinking water are significant factors in shaping those differentials.

Child mortality levels in households with the least favorable conditions - earth floor, no toilet facility and well or pond as main source of drinking water - are 65% higher than the average in the sample (compare this with the figure corresponding to the least favorable individual resources 75%). At the other extreme, the level in households with flush toilet using only piped or bottled water for drinking (regardless of floor material) is 43% lower than the average which almost matches the level induced by the combination of most favorable individual resources.

Table 5.10 shows that once the region of residence is controlled the significance of the source of drinking water vanishes and that of the type of toilet facility is reduced. The net effects of the region-term parameters in this model are smaller in magnitude than comparable estimates shown in table 5.7 and have

Table 5.10 Parameter estimates and associated standard errors of household characteristics controlling for region of residence

Household char. & Region	Net effect	Standard error
(1)	1.7280	0.1684
Cement floor	0.2501	0.1526
Drinking water source		
Piped, bottled	-0.1499	0/1139
Other source	0.1021	0.2144
Type of toilet facility		
Pit	-0.3329	0.1745
Flush	-0.4650*	0.1631
Region of residence		
Rural West	-0.2348	0.1355
Central	-0.5780**	0.1239
North	-0.3586*	0.1455
East	-0.9006**	0.1338
Urban South	-0.2501	0.1880
Urban West	-0.6213**	0.1199

* : Significant at .05 ** : Significant at 0 .01

(1) : Estimated ratio in the reference cell, children in households with earth floor where the main source of drinking water is either well or pond and without toilet facility in the household (open ground) in rural South.

less significance. This result pinpoints to the strong association between region of residence on one hand and household infrastructure indicators on the other and suggests that the two terms (region of residence and household infrastructure) should not be included in the same model. The latter are almost totally captured by the first.

Table 5.11 displays parameter estimates from the model combining the two sets of detrmining forces, individual resources and household infrastructure, highlighting the relative importance of each of the two sets controlling for other.

Table 5.11 emphasizes that both sets are important factors in manipulating the chances of child survival and have significant effects after adjusting for the other set. However, net parameter estimates of the education of wife and occupation of husband are larger in magnitude relative to infrastructure estimates.

Table 5.11 Parameter estimates and associated standard errors for the model combining individual and household characteristics

Individual and household characteristics	Parameter estimate	Standard error
(1)	2.1320	0.1759
Source of drinking water		
Piped, bottled	-0.2951**	0.0935
Other source	-0.0060	0.2247
Type of toilet facility		
Pit or Flush	-0.3912*	0.1578
Ed. of woman, primary +	-0.4022**	0.0836
Ed.of husband, prep +	-0.1471	0.0829
Occupation of husband (service, skilled..)	-0.4877**	0.1480
Occupation of husband (professional,clerk,sales)	-0.4891**	0.1511

* : Significant at .05 ** : Significant at .01

(1) : Estimated ratio in the reference cell, children in households without toilet facility and with well or pond as main source of drinking water. Their mothers have less than a primary certificate and their fathers have less than a preparatory certificate and are occupied in the agricultural sector.

5.3 Intervening mechanisms

The previous section has shown that both women's education and household infrastructure exert independent influences on mortality. The purpose of this section is to investigate the intermediate roles through which factors intervene.

The education mechanism may be reflected in reproductive patterns, feeding of children, health care of mother and child. Table 5.12 provides details on some of the intermediate variables by different education levels of mother.

Table 5.12 The relationship between the education of women and some intermediate variables

Intermediate variables	Education level of the woman		
	< Primary	Only prim./+ prep.	Secondary +
age at marriage			
% agemar1 < 15	19.3	11.2	1.1
% agemar1 < 18	62.3	56.2	14.4
% agemar1 < 25	91.6	97.5	93.0
breast-feeding			
% Ever breasfed	86.8	85.3	83.4
duration in months	9.25	8.73	6.02
ante-natal care			
% Having prenatal checks among those currently pregnant	64.2	81.1	93.8
Delivery			
% Having delivery in GHC or PHC	66.8	89.2	95.5
Post-natal care			
% Who had postnatal care by prof. among those with last l.b less than 5 years before the survey	51.1	69.0	76.2
Child care			
% Children 1-6 yrs who completed all Immunization (among those with seen health cards	88.2	88.2	88.8

Table 5.12 indicates that the lower the education the higher the percentage marrying at an earlier age. For example, 14% of women with secondary education or more get married at age less than 18 compared to 62% of women with less than primary education. The percentage of breastfeeding decreases slightly with higher education but the duration of breastfeeding is, on average 3 months shorter for women with secondary plus education as compared to those with lower education. Ante-natal, delivery and post-natal care is markedly better for those with higher education. Child immunization in Saudi Arabia shows impressive figures. It is true that such percentage pertain to women with seen health cards and hence the actual overall levels of immunization may be lower, but the important observation is that the percentage who immunize their children is similar across different levels of education. In fact there are no differences by education of mother with respect to the proportion of health cards seen by the interviewer (51% and 53% for children of women with than primary certificate and those with primary +, respectively) or the proportion reported to her had both injections and drops among those whose health cards were not seen (96.5% and 100%, respectively). This points out to the success of the health system, and may positively relate to universal access and availability to the health facility thereby overcoming the usual constraint seen in the utilization of child care.

Table 5.13 Percentage of children having diarrhoea in the last two weeks preceding survey (among the less than 3) clssified by household infra-structure

Floor material	%Having diarrhoea	Main source of drinking water	% Having diarrhoea	Type of toilet facility	% Having diarrhoea
Cement	10.5	Piped	9.9	Flush	10.4
Earth	18.3	Bottled	9.5	Pit	11.0
Other	3.3	Well	14.1	Open ground	18.7
n.s	7.5	Pond	15.4	Other	5.8
		Other	14.7	n.s	3.9
		n.s	3.3		

Table 5.14. Percentage of Children having diarrhoea in the last two weeks preceding survey (among the less than 3) classified by household infrastructure and education of mother

Household infrastructure	< Primary	Prim/preparatory	Secondary +
Floor material			
Cement	10.4	11.5	7.0
Earth	17.7	23.9	*
Source of drinking water			
Piped or bottled	9.8	9.9	7.6
Well or pond	14.1	17.1	*
Type of toilet facility			
Flush or pit	10.3	11.1	7.6
Open ground	17.5	*	*

* number of cases < 10

Table 5.13 provides information prevalence of diarrhea and its association with household infrastructure. Table 5.14 provides similar information by educational status of the mother.

Table 5.13 illustrates the environmental pollution mechanism (reflected in higher percentage having diarrhea) played by the infrastructure. Table 5.16 supports that the inference from Table 5.15 is not biased by the association between the level of infrastructure and the educational level. For each education level, the prevalence of diarrhea significantly increases with the less favorable infrastructure.

Table 5.14 shows the unexpected result that the higher the education the more prevalent the diarrhea. This result is particularly noted in the lowest level of infrastructure.

Table 5.15 through 5.17 provide aggregate information on ante-natal, delivery and post-natal care classified by region and educational level. Given equal availability, accessibility and affordability to health services in all the regions and education kept as a constant, these tables show regional norms governing utilization of maternal health acre. It is clear that the performance of women within

each level of education status is not the same in all regions but rather exhibit wide variations. These results indicate the regional differentials in child mortality. Education plays a distinct role in shaping practices, but also area features may play an additional influencing role.

Table 5.15 Percentage who had antenatal check by a professional among those with last live birth less than 5 years classified by region of residence and educational level

Region	Less than primary	Primary +/ prep.	Secondary or >
Central	74.3	68.7	93.6
North	49.9	68.7	74.8
Urban South	53.7	80.0	80.0 (7)
Rural South	47.3	66.7	85.0 (9)
South	48.5	71.8	82.7
East	75.7	92.1	91.1
Urban West	74.6	90.1	95.2
Rural West	40.7	72.7	87.5
West	59.3	88.6	95.1

Table 5.16 Percentage who had delivery in a health establishment among those with last live birth less tha 5 years classified by region of residence and educational level

Region	Less than primary	Primary +/prep.	Secondary & >
Central	82.9	93.4	96.2
North	78.0	87.3	91.6
Urban South	53.7	65.0	40.0 (8)
Rural South	43.0	63.0	80.0 (10)
South	45.0	63.7	61.8
East	89.1	96.4	100.0
Urban West	72.0	90.6	96.2
Rural West	36.1	67.3	75.0
West	55.8	88.7	95.7

Table 5.17 Percentage who had post-natal check by a professional among those with last live birth less than 5 years classified by region of residence and educational level

Region	< Primary	Primary/+ prep	Secondary & >
Central	52.2	63.1	75.6
North	57.9	70.1	91.6
Urban South	37.0	30.0 (10)	60.0 (5)
Rural South	38.8	48.1	40.0 (4)
South	38.5	41.2	49.1
East	65.6	74.8	69.8
Urban West	64.2	81.8	80.0
Rural West	33.3	45.5	75.0 (3)
West	50.3	78.7	79.9

Table 5.18 Percentage of children 1-6 years old who completed all immunizations among those with seen health card by education of mother and region of residence

Region	< Primary	Primary/prep	Secondary & >
Central	96.4	94.3	97.2
North	95.6	100.0	100.0
Rural South	92.9	100.0	*
Urban South	98.1	95.1	*
South	93.5	96.2	*
East	96.6	96.4	100.0
Urban West	98.6	97.9	100.0
Rural West	94.0	96.8	*
West	96.5	97.8	99.6

* number of cases less than 10

Table 5.18 provides aggregate information on child care practice classified by region and educational status. Child care practice is an example of a favourable setting effect that overcame the constraints of low educational status.

Chapter 6

DISCUSSION

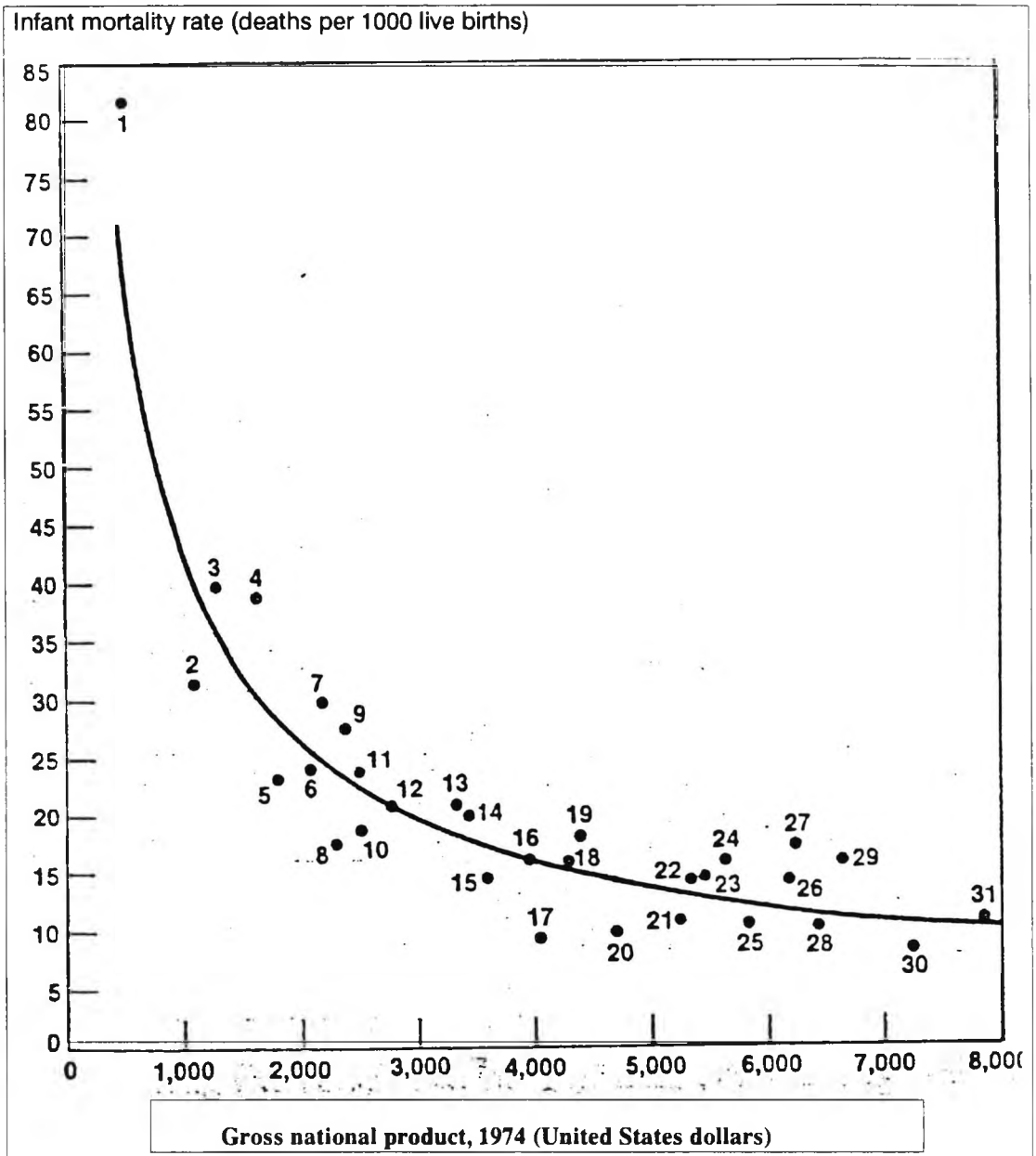
The discussion presented in this chapter will be based mainly on the results of the study with supporting evidence from published literature and published government reports. Personal experience and observations will also influence the discussion in situations where it is needed. The chapter is divided into three parts, the first deals with levels and trends of IMR and CMR and includes those of the ten most developed and the ten least developed countries and concludes with those of Saudi Arabia. The second part of the discussion deals with the multivariate analysis of the variables affecting the IMR and CMR which is preceded by discussion of the aggregate levels of such variables. The discussion of reproductive behaviour and other factors will also be highlighted in this section. The third part deals with the intervening mechanisms through which the factors that influence the levels of IMR and CMR in Saudi Arabia operate.

6.1 Levels and trends of IMR and CMR

6.1.1 Characteristics and importance of IMR and CMR

The review of the literature, presented in chapter 2, has shown that the IMR and CMR vary widely between the less developed (LDCs) and the industrially developed countries (DCs). The universal human concerns are avoidance of premature deaths and lengthening of life and many would like to think that the easiest route to the access of these concerns is socio-economic development. Examples against this notion are Japan and Sweden in the developed world, who are not on the peak of the economic pyramid and still have the lowest IMR and CMR in the world. In the developing world, Costa Rica and Sri Lanka are two examples of countries having low IMR and CMR in spite of having very low economic development compared to many other countries with higher level of economic development, but also with higher IMR and CMR.

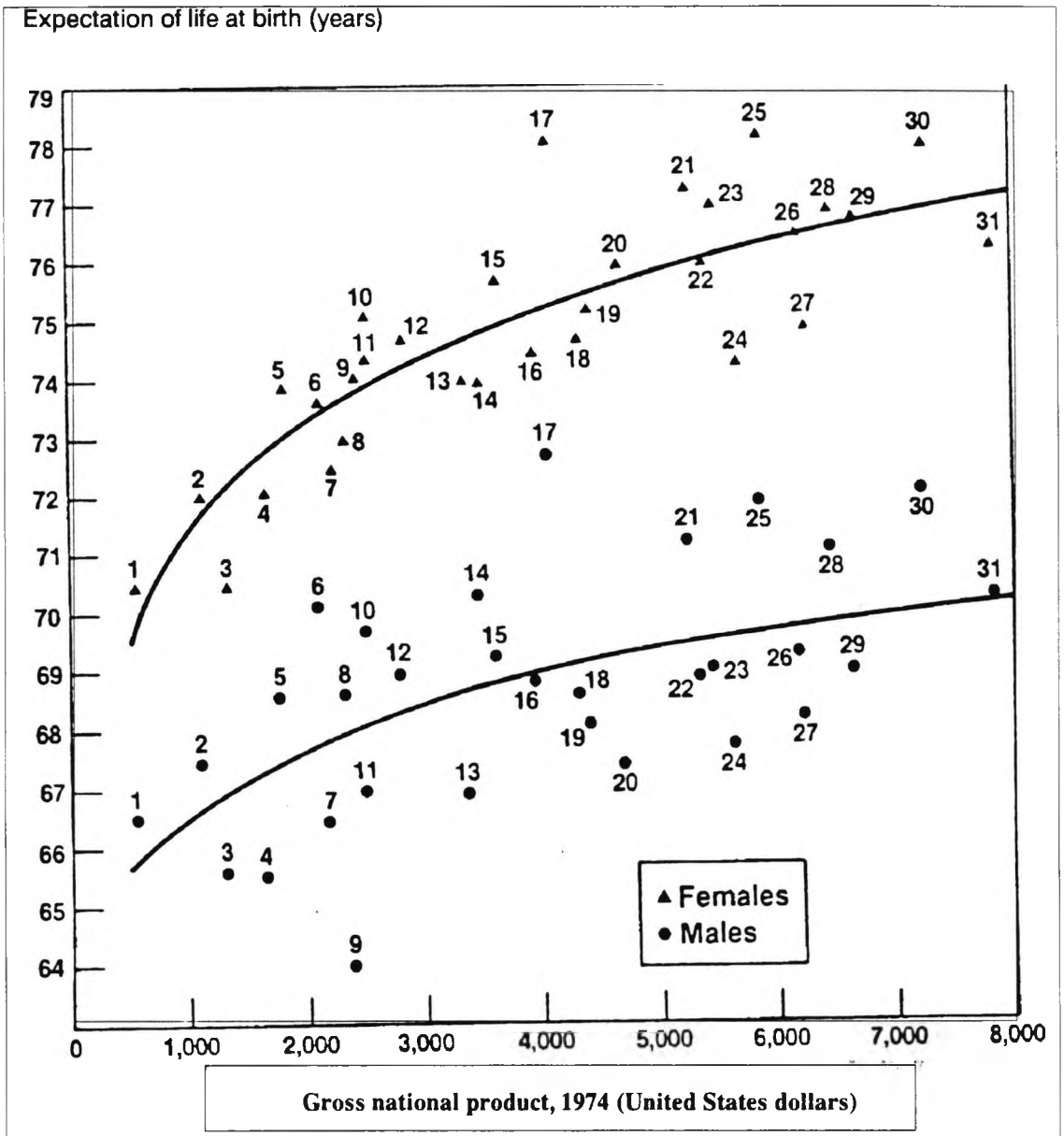
Figure 6.1 Relation between infant mortality rate (mid 1970s) and *per capita* GNP (1974), more developed countries



Sources: Infant mortality rates from United Nations, *Demographic Yearbook,* various issues, gross national product from *World Bank Atlas; Population*, Per Capita *Product, and Growth Rates* (Washington, D.C., World Bank, 1976) p.5

Countries: 1. Albania; 2. Romania; 3. Yugoslavia; 4. Portugal; 5. Bulgaria; 6. Greece; 7. Hungary; 8. Ireland; 9. USSR; 10. Spain; 11. Poland; 12. Italy; 13. Czechoslovakia; 14. Israel; 15. United Kingdom; 16. German Democratic Republic; 17. Japan; 18. New Zealand; 19. Austria; 20. Finland; 21. Netherlan; 22. Australia; 23. France; 24. Belgium; 25. Norway; 26. Canada; 27. Federal Republic of Germany; 28. Denmark; 29. United States; 30. Sweden; 31. Switzerland.

Figure 6.2 Relations between expectation of life at birth (early to mid 1970s) and *per capita* GNP (1974), more developed countries



Source: Expectation of life at birth from table IIA.1; UN, 1982, p.40, 65., gross national product from *World Bank Atlas*; *Population,* Per Capita *Product, and Growth Rates* (Washington, D.C, World Bank, 1976), p.5.

Countries: 1. Albania; 2. Romania; 3. Yugoslavia; 4. Portugal; 5. Bulgaria; 6. Greece; 7. Hungary; 8. Ireland; 9. USSR; 10. Spain; 11. Poland; 12. Italy; 13. Czechoslovakia; 14. Israel; 15. United Kingdom; 16. German Democratic Republic; 17. Japan; 18. New Zealand; 19. Austria; 20. Finland; 21. Netherlan; 22. Australia; 23. France; 24. Belgium; 25. Norway; 26. Canada; 27. Federal Republic of Germany; 28. Denmark; 29. United States; 30. Sweden; 31. Switzerland.

The general rule is that the nations having lower IMR and CMR, have longer life expectancy. It is further true that in most developed countries, the IMR and CMR are often lower in females than males. The life expectancy in those countries is also significantly longer among females than among males. Two figures are reproduced below supporting the above statements (UN, 1982, pp.39-40).

Figure 6.1 shows the levels of child mortality and their relations with life expectancy at birth. Figure 6.2 shows differences in life expectancy between males and females for developed countries. These figures are self-explanatory and need no further comments.

Keeping in mind the study's objectives, we would like firstly to assess and compare the levels of IMR and CMR in the ten most economically developed countries of the world and in the ten least developed countries of the world. Secondly, we would like to assess the levels and determinants of IMR and CMR in Saudi Arabia.

Table 6.1 Infant mortality rates and child mortality rates in ten most developed countries

Country	Life expectancy at birth 1989	GNP US $ 1988	IMR		CMR		% Recent decline in CMR
			1960	1990	1960	1990	
Japan	79	21020	31	5	39	6	6.1
Sweden	77	19300	16	6	20	7	2.5
Finland	75	18590	22	6	28	7	2.5
Canada	77	16960	28	7	33	9	3.7
Switzerland	77	27500	22	7	26	9	2.9
France	76	16090	29	8	34	9	2.9
U.K	76	12810	23	8	27	9	5.1
U.S.A	76	19840	26	9	29	11	3.1
Australia	76	12340	21	8	24	10	2.6
Norway	77	19990	19	8	22	10	0.0
Average	76.6	18444	23.7	7.2	28.2	8.7	3.14

Table 6.1 shows the IMR and CMR levels and trends during the last 30 years. Though Japan is not on the top of GNP list, it has the highest life expectancy at birth, the lowest IMR and CMR and the highest percentage of recent decline in CMR. Sweden also closely followed Japan. The average annual fall of IMR and CMR, during the last 30 years in these countries were 7.64% in IMR and 7.47% in CMR. The average decline in CMR during the most recent years was however smaller, 3.14%, mainly because most of these countries had attained low levels of IMR and CMR before 1960. Their average estimates of IMR and CMR were 7.2 and 8.7 in 1990, as compared with 23.7 and 28.2 in 1960, respectively.

Table 6.2 shows values of the IMR and CMR of the ten least developed countries of the world. Although these countries had on average very high IMR (181.3) and CMR (295.7) 30 years ago, they have not made much progress in lowering their IMR and CMR during the recent past. Their current averages are 127 and 206.5 for IMR and CMR, respectively. The annual reduction during the last 30 years was 1.43% in IMR and 1.44% in CMR. Although the life expectancy

Table 6.2 IMR and CMR in ten least developed countries

Country	Life expectancy at birth 1989	GNP US $ 1988	IMR		CMR		% Recent decline in CMR
			1960	1990	1960	1990	
Mozambique	47	100	190	173	331	297	-1.0
Afghanistan	42	280	215	167	381	292	0.9
Sierra Leone	42	240	219	149	257	219	1.5
Ethiopia	45	120	175	130	294	220	1.7
Burundi	48	240	153	115	260	192	1.6
Bangladesh	51	170	156	114	262	180	1.6
Nigeria	51	290	190	101	316	167	1.7
Pakistan	57	350	163	104	276	158	2.0
India	59	340	165	94	282	142	2.4
Nepal	52	180	187	123	298	189	1.6
Average	49.4	231	181.3	127	295.7	265	1.4

Source: UNICEF report 1991 and 1992

at birth in the least developed countries is nearly 65% of that of the developed countries, these countries are not apparently making any headway to achieve low levels of IMR and CMR. Though GNP is not the only factor, it may be an important hindrance for them to invest money for improvement of IMR and CMR. It is worth mentioning that the average GNP of the people of least developed countries is only 1.25% of that of the people of developed countries. Possibly they are concerned more with other things than the investment in the reduction of IMR and CMR.

As an introduction to Table 6.3, a few points need to be mentioned about the Kingdom of Saudi Arabia. The current expectancy of life at birth of Saudi Arabian people is 68.5 years, which is 89.4% of the average figure for the ten top developed nations and 39% higher than the figure for the least developed countries. The GNP per capita (1988) in Saudi Arabia, according to UNICEF, was US$ 6,200, and this was one-third (33.6%) of the average of the top ten developed countries, but certainly equal or more than many other European countries (e.g. Poland, Hungary, Greece, Portugal, Bulgaria, Czechoslovakia).

The Saudi economic development started in full in the early 1970s. Nevertheless, some IMR figures or estimates are available for 1960, 1970 and 1973. It appears that these were better than the least developed countries. In other studies, it was shown that it declined from 170 in 1960 to 157 in 1970, to 97, 110 (two findings) in 1978, to 84.4 in 1982 and to 56.7, 69 (two findings) in 1984. The latest estimates show that the overall IMR was 52 in 1985. Therefore, the total decline in IMR between 1960 and 1985 has been in the order of 118, or 2.8% annually. As for CMR, although there is no previous record, this study shows that a similar decline has been achieved. The CMR has declined from 155 in 1973 to 63 in 1985, an annual decline of 4.9%.

The recent annual decline of the Saudi CMR is 5.2% which is more than the average annual decline (3.24) in the ten most developed countries (UNICEF, 1992, p.88).

Table 6.3 Available information on trends and levels of IMR and CMR in Saudi Arabia

Reported by	Year	IMR	CMR	Remarks
UNICEF 1992	1960	170	292	Report
Abu Osba et al	1970	157		Limited study
Ali Rashid et al	1978	97-110		Multiple surveys
Hammam et al	1980	40		Small study
Ministry of Finance KSA	1982	84.4		Multipurpose survey
Al-Sebai	1983	134		Small study
Ministry of Finance	1984	69		Multipurpose survey
An Analyst	1985	106.5		Special report
Obeidy Ibrahim	1985	- (26%)*		Study in Riyadh
Nur Osman	1973	92.5		Limited study
Nur Osman	1984	56.7		Limited study
Analyst	1986	100		Report
Serenius & Hofvander	1988	65-120		Sample survey & estimate
NCHS	1973	105	155	Survey reports
NCHS	1975	93	131	
NCHS	1980	66	86	
NCHS	1985	52	63	
Al-Mazrou et al	1976	81	113	
Al-Mazrou et al	1979	70	93	
Al-Mazrou et al	1982	57	71	
Al-Mazrou et al	1984	46	55	
Al-Mazrou et al	1987	38	43	
Al-Mazrou et al	1989	30	34	
UNICEF, 1991	1990	65	91	Report

* Lowewr than UN

The recently estimated IMR for 1989 has been shown to be 30. The higher UN estimates for 1990 are based on past experience, and also probably on the basis of other developing nations experience. Their estimates probably did not consider the pace of economic and health development in the country as compared with that in other developing nations.

Table 6.4 The IMR and CMR trends of Saudi Arabia as established by the present study

	1985	1980	1975	1973
IMR/lq0	52	66	93	105
CMR/4q1	12	21	40	52
CMR/5q0	63	86	131	155

These figures, although higher than the average of the top ten developed countries, are not much different from the 1989 status of Jordan, Colombia, Mexico, China and Thailand (UNICEF, 1991, p. 103). The current IMR and CMR of the most rapidly developing countries such as Korea are 24 and 31, Costa Rica 18 and 24, Sri Lanka 27 and 36 and Malaysia 23 and 30, where they initiated health intervention programs much earlier than Saudi Arabia.

6.2 Factors affecting IMR and CMR levels

In this section, we will highlight and discuss the findings of the bivariate and multivariate level analysis of the determinants of infant and child mortality in Saudi Arabia and refer to findings obtained elsewhere.

The apparent or marginal efficacy of the results of the bivariate analysis may be eliminated by multivariate analysis. Whatever significant results may persist after screening will be dealt with in our conclusions and recommendations based on the net effect of multivariate analysis.

We have indicated in the review chapter that three main categories of variables are used in the analysis. These are:

1. Social resources:
   - (a) Education of mother
   - (b) Education of father
   - (c) Occupation of father

2. Household infrastructure:

- (a) Floor material
- (b) Source of drinking water
- (c) Type of toilet facility

3. Area characteristics:

- (a) Region of residence
- (b) Type of place of residence (urban/rural).

6.2.1 Social resources

6.2.1.1 Parent's education

The aggregate indicators of the levels of IMR shown in Table 5.2, shows that about one-fourth of the ever-married women under age 50 of the country have at least primary education certificates. The percentage will be certainly higher if the unmarried young women are included, especially when we know that there are 53,000 girls studying in various universities in the country in 1990, compared with only 434 in 1970, and that there are 1,300,000 girls enrolled in schools (below universities) in 1990. However, the percentage of ever-married women with primary education is lowest in the rural west (5.4%) and rural south (8.4%) and highest in the urban west (34.8%). In the rural south and rural west, the IMR are also highest, while in the urban west, the IMR is lowest. This indicates that mother's education has a definite impact on IMR and CMR in Saudi Arabia.

We further observe from the figures in Table 5.2, that the proportion of husbands with at least preparatory education is also about 24.5%. If husbands with primary education and the unmarried young men are included, then their percentage will also be much higher. There were 6,508 male students in Saudi universities in 1970 and this number increased to 69,100 in 1990. There were 401,000 male students in schools in 1970, which increased to 1,500,000 in 1990 (Ministry of Planning, 1990). The lowest percent of husbands with preparatory education are again in the rural west (10.7) and rural south (17.4). The highest rate of educated husbands is in the urban west. The percentage of white collar jobs of husbands are lowest in rural west (15.1) and rural south (25.4), compared

to other regions. All these suggest that the IMR is greatly affected by parents' education and father's occupation. Table 5.4, which is restricted to women married less than 15 years ago and having at least one child, shows that the percentage of mothers with primary or more education and father with preparatory education has increased by 13.8% (due to omission of older parents). The lowest education and highest IMR are still in the same zones. This point will be further considered at a later stage.

A. Mother's education

Many researchers have investigated the pattern, efficacy and mechanisms of action of maternal education in shaping the infant and child mortality. No such study, representative of the whole country, has been conducted in Saudi Arabia before the present study. The results obtained have been described in the results section (Chapter 5). We would now discuss the pros and cons of the results obtained and compare them with other research findings done overseas and in adjacent countries.

The multivariate level analysis shown in Tables 5.6, 5.7 and 5.11 show that mother's education is associated with child survival. The results remain significant ($p < 0.01$) even when other variables are controlled. Our results are based on solid analysis and proves that mother's education has significant effect on lowering IMR in Saudi Arabia. The results show that improvement in mother's education can reduce IMR by 12 points without changing husband's education or occupation. The magnitude of the effect is larger than what has been observed in other countries. We have confirmed thereby, many research results done both by individuals and international agencies. It may be mentioned here, that within the last two decades, the spectrum of female education in Saudi Arabia has been completely changed. The achievements in this field have already been cited. The minimum maternal literacy level, we have considered, is the primary level of education. The years of study required for completion of primary level of education varies between countries from five to nine (Bicego & Boerma, 1991). In Saudi Arabia, it is six years.

The relationship between maternal education and child survival has not always been in the expected direction. For example, Ahmed et al (1991) did not find a direct effect of mother's education on IMR in Liberia. Instead, he found complex relationships between maternal education, maternal age, breast-feeding and child survival. Eid and Casterline (1988) found weak association between parental education and child survival in Egypt. The relationship derived by Bhuiya et al (1989) in Bangladesh was not significant, while Lindenbaum (1985) and Jayachandran (1985) found it significant in the same country. Casterline et al (1989) found very weak effect of maternal schooling on IMR in Egypt. Bicego and Boerma (1991) reported that uneducated mother's were at lowest risk of neonatal deaths. This is an unusual finding. This result may not held true in most developing countries. It is also not the case in Saudi Arabia where educated mothers have almost half the rate of infant mortality compared to uneducated mothers.

Mechanisms of action of mother's education

Mother's educational qualification per se does not prevent children from childhood mortality. Education modifies the knowledge, attitude and practice of mothers in favour of better child care and better understanding of child health. Many studies have been conducted to specify the exact channel of action of mother's education. Although the findings were not uniform, ultimately, all findings directly or indirectly indicated the change of knowledge, attitude, practice and beliefs. Caldwell (1979) observed that maternal education undermines the harmful traditional practices of child care. The alteration of the sexual and general balance of power may result in a re-allocation of resources from the old to the young. Jain (1985) stated that women's literacy influenced infant mortality through (a) better medical care at birth, (b) better preventive care, and (c) better medical care during post neonatal period. Pebley and Stupp (1985) suggested that in addition to the usual influence, higher education of mothers enabled them to compensate for (a) the negative effects of short birth interval and (b) extreme maternal age. Choe (1985) thought that in situations where female children are not preferred and their mortality is high, educated mothers could influence their survival. An elaborated and detailed study was

conducted by John Lindenbaum et al (1985) in Bangladesh. He observed that education is not the same as literacy. People follow Western therapy without dislodging their own theories of disease causation. The maternal education as a determinant of child survival should traverse both social and biological domains. Education (a) raises the women's age at marriage, (b) protects her from the risk of teenage pregnancy and high IMR. He further postulated that (c) schooling safeguards young women from performing laborious works during their growth. Education is also (d) an upward mobility for women who tend to marry economically secure husbands. Their marriages (e) stabilizes their nutritional status. In addition, they (f) adopt hygienic practices of daily cleaning and washing. On the whole (g), the lives of educated women differ from those of uneducated women, which offer better chances of survival of their infants and children. A few of his observations are supported by our results. Table 5.12 shows that mothers with primary education are 10.2 times more likely to be married at an age less than 15 years than secondary educated ones. However, for improving the status of IMR and CMR, Serenius and Hofvander (1988), in a review article recommended extensive maternal education for Saudi women. These are some of the mechanisms suggested by different researchers. We have no reason to disagree with them. As for Saudi Arabia, we understand from our experience that, an educated mother influences child survival through a series of mechanisms. These may be summarized as follows:

1. Taking care of infants and children is not absolutely new to any Saudi mother. In fact, she acquires knowledge about child rearing before reaching teenage from her family when she cares for her own younger brothers and sisters. She gradually accumulates and improves her knowledge of child caring from family, relatives and neighbours.

2. Schooling provides her additional understanding about safe foods, personal hygiene, sanitation, water, refuge and excreta disposal, harmful traditions and elementary biology.

3. As she becomes educated and through observing relatives and neighbouring families, she acquires knowledge about conception, reproduction, prenatal, natal and postnatal care, child care, physician consultation, utilization of health care facilities, immunization and so on.

4. Frequent publicity through newspapers, magazines, radio and television provides her with information about maternal and child health. She becomes more inquisitive, reads books, participates in discussions with her female relatives, grandmothers and female friends about the topics of reproduction, infant and child care. All these inputs shape her attitude towards marriage, reproduction and child care.

5. Due to schooling years her marriage is delayed and she gets more mature. Motherhood is also delayed beyond the age of 20 which works in favour of herself and her children.

6. She usually marries a financially secure husband.

7. The harmful traditional practices are not entertained by her in the family. This has been observed in the UN study (1985, p. 27). She establishes her authority on matters relating to the family, specially in caring for the health of her children.

8. The value of immunization against infectious diseases is well understood and practiced in her family. She takes more frequent prenatal and postnatal checks and prefers delivery in Health Centre or Government Hospital (Table 5.12). She controls her family size which offers scope for better child care. Our results show that family size of educated mothers is almost half the family size of uneducated mothers.

In a recent study, Cleland and Ginneken (1988) tried to quantify the effect of maternal education. They found that for each year of increment in maternal education, there is a reduction of 7-9% of under five mortality. They concluded that half of this is due to mother's education and the other half is due to the

associated economic gains such as: income, water, latrine, housing, etc. They also found that only 1-3 years of schooling of mothers is associated with 20% reduction in IMR and CMR. Cochrane (1980) suggested that maternal education is closely related with child health, whether measured by nutritional status or infant child mortality. She also suggested that an additional year of schooling of mother reduces 9 deaths per 1,000 births. She further suggested that educated women marry educated men. This is, however, an economic advantage. She decomposed the reduction in IMR into three parts: one-third or 3 per 1,000 was due to mother's education, one-third was due to husband's education and one-third to economic gains. Farah and Preston (1982) suggested that mothers with no education have more than twice the under five deaths of their children compared to mothers with seven or more years of schooling. They found that each additional year of schooling of mother is associated with proportionate reduction of 0.036. In other words, five or 10 years of additional schooling of mothers is expected to reduce the CMR by 18% or 36%, respectively. We have also quantified the benefit of mother's education. Mother's education up to primary or more education (Table 5.6) reduces IMR by 18 points after controlling for husband's education and occupation, irrespective of region of residence. This becomes 12 points when region of residence is accounted for (Table 5.7). Based on the mortality levels shown in table 4.1.6 it can be said that, for each year of schooling the IMR is reduced by at least 4.5% and the CMR by at least 6.66%. These figures are well comparable with figures quoted earlier by Cleland and Ginneken.

B. Father's Education

Father's education is like a banner of the status of a family. Other than social and political roles, father's education plays an important role in shaping the IMR and CMR of his own children. Many researchers have worked to specify the pattern, effectiveness and channel of operation of father's education in reduction of childhood mortality. No such work has been done in Saudi Arabia before this study. The results obtained from this study have been described in Chapter 5. We would again highlight and discuss our results and compare them with those obtained in other countries.

It may be stated here that we have considered father's education on the basis of preparatory education or over. Preparatory level takes at least nine years of schooling. Results show that one fourth (24.5%) of all husbands have preparatory level of education. This suggests that at least one fourth of all families enjoy the benefit of father's education in shaping the IMR and CMR in this country. We would examine how this benefit is reflected in our results.

Table 5.6 which gives the results of multivariate analysis of social resources, shows that father's education is a significant factor in reducing child mortality. Both gross effect and net effect remain significant at $p < 0.01$ and $p < 0.05$ levels, respectively. It signifies that the IMR among children whose fathers have at least preparatory or higher level of education is significantly lower than that among children whose fathers have less than preparatory education. It also signifies that, by improving the level of education of fathers to preparatory level or over, the IMR can be significantly reduced in Saudi Arabia. Table 5.7 also shows similar type of results analyzed in a different model. This also shows that, the effect of father's education remains significant both in gross and net effect at $p < 0.01$ and $p < 0.05$ levels. Table 5.11 shows the parameter estimates combining two sets of variables. It highlights the relative importance of each set. It signifies that the effect of education of wife is larger than the education of husband. Our results are thus confirmative to many studies. Furthermore, the results are identical with those of O'Toole (1991) who found larger effect of maternal education than father's education. We now specify some other works done overseas where they found identical results of the effect of father's education.

Our results agree with the findings of the following investigators; Hamed (1988) suggested that raising the level of father's education will improve child survival in general. In Greece, father's education was found to be a significant determinant of child survival by Tzoumaka et al (1989). Tawiah (1989) also agreed with them. Hull et al (1986), Trussell & Hamerslough (1983),Kenneth Hill (1991), Trussell & Preston (1982), and Victora et al (1986) found identical effect of father's education. This was also shown by the UN 1985-study in 15 developing countries. However, Trussell and Hammeslough (1983) showed that

father's education had a higher impact on IMR and CMR. This is in sharp contrast with Cochrane (1980) and our results. The UN study (1985, p. 61) however, showed that father's education reduced IMR by 5%. Estimates from our results also show that father's education reduces IMR by 10 points. Thus our results are quite in agreement with previous studies done overseas. We expect that, within the coming decades, the majority of husbands will be educated and the IMR will come down further. We see from our results that when both parents are educated, the IMR is reduced by 22 points. We thus obtained significant effect of both parents' education.

However, a few investigators did not find father's education as a significant factor, e.g. Adlakha and Suchindran (1985).

Mechanisms of action of father's education

Many investigators have attempted to specify the mode of action, but very few have come up with conclusive evidence. The ultimate effects of father's education are to earn adequate money sufficient for supporting the family and for social prestige. Casterline et al (1989) observed that income has little effect on IMR, but is inversely related to mortality in early childhood. This relationship persisted on controlling for other variables. The mechanism was not clear. Some effects of income, they suggested, were exerted through household drinking water, toilet facilities and maternal demographic factors. They stated that the said items also do not explain the net effect of income on child mortality. The UN (1985, p. 62) studies stated that father's education was more effective in urban situation, while mother's education was more effective in rural situation, but the causes have not been identified. Their study suggested that good occupation of father ensures quality of food for the children, higher consumption standard among children, adequate household technology for cleaning, preparing, storing and disposing of food, quality of housing and medical care. On the other hand, prolonged absence of the father may interfere with the quality of medical care for children. Low grade occupation may compel him to stay in unhygienic areas and areas having toxic air. These factors affect child survival.

As for Saudi Arabia, from experience, we would like to suggest that father's education operates through various mechanisms, partly like mother's education. (1) An educated father in Saudi Arabia changes his knowledge, attitude and practice towards the welfare of his children. (2) Usually he marries an educated woman who is able to take better care of the children. (3) An educated wife of an educated husband will have lesser risk of infant mortality. (4) Since there is no unemployment problem in Saudi Arabia for an educated Saudi citizen, after marriage he lives in good housing conditions. (5) In addition, he provides appropriate food, medicine, clothing and cleaning agents to his family. These influence child survival positively. (6) As in the case of mothers, he acquires health information during study and subsequently, by hearing, observing and reading.

For the above reasons, our results show significant effectiveness of father's education in preventing infant and child mortality. Our results are in conformity with a large number of studies done in developing countries both by individuals and UN agencies.

6.2.1.2 Father's occupation

Husband's occupation is a prime determinant of most of the family activities including economic, social, medical and educational spheres. Husband's occupation depends in most cases on the level of his education. We observe in Table 5.2, that on average, one-fourth (24.5%) of all husbands have education at least up to preparatory level or more. The proportion of husbands having this level of education varies from 10.7% to 37.5% between regions. Table 5.4, which includes only younger wives with young and middle aged husbands only, shows that the average rate of educated husbands has increased from 24.5% to 38.3% (due to exclusion of older husbands).

On the whole, one-third (33.6%) of all husbands, young and old, are employed in white collar jobs, although this proportion varied between regions from 15.1% to 40.1%. The proportion of white collar jobs in rural areas is lowest. This is not unusual for the fact that, after completing their education, rural youths migrate to cities where they are employed.

Father's occupation was found to be a significant factor affecting child survival by many researchers. A few of them are, Tawaih (1989) in Ghana, UN (1985) in many countries, Robinson et al (1987) in England and Aksit and Aksit (1989) in Turkey. Our findings are thus in conformity with the above works. We expect that with gradual improvement of father's occupational status, the IMR will be further reduced in the Kingdom of Saudi Arabia.

Father's occupation exerts good effect on child survival. But if he is occupied in farming or not at all, it may do the reverse. Our results show strong association between father's occupation and child survival. Tables 5.6 and 5.7 show that, at multivariate level, the effects of father's occupation remain significant at $p < 0.01$ level, both in gross effect and in net effect. This effect of occupation remains in leading position compared to other social resources. The effect is almost twice the magnitude of the education of either of the parents. This is in full agreement with other researchers who have observed significant effect of father's occupation in shaping IMR and CMR. Some examples are as follows: Tawiah's (1989) work in Ghana has proved that husband's occupation had the second strongest effect on child survival after parent's education. He also found that mother's occupation was in third place in the line. But Adlakha and Suchindran (1985) could not find significant effect of father's occupation in Jordan, Yemen, Egypt and Tunisia. However, Victora et al (1986) found in Brazil that, the low employment status of the family heads and low income were associated with high child mortality. Belma Aksit (1989) also observed in Turkey that, father's occupation was crucial for child survival. Not only just occupation, but also underemployment of the family heads had association with high IMR and CMR. This was confirmed by Robinson and Pinch (1987) in England. Brennan and Lancashire back in 1978, found significant association between unemployment of family heads and high IMR and CMR in England and Wales. A recent UN study on Jordan (1991, p. 105-6), showed that IMR among children of fathers occupied in good jobs was lower as compared to IMR among children of fathers' occupied in agricultural jobs or in no job at all. Another recent UN study on Thailand (1991, p. 125-7), also established the same trends. UN studies (1985, p 129-30) done earlier on 15 developing countries also found higher rates of infant and child mortality among children of fathers occupied in agricultural jobs.

Thus, our study agrees with the results obtained by the stated researchers and by the UN. We have conclusively demonstrated very high effect of good occupations of fathers in reducing the IMR and CMR in Saudi Arabia. The total reduction in IMR due to white collar occupations of fathers is 24 points. We have observed in the previous tables that 33.6% of all old and young husbands were occupied in good jobs, while 24.5% of the fathers were literate. With the rapid increase in the rate of education and good opportunities for Saudis, the IMR and CMR will decline sharply in the coming years.

Mechanism of action of father's occupation

The mode of operation of husband's occupation has not been specified by any investigator. Some suggested, however, that it acts through the economic advantages derived from the good jobs as for the higher educated fathers. Good occupation provides households with good infrastructure, provides good health and medical benefits and consequently provides good nutrition for all members of the family.

However, Suchindran and Adlakha (1985) observed that in many societies the IMR and CMR, under existing levels of social and economic development, including public health and medical facilities, may vary between different social and economic strata. These variations may be reflections of differentials in the sophistication of parents with relation to understanding and practicing modern methods of child care and their access to modern health care facilities.

However, as for Saudi Arabia, from our experience it is observed that, the influence of good occupation of husband or father operates through the same channels as for the effect of high education of father and mother which have been described already.

There has been rapid developments in all fields including economic, medical, social, educational, industrial, and technological. Within a very short span of time, there has been consequent rapid decline in IMR and CMR also. We, therefore, believe that, the rapid fall in IMR and CMR in Saudi Arabia, is largely

due to better occupation of husbands or fathers and education of mothers and fathers.

6.2.2 Housing characteristics

The status of housing conditions in the country is quite satisfactory. Over 91% of the houses have cement floor, 78% of the people use piped or bottled water for drinking and nearly 87% have flush toilets. But these rates vary from region to region. For the highest IMR area of rural south, nearly 80% have cement floor, 42% use piped or bottled water and 60% have flush toilets. Similarly, for the rural west, another region of high IMR, 88% have cement floor, 51% flush toilets and only 18% have access to piped or bottled water. If cement flooring, access to piped or bottled water and flush toilets are indicators of economic progress, then we find that, along with other things, economy also plays a role in shaping the IMR and CMR in the country.

The association between the type of toilet facility, IMR and CMR was proved by Trussell and Hammerslough (1983) in Sri Lanka, while Stern et al (1990) correlate the early introduction of sanitation with the reduction of IMR and CMR.

The effect of water availability through piped water supply on the infant and child mortality was studied by Lindskog et al (1988) in Malawi, where it was shown that child mortality tended to be lower in households using piped water supply than those using traditional water sources. A study by the UN (1985, p. 241) in 15 developing countries suggested that mortality was lowest in houses where running water was available inside the house.

Our results are quite in agreement with many other studies. However, a few investigators did not find consistent efficacy of household infrastructure. These aspects will be further considered in connection with the multivariate analysis of our results.

From tables 5.2 and 5.4 we observe that, households with cemented floor varied from 83% to 98%, houses with flush toilets from 51% to 99% and houses using drinking water from supply pipe or bottles varied from 18% to 95%. These favourable situations are less seen in many developing countries. The availability

of houses and quality of household infrastructure in Saudi Arabia are thus very satisfactory.

In many countries household infrastructures have been shown to play a significant role in health and diseases of the family members, specially of children. For examining the effectiveness of specific variable, as already mentioned, we have separated the household infrastructures into three categories; a) flooring materials, b) sources of drinking water and c) types of toilet facility.

6.2.2.1 Flooring material

Tables 5.2 and 5.4 have shown that with the increase in the percentage of houses having cemented floor, the rates of infant mortality declined and with the decrease in cemented floor, the rates increased. This shows significant association at univariate level. We now consider the effect of household flooring material (cement) as shown by the multivariate analysis. The results presented in Tables 5.9 and 5.10 show that the effectiveness of using cement floor is no more significant when other variables are introduced.

The floor is part of the residential environment, the standard of which is determined by the socio-economic level of the family. In situations where the floor is made up of material other than cement/tiles, as in case of earth or mud, it can not be kept clean and dry. Mud floors in addition to being permeable, tend to break up and cause dust, leading to increased chances of transmission of gastro-intestinal and respiratory diseases. Earth floor can get contaminated by excreta of infants, toddlers, excreta of domestic pets and droppings of rodents, enhancing the chances of faeco-oral transmission of gastro-intestinal diseases (like ascariasis, hydatid disease, rat tape worm, H.Nana, amoebiasis, giardiasis etc). In such low socio-economic situations, the cumulative effect of other prevailing insanitary conditions and unhygeinic practices also contribute in spreading the diseases.

The earth floor, due to variety of human activities and during the process of dry dusting can further contaminate the cooked food, stored water, utensils and linen which would further aid in the transmission of related diseases.

Such a situation, though rare in Saudi Arabia, has its effect on the incidence of diarrhoeal diseases and hence on IMR and CMR as seen by the univariate analysis. The reason, why the effect disappered at multivariate level can not be totally explained without knowing the leading causes of IMR and CMR. However, low diarrhoeal mortality and educated mother's ability to cope with poor environmental situation can partially explain this nil effect.

Many researchers, however, observed significant differences in IMR between users of different qualities of houses. Brennan and Lancashire (1978) found significant association between IMR and CMR and low socio-economic position, high density housing, inadequate housing amenities and unemployment. They found significant association even when the effects of socio-economic status and unemployment were kept constant. Their study supported the hypothesis that much of the differences in mortality between groups in different social circumstances and geographical areas are related to environmental factors. Victora et al (1986) found significant relationship at multivariate level between CMR and well-built houses and place of residence. The significance persisted even after adjusting for other factors. Kim's (1986) analysis revealed the number of rooms used as one of the significant differentials of IMR and CMR. Methods of disposal of household refuse was found to be a significant factor in Onyemunwa's (1988) studies. Low housing services was identified as a factor by Bronfman (1990). Cleland and Ginneken (1988) observed quality of housing as a significant factor for IMR. In a further study, Victora et al (1988) agreed that poorly built houses were significant factors. This was also confirmed by Robinson and Pinch (1987) in their study in England. In Sweden, Ericson et al (1990) found that the only social indicator related with perinatal and post perinatal deaths up to one year, was housing conditions.

Thus, it is found that some researchers considered construction materials and crowding, some considered the flooring materials and some considered the quality of the houses. Thus, housing qualities and standards considered for criteria were different creating problems for exact evaluation and comparison. Similar to our study, the results of a study by the UN (1985, p. 242), were significant at the univariate level, but it did not remain significant when other

covariates were introduced at the multivariate level. In some cases, it was mostly obliterated at multivariate level. Nevertheless, housing materials (e.g. cement floor) had some contribution. Thus, our results agree with the majority of studies, specially with the UN study showing significant effect at univariate level, which disappeared at the multivariate level.

6.2.2.2 Drinking water

Safe drinking water has been found to be a significant determinant of child survival. UNICEF found that the poorest fifth of humanity still lacks clean water and sanitation. The UNICEF's target is to have safe water and sanitation for all families by the year 2000 (UNICEF, 1991, p. 2). The decade of 1980-90 had been earmarked as the decade of water and sanitation.

We found in tables 5.2 and 5.4, which include the aggregate indicators, that the rates of use of safe drinking water (piped or bottled) ranged from 18.4% to 95.5%. On the whole, 78.3% of the people have access to safe drinking water. The use rates in rural area is however low for obvious reasons. These have been described in the results chapter.

We expect that within the past five years after the 1987 survey, piped water supply have been further expanded and a larger number of families are now enjoying the benefit of piped water. So, the UNICEF's target may be achieved before the year 2000 in Saudi Arabia. However, in the aforesaid tables, we further observed that, with the increase of use rate of safe water, the IMR declined, while with the decrease of use, the IMR increased. Thus, the water use pattern shows significant relationship with child survival. Tables 5.9 and 5.11 show the results of multivariate analysis. The results show highly significant relationship between IMR and CMR and the use pattern of safe drinking water. The relationship persisted at $p < 0.01$ levels both in gross effect and in net effect. This suggests that, the use of safe water has contributed significantly to the recent decline of IMR and CMR in Saudi Arabia. Also, further extension of water supply and the consequent use pattern will reduce the IMR in the country further. Additionally, our results have confirmed the results of many investigators. In Malawi, where there are very high rates of infant and child mortality (270/1,000), the efficacy of improved drinking water was examined by Lindskog et al (1988). They observed

that the mortality among children, living in houses having piped water supply, was lower than those using traditional water sources. In Sri Lanka, Waxler et al (1985) observed that minority groups had higher child mortality rate. Searching further the causes, they concluded that, minority group status resulted in poverty which prevented families from having safe water and sanitary facilities which caused high infant death. Victora et al (1986) found association of IMR with availability of piped water and access to toilets. The significance persisted even after allowing for the effects of income and employment. Habicht (1988) and Esery et al (1988) agreed that both water and sanitation were associated with child mortality. Some water wash, water based and water related diseases were predominant in low socio-economic situations (Brennan & Lanchashire, 1978).

The UN (1985, p 241) studies found that though there is significant effect of safe water use on IMR, deviations are not unusual. They found in Sierra Leone, that CMR was higher in houses having taps in the household yards than in houses using water from public taps. In Sudan also, they found higher infant mortality in houses having piped water in the compound than in houses using water from village pipes. In Ghana, they observed lower IMR in children of houses using river or stream water compared to those using well, pump or rain water. These were possibly due to inadequate protection of piped water or contamination at storage or at some other points.

Water can carry eggs or ova of parasites and also protozoa, bacteria, virus, chemicals, etc. which can affect all, specially the children. As we see in our results, incidence of diarrhoea was higher in those who used poor quality water for drinking (Table 5.13).

However, supply of drinking water for all is not an easy undertaking. Based on WHO results, Huttley (1990) commented that as of 1985, 38% of the countries did not have safe water for half of their people.

Nevertheless, UNICEF/WHO have been able to create awareness about the importance of the quality of drinking water which in future may reduce IMR in developing countries. It is therefore, certain that in Saudi Arabia, use of potable

water by a vast majority of the people played a significant role in the rapid decline of IMR and CMR.

6.2.2.3 Toilet facilities

As for safe water, sanitation for all families by the year 2000 is also a goal of UNICEF (1991, p. 2). Improper disposal of human faeces and its access to water was proved to be associated with a huge number of deaths in London, by John Snow, nearly 140 years ago (Snow, 1854). UNICEF (1991, p. 30) considers that an increasing access to water and sanitation, the two vital amenities, will be as good a guide as any to real human progress in the last decade of the twentieth century.

However, it is for the first time that we have attempted to assess the effectiveness of using proper sanitation in reducing the IMR and CMR in Saudi Arabia. Tables 5.2 and 5.4 showed the use pattern of toilets with flush. Although these two tables have been presented in the results section, it is necessary to recapitulate the findings before considering the multivariate results. The rates of use of toilet with flush varied from 51.2% to 100% between regions. This is quite satisfactory compared to 55% in Thailand (UN, 1991, p. 114).

The highest use rates are associated with lowest IMR and lowest use rates with highest IMR. The regional variations are within normal expectations. These differences in IMR between users of flush toilets and non-flush toilets are significant at the univariate level. To be more specific and confident about their efficacy, we have used multivariate analysis. Table 5.9, 5.10 and 5.11 show that the effectiveness of flush toilets remains at $p < 0.1$ and $p < 0.05$ levels when other differentials are controlled. There is some reduction in significance on controlling for other factors. The most likely reasons of such reduction was small number of infant death in the two groups which was due to (1) low rate of diarrhoea (Table 5.13), and high ORS use rate thereby minimising diarrhoeal mortality, (2) dry and hot weather which kills most pathogens before entering the water system or contracting humans, (3) rapid destruction of pathogens present in environmentally excreted stools by hot and dry temperature minimizing environmental pollution, (4) very high coverage by vaccination (Table 5.18), (5) absence of surface sources of water, (6) adequate sewage and

garbage disposal facilities and overall (7) acess and utilization of health service facilities (Tables 5.5; 5.12) thereby availing timely treatment, by poor and rich and by rural and urban populations.

Our results are in confirmation with many works done in developing countries. In many cases these studies considered both the effect of drinking water and toilet facilities together. Trussell and Hammerslough (1983) found significant association between IMR and CMR and types of toilet facility in Sri Lanka. One of the reasons of rapid decline in IMR and CMR in Mexico was early introduction of sanitation (Stern C, 1990). In Nigeria, Onyemunwa (1988) found that types of toilet facility and methods of refuse disposal were associated with IMR and CMR. The Rand Corporation (1988) found that the (<5) children of households without water and sanitation and who did not breast-feed had five times more chances of dying. Puffer and Serrano (1973) observed that higher quality of sanitary facilities and improved water supply are directly and epidemiologically associated with lower child mortality.

All studies were not however conclusive about the efficacy of toilet facilities in shaping IMR and CMR. Conteh et al (1990) found that use of water from river or streams and no access to toilet had elevated risk of child death. On multivariate analysis, the efficacy of water retained, but not the efficacy of toilet. The UN (1985, p 240-3) study results showed efficacy of toilets at univariate level, but it disappeared at multivariate level when other covariates were controlled.

The pattern of water supply and sanitation varies round the world. The conventional sources of drinking water in Saudi Arabia are different. People use either desalinated or bottled water for drinking. Sewage disposal systems also differ from many countries. This country disposes sewage after being treated into the sea or in desert far away from human habitations. The ecology also protects people from environmental contamination. We have already discussed some of the factors which prevent environmental pollution in this country and which have beneficial effects on IMR and CMR. From the results of the WHO study, Huttley (1990) observed that up to 1985, 46% of the countries had sanitary facilities only for 50% of their people. This indicated a great possibility of

environmental contamination with disease agents and thus keeping the IMR and CMR high in countries with poor sanitary facilities. This is not so in Saudi Arabia where 85.6% of people have access to toilet with flush.

In most cases, how these variables work has not been specified. We may suggest that the quality housing prevents survival, growth and spread of pathogens to household materials and to susceptible individuals. Contaminated or inferior quality of water may help survival, growth and dispersal of pathogens to distant places, houses and to children. It may contaminate food, beverages and utensils. Similarly, human excreta from non-flush toilet may contaminate the environment, houses, raw/cooked food, beverage, water sources through air, rain, fomites and by direct or indirect (flies)contact in some cases. The extent of the effect of such poor housing environment is also determined by the hygeinic practices adopted by the members of the household, especially the mother when it relates to child survival chances. These factors thus increase the levels of environmental contamination and exposes the children to greater morbidity and mortality experience.

It is thus proved that, the rapid decline in IMR and CMR in this country was associated, like social resources, significantly with the housing, water and sanitation.

6.2.3 Area characteristics

In this section we will discuss variations in IMR and CMR according to region of residence and type of place of residence. The results have been presented in Tables 5.1 to 5.5 and 5.7 to 5.10.

6.2.3.1 Regional differentials

As in many other countries, there are wide variations in rates between the various regions of Saudi Arabia. The lowest infant and child mortality rates are 44 and 51 in the eastern region and the highest rates of IMR and CMR are 74 and 95 in the southern region (Table 4.1.5). The lowest rates are usually expected from a region which includes the capital city of the country. Since the central region hosting the capital, started development at a later stage, compared to the eastern region, the rates for the central region are higher only

than those shown for the eastern region. The southern region's contacts had been with a lesser developed country (Yemen) and possibly had less exchange of ideas with other regions. In addition to other factors, which will be elaborated later, these might be the two factors responsible for the high IMR and CMR in the southern region.

Chan and Portnoy (1986) found that the maternal and child mortality rates in Mexico was less in areas bordering the USA than the five non-US borders. They found also that the mortality rates in the US-side of the border was higher than the national average. Aksit (1989) found clear regional differences in Turkey. Farah and Preston (1982) also found clear regional differences in Sudan, which they attributed to differences in years of schooling of mothers. Wegmen (1990) identified significant differences in rates between the states of USA. Wilson (1990) concluded that, the differences in rates between states of USA was due to the presence of preventable causes of disease at different rates between states. Thus the regional differences as we have uncovered for Saudi Arabia are not uncommon even in developed countries.

To whatever state of development a country may attain, there will always remain some differences in progress, culture and health parameters prevailing at different regions, especially in a large country. Since IMR and CMR are not independent of culture, progress and health facilities, these will be dependent on stages of development of different regions. Parry (1984) stated that a society's attitudes to health and disease are closely bound up with its culture. The Saudi society gives high priority to child care. The maternal and child care programs have been given top priority in the health, education, social and other fields of development. Antenatal care, well baby clinics and national screening programs for congenital abnormalities in the health sector, in addition to special care centers for physical and social problems, are some examples of the efforts to care for infants and children. However, the culture is rarely static and can usually accommodate new ideas if they do not appear to threaten it. Whatever changes health workers introduce, they should always harmonize their activities with the culture in which they find themselves.

Our results revealed large regional differences according to the aggregate analysis. At the multivariate level, the differences between regions persisted both in cases of gross effects and net effects. These indicate that the differences are real and significant.

These regional differences in IMR and CMR are prevalent both in developing and in developed countries. For example, Penna & Duchinde (1991) examined the effects of concentration of suspended particles in atmosphere and infant mortality from pneumonia by geographic area of Rio de Janeiro. Multiple regression analysis was used to analyze IMR due to pneumonia, diarrhoea and all causes (in 1980), income level and degree of contamination. The average contamination index had a statistically significant co-efficient only in cases of mortality due to pneumonia. Although this suggested a biological association, they were of the opinion that, air quality indicators were essential to consider in studies of acute respiratory infections on regional basis.

Saudi Arabia is a vast country with wide topographic, ecologic and climatic variances. The rural south has the highest IMR and CMR, followed by the rural west. Although an in-depth study has not been done, it can be stated that the rural south is economically, developmentally and educationally less advanced than the eastern and central zones, which have the advantage of industries and of hosting the capital respectively. The south has the high mountains, zigzag and limited roads, some wadis and also the humid and warm coastal zones. Some diseases such as malaria, schistosomiasis and leishmaniasis are still encountered there. The population is dispersed and located at mountainous terrains, which makes it difficult for them to avail schools and health center services located at long distances, often beyond the rough wadis and across the mountains and series of hills.

The western zone is, on the other hand, traversed by the continuous mountainous heights (sarawat) from north to south. In some places of the rural west, this mountain prevents extension of many development programs of the government. As in the south, the people here also may face difficulties in availing the health facilities and schools. These are some of the visible factors which may

raise the IMR and CMR levels there, compared to the remaining regions of the country which are more developed. The results show that the percentage of ever-married women with primary education, the percentage of husbands having preparatory education, the percentage of husbands in good occupations, the percentage of houses with cement floor, flush toilets and piped water, are all lower in the rural south and rural west than in the other regions of the country (Table 5.2). The difficulties in availing the health facilities are also indicated by the less frequent consultation with physicians, less frequent pregnancy checks, less frequent deliveries in health establishments and less frequent post-natal check-ups (Table 5.5). The UN (1985, p 281) study result for Nigeria showed strong relationship between IMR and CMR and accessibility of health facilities. IMR was shown to be 30% greater for those who were living away from the health centers. These factors may be responsible for high IMR in Saudi Arabia.

Most of the regional differences in IMR and CMR shown by other investigators, do not mention the specific causes of these differences. However, we could at least specify differences in education, husband's occupation, infrastructure of households and in health service utilization as most possible causes. Most of these differences remain at significant levels even after multivariate screening.

6.2.3.2 Urban/rural differential

Table 4.1.5 shows that, in 1985, the IMR and CMR in urban areas were 47 and 53, and in rural areas, 68 and 91, respectively. In 1973, the urban IMR and CMR were 101 and 148 and the corresponding rural figures were 111 and 168. This indicates that the present day urban dwellers are enjoying more benefits than the rural dwellers. This is not exceptional for Saudi Arabia. Very high rural CMR has been observed by Lijestrand et al (1984) in Mozambique. To reduce IMR and CMR in rural areas, they recommended overall developments of rural areas. Jain (1985) concluded that for high rural IMR and CMR, non-availability of medical facilities and Triple vaccines were responsible in cases of post-neonatal mortalities.

Urban and rural differences were also observed by Adlakha et al (1985) while examining the WFS data from Jordan, Yemen, Tunis and Egypt. Kibet (1987) in his studies in Kenya, observed strong influence of type of residence on IMR and CMR. Figures relating to Zimbabwe(, 1989) showed that the IMR and CMR in urban areas were almost half the level of the rural areas. This is the first time that the rural/urban differences in IMR and CMR in the Kingdom of Saudi Arabia have been specified. We will discuss further this aspect while considering the results of the multivariate analysis.

Urban/rural residence as a determinant of IMR and CMR was examined by several authors, using mainly multivariate analysis techniques. For example, Eid & Casterline (1988) reported higher IMR in rural Egypt and that one-fourth of rural children died before reaching their fifth birthday.

Rahaman et al (1992) conducted a study to examine the effects and patterns of utilization of a semi-urban diarrhoea clinic by people living far and near. It was found that people living close to the clinic visited it more frequently than the people living away. But the number of deaths from diarrhoea were more among people living away. This indicated that the distant population did not have less diarrhoea, but in fact they could not attend the clinic. The distance, therefore, affects utilization and morbidity and mortality rates. We also observed that the health service utilization rates were higher in urban areas than rural areas.

We observed distinct and significant differences between urban and rural areas (Table 5.7 & 5.8). The significance persisted at $p < 0.01$ level in the multivariate analysis. So, our results are quite in agreement with the experience of other countries. However, in many cosmopolitan cities the urban rates are not as low as expected, as a large portion of their urban population is constituted by slum dwellers, among whom IMR and CMR are even higher than in rural areas. However, these are submersed by the lower death rates of children of the upper social class. The situation in Saudi Arabia is different, as practically there is no slums in Saudi urban areas. For this reason, the urban/rural differences in KSA are very striking, they persist even after multivariate screening (Table 5.7).

Table 4.1.5 elaborated the urban and rural IMR and CMR observed in our study. The differences in IMR and CMR are quite obvious. The lower rates shown for urban areas may be due to better socio-economic conditions, better educational status, easy availability of health services and better housing conditions. But mere presence of all these facilities does not constitute utilization and possession. In our results, we observed marked differences in certain factors which must have influenced the rates between urban and rural settings of this country.

As we have seen for the regional differences, the prevalence rates of certain factors are different between the rural and urban areas of the same zones. The obvious differences, between urban south and rural south and between urban west and rural west, as compared to other regions, are observed in percentages of married women with primary or higher level of education, husbands with preparatory or higher level of education, husbands in professional or clerical occupations, and residency in households with cement floor, piped water and flush toilet facilities. Further, we find differences in the utilization of health facilities through consultation of professionals by pregnant women, pregnancy check-ups, confinement in health establishments and post-natal check-up by professionals. Most of these differences were found to be statistically significant. It is, therefore, possible that these factors are responsible for the urban/rural differences in mortality in Saudi Arabia. Most of the investigators, cited above, have not specified the exact causes of prevailing differences between the urban and rural IMR and CMR and all of them did not observe the same strength of the variables studied. One investigator found more strength of maternal education in rural areas and more strength of father's education in urban settings, (Kim, 1986). One investigator found better child survival when the mothers were engaged in agricultural occupations and the fathers in technical jobs, UN (1991, p. 124). These are rare instances rather than the rule. Our results are confirmative and supportive to most findings overseas.

6.2.4 Reproductive behaviour

Table 5.5, showing some aspects of reproductive patterns in the country, provides some indicators related to socio-cultural and regional characteristics of the country. It shows that on the average, 58.3% of the ever-married women

are related to spouses, the highest being 69.9% in the north and the lowest 42.4% in urban south. Nearly 25% of ever-married women got married before the age of 15, the highest being 30% in the east and the lowest 22% in the rural west. The prevalence of pregnancy in elderly women (35 years and more) was most common (21.2%) in the urban west and rural south (20.3%), while it was least common (5.4%) in the urban south (Table 5.5). Although it is a well known fact that pregnancy after age 35 is associated with many congenital abnormalities of newborns, no adequate investigation in the occurrence of these abnormalities have been done in Saudi Arabia. The lowest rate of pregnancy may be due to frequent separation between the spouses or to the husband's absence from home for jobs or business in other regions.

6.2.5 Health service utilization

6.2.5.1 Maternal care service utilization

Utilization of health services by currently pregnant women for medical check-up varies from 48.7% to 80.9%, the average being 69.2%. The lowest rate of check-up was in the rural west, followed by the rural south, the highest was in the east, followed by the urban west. Pregnancy checks of women with last live birth, less than five years before the survey, by physician or nurse varied between 40.7% and 79.5%, the average being about 68%. The lowest rate of pregnancy check in this group was in the rural west, followed by the rural south. The highest was in the urban west (79.5%), followed by the central (79%). These rates illustrate clearly the urban/rural differences even within the same region (west). The lowest percent (37.6%) of deliveries in health establishments was in the rural west and this was followed by the rural south (46.7). The lowest percent of postnatal checks were again in rural west (35.1) and rural south (41.1). The highest utilization of government health services were in the Central, Eastern and Urban West regions. In these urban regions, health centres have some supportive facilities (e.g. x-ray, laboratory, etc.), encouraging people to utilize them. The health facilities in these urban regions are located within short distances from their homes, takes less time for travel and for consultancy. On the other hand, people in the less health services utilized areas, might have been traditionally conservative, less motivated and less conversant, in addition to

requiring longer time and greater distances to reach the health facilities and also having transport difficulties.

Hornstrup et al (1991) estimated that in Nigeria there were 22% difference in the survival rates of under-five children (90% vs. 68%) between areas having nurse or doctor operated medical facilities and areas having no medical facilities. About the efficacy of health establishments and their utilization, Jain (1985) observed that in India trained medical personnel, village level availability of medical facilities and vaccination are important factors in reduction of IMR and CMR. Buck and Bull (1986) after analyzing data from 17 different developed countries, come to the conclusion that IMR was highly correlated with health services availability. Harris et al (1990) showed the efficacy of access to health care amongst the Australian aboriginals.

Cochrane (1980) suggested that education is associated with increased health care utilization. Examining the regions with less utilized health services (rural west and rural south) and comparing them with high utilizers (central, east, and urban west), it is clear that education is associated with increased health care utilization.

Saudi Arabia had embarked on extensive implementation of primary health care programme since 1983. This had been shown by numerical expansion of health centres so their number has risen from 1,084 in 1983 to more than 1,700 in 1990. In addition, many innovative schemes have been introduced including family health record, demarcation of catchment area for every health centre, risk approach for maternal and child care, defaulter tracing and many others. The utilization of these centres is shown by the number of visits (preventive and curative), made by the communities to these centres. In 1983, there were 24,597,979 visits nationwide which increased to 40,920,593 visits in 1990 (Annual Report, 1410, p. 46, MOH, KSA). These health centres are manned by health teams, each one is headed by a physician and may have more than one physician according to the size of population it serves. Essential services include curative services, antenatal care, child care, immunization, health education, drug dispensing and others. Supportive services, e.g. laboratory and x-ray are

provided according to the need based on cost-effectiveness of the service. Ahmed et al (1991) also observed efficacy of prenatal care in reduction of child mortality in Liberia as part of health service accessibility. Introduction of primary health care reduced IMR and CMR in Gambia (Greenwood et al, 1990). The most spectacular reduction in IMR and CMR in Costa Rica was achieved after introduction of health services to rural area (Rosero, 1986). These findings were quite in agreement with our study.

6.2.5.2 Child care service utilization

In the area of preventive health care, we observe the same trend as utilization of health services for maternal care. Although possession of birth certificate is compulsory for citizenship identification, the rural south and rural west show the lowest percentage of birth certificates. However, the differences were not very high. The percentage of complete immunization of children aged 1-6 years between regions were very close and very satisfactory considering the vastness of the country and topographical differences. It appears that the residents of all regions were quite aware of the importance of immunization and the government machineries did an excellent job. For survival of children, the people undertook treatment for diarrhoea, using Oral Rehydration Salts and seeking professional advice in majority of cases (Diarrheal treatment 75%, ORS use 67% and Professional advice 68%). In spite of the more adverse circumstances prevailing in the rural south and rural west, they were not far behind in utilization of government health services for the children's welfare. It may be stated that, in many countries, treatment for diarrhoea, use of ORS and professional consultancy for diarrhoea are not yet popular and adequate, while diarrhoea is associated with 5 to 7.5 million children's death around the world (UNICEF, 1985).

Through these discussion of aggregate analysis, we pinpointed many differentials responsible for high or low IMR and CMR. We have also put forward possible suggestions for regional differentials. Our findings are in agreement with the literature.

6.2.6 Other factors

The other important factors responsible for high IMR and CMR in other developing countries are nutrition, birth weight, birth spacing, breast-feeding, infectious diseases, parasites, age of the mother and sex of the child.

The nutritional status of Saudi people is very good. The per capita daily supply of calories is 125% of the average daily requirements (UNICEF, 1991, p 104). Over 90% of mothers ever breast-feed their babies, the average period of breast-feeding (alone or with bottle feeding) is 10.47 months. The average birth weight (3.2 kg) of Saudi newborns is almost the same as the international standard (3.3 kg.) The percentage of underweight is also negligible (5.5-11.5%, unpublished figures). Birth spacing (2.43 years) among Saudi women is also more than the minimum recommended (2 years). For infectious diseases the percentage of vaccine coverage in Saudi Arabia is excellent. The coverage in 1990 for BCG was 99%, poliomyelitis & triple vaccine (third dose) coverage was 94% and measles vaccine coverage was 90% (MOH Annual Report 1990). For the few uncovered children, the herd immunity is expected to extend protection. Parasite prevalence in Saudi Arabia is very low. There is no existence of hookworm, which is the most dangerous for children (Khan M et al, 1989). The age at marriage of the older generations of Saudi mothers were low compared to that of the younger generations. Age at marriage of future generations is expected to be even higher. So there is no danger of high IMR posed by young mothers. As in Korea and some other developing countries, there is no sex bias or hatred for female children in Saudi Arabia, which is mainly due to economic reason. The Kingdom has no economic problem, therefore, many child mortality differentials prevailing in other developing countries are absent in Saudi Arabia. We therefore, hope to achieve IMR and CMR comparable to that of developed countries in a few years time taking care of the few areas identified by this study.

6.3 Intervening mechanisms

The previous section has shown that both women's education and household infrastructure exert independent influences on mortality. The purpose of this section is to investigate the intermediate pathways through which factors intervene.

Intervening variables are those variables that are intermediate in the causal pathway between some study variables and child survival. When the effect of a single study variable is to be measured, the intervening variables have to be taken into consideration along with the mechanisms through which the variables having a positive or negative effect exert their influence. The effect of a single variable, thus, sometimes can be of a lesser concern when one or more of the intermediate variables either singly or together exert a more powerful influence on the outcome.

If woman's education is taken as a variable, a detailed look into the mechanism through which the effect is manifested is necessary. On the one hand, education itself can be sub-categorized into several categories e.g., (1) less than primary, (2) only primary level or primary plus preparatory and (3) secondary level or above. On the other hand, intermediate variables may include: (1) age at marriage, {for example; age at marriage (i) less than 15, (ii) 18 and (iii) 25}; (2) whether breastfed and, if so, duration in months; (3) ante-natal care; (4) place of delivery; (5) post-natal care and (6) child care, e.g., immunization. Below, we shall discuss some intervening mechanisms in social, household infrastructure and area characteristics variables.

6.3.1 Social resources

Let us take education as a social resource as already discussed earlier and identify some of the intervening/intermediate variables/factors that individually are amenable to be influenced by mother's education. Table 5.12 shows that 19.3% of women who got married earlier than 15 years of age had less than primary education.

While the education of the woman with primary or more education is by itself significant in comparison to those with less education, the intervening effect of father's education is an important consideration. The mortality of children to mothers with less than primary education and whose husbands had less than preparatory certificate with occupation in the agricultural sector, was 75% higher than the mortality experience of the overall sample.

Results of the 1981 census of India showed that the educational level affects age of marriage and that the mean age at marriage of women was 18.3 years (in South-Central India 16 years). The census results also showed that child mortality among illiterate mothers were about five times higher than that of literate mothers (India, 1989). Without knowing the effect of the intervening variables it is difficult to determine as to through which variables the mortality rates were so different. If education alone could be as effective as to reduce mortality sharply and considering the rapid changes that have taken place in Saudi Arabia, IMR and CMR would have taken a nosedive and the difference in rates of that magnitude would be clearly visible between the older women who got married before the education boom as mentioned earlier and the recently married women with higher education levels. However, considerable effects of education of particularly the mother, and also to a lesser extent of the father, has been shown in our study.

Education is comparatively easier to extend and the benefits derived go far beyond the effects on IMR and CMR. More new educational institutions may be needed in rural and hilly areas, especially for easy access for girls living there, in addition to the already developed excellent education infrastructure in this country. Our study shows that husband's occupation has a powerful influence on IMR and CMR, but it is neither easy nor practical to aim at white collar or highly paid jobs for all husbands.

We had a detailed look at the effect of education of mother on intervening variables like breast-feeding pattern, ante-natal care, delivery practices and child care (Table 5.12). The benefits of prolonged breast-feeding are well known (Mata 1978, Feachem and Koblinsky 1984, Howei et al 1990). On the one hand, our study showed that primary or more education has a net effect on the reduction of IMR and CMR; on the other hand, women with primary or higher level of education, especially in the secondary level, had slightly lower percentage of women ever-breast-feeding and significantly shorter duration of breast-feeding. On this account women with secondary or more education had significantly higher ante-natal and post-natal care along with higher utilization of delivery facilities, which compensate for the difference in breast-feeding. Furthermore,

the food handling habits, particularly for weaning, would be better among women with higher education. However, it is likely that if women with higher education would also breast-feed for longer duration there could be further reduction in IMR and CMR in that group. It is likely that more educated women are most likely to take initiative to reach out to the health services offered. An educated woman is likely to have increased social status as education of both female and male is valued in this society. She is more likely to be listened to because of this increased status and also more likely to have increased conviction herself and increased capacity to convince others. She is more likely to have a more educated husband with better occupation.

The question arises as to what the educated women do which act(s) as intervening mechanism(s) and why? In general, it can be said, that the higher the education of women, the higher would be the awareness that the utilization of modern health facilities makes a difference. It can be seen that 93.8% of women with secondary level education as opposed to 64.2% women with less than primary education had pre-natal check-up among those currently pregnant, and 95.5% of the former group had delivery in a health facility as compared to 66.8% of the latter group. The difference in post-natal care between the two groups was also similar. If the group with less than primary education is classified as low, primary or preparatory group as medium and secondary or more as high education groups then the intermediate variables just discussed also show low, medium and high utilization of these services.

6.3.2 Housing conditions

Let us look into three elements of household infrastructure and the number of diarrhea cases. The mechanisms involved here concern disease transmission. Each of these household infrastructure elements would act differently. Diarrhea was chosen as an intervening variable, being a common disease among children under 3 years of age. Table 5.13 shows that when, (a) the floor material was earth, (b) drinking water was from the well and (c) open ground was used for defecation, being more suitable for transmission of disease, the percentage of children having diarrhea was higher. Rapid improvements towards having cement flooring, potable drinking water and improved toilet facilities (flush or pit) all had effect on the transmission of some disease, as

exemplified by diarrheal disease rates. It was interesting to note that flooring quality more than offsets the benefits that mother's education provides. Table 5.14 shows, however, that in both, less than primary and primary/preparatory education groups, earth floor inhabitants had more diarrheal disease than the families living in housing with cemented floor. What was surprising is that the group with higher level of education had comparatively higher diarrhea rates. It is possible that this is due to better reporting by the better educated. In our study, mortality was higher among the less educated or uneducated groups, while the incidence of diarrhea was lower. Islam et al (1984) found that higher diarrheal rates were reported from households with educated heads but the same study showed higher mortality rate in households with no schooling or 1-6 years of schooling of heads of households.

A highly significant association of father's occupation with the number of mothers having children with diarrhea was reported in Saudi Arabia (Al-Mazrou et al 1991) as was also shown by Islam et al (1984) in Bangladesh.

The same trend was true for the drinking water source and education levels. Unfortunately, the sample size was too small for commenting on the interaction of type of toilet facility and education.

In the area of household infrastructure, two variables have been identified to be important, piped water and flush toilets. Provision of safe water is in the way of completion in most areas of the country, although in certain areas it may take time. In certain instances, both toilet and water are jointly effective. Keeping sanitation uncared for, despite provision of water, will have limited efficacy.

6.3.3 Area characteristics

One of the important mechanisms of intervention is to provide definitive health services that are known to reduce IMR and CMR. Having static health services facilities alone does not necessarily mean that they are utilized. There are urban/rural and regional influences in the health services utilization.

The regional and urban/rural differences are mostly the effect of social resources, household infrastructure and mainly the economic solvency. To bridge these gaps, wide scale economic development, more communication facilities, more health service extension and manpower development programs are needed. These involve adequate economy and time. Costa Rica achieved dramatic results only by extending health services to rural areas (Rosero-Bixby, 1986). If we look into the mortality trend, we can earmark certain areas to concentrate our efforts, we can minimize the child mortality. Worldwide data shows that 80% of the under-five deaths occur among the infants aged less than one year. Among the infants, 75% of the deaths occur in neonates aged less than one month. Therefore, in addition to extension of education, if we target reduction of neonatal deaths and infant deaths, we may achieve quick and dramatic success. Saudi Arabia has succeeded in extending health benefits to all in a matter of few years. If we desire to close the gap between the Saudi IMR and CMR levels with that of the developed world, we have to adopt the shortest and easiest route for the purpose.

6.3.4 Health service accessibility and utilization

Mechanisms through which ante-natal check-up, delivery in a health establishment, post-natal check-up and immunization intervene to reduce IMR and CMR are well known.

Briefly speaking, ante-natal check-up will help to identify the majority of pregnancies that are normal with no risk to mother and baby. In case of patients of any risk, it can be identified at an early stage and the woman at risk or potential risk is referred for appropriate preventive measures which ultimately will improve the perinatal outcome.

The importance of attendance by trained personnel and the quality of care provided by such personnel is crucial to the outcome of pregnancy and also to the ability to distinguish between still births and live births. The care of handling the baby immediately after birth is of utmost importance in saving newborns at risk. For example facilities for proper care for the initial breathing, resuscitation, etc., my vary in different regions and urban and rural areas.

Post-natal care includes many components each of which can be intervening with IMR and CMR. Let us divide the post-natal care into several aspects, such as, (a) those specially pertaining to the baby care, e.g. early identification of feeding problems, infection, etc, and dealing with them promptly, (b) the effect of maternal well being intervening in the care of child and (c) socio-economic problems that influence the mother and child, e.g. home conditions, environmental factors (clean house, ventilation, water, sanitation, etc.), nutrition, personal and home hygiene. The post-natal period is an important period to educate the mother on the health aspects both for herself and for her chid, to identify when medical intervention/consultation is necessary and to reach out to avail of the facilities provided, especially in areas with weak home visiting facilities.

Immunization as an intervening mechanism forms a hallmark in the reduction of IMR and CMR and has been proven to be an effective measure of child care. Proper immunization of the pregnant women by tetanus toxoid prevents death due to neo-natal tetanus. Subsequently, immunization of infants and children as per the Ministry of Health and WHO recommended schedule had a definite impact on IMR and CMR. The immunization schedule starts when the maternal antibodies are waning and completed before the infant reaches his/her first birthday, thus harvesting both the benefits of passive and active immunity, to protect the child throughout the most vulnerable period of his life. The percentage of children who completed all immunizations in the rural south was about 93% in the group with less than primary education. Despite the disadvantage of being illiterate or having education less than primary level, the mothers completed a higher rate of immunization of their children which varied from 93-100% in all the education groups and all regions. Mortality due to immunizable diseases in most parts was thus averted due to the intervention by one of the intervening variables of child care. We already noted that the higher the level of education the better the ante-natal care, delivery at health facilities and also the better the post-natal care. It can be hypothesized that education in the school has increased the awareness of the mother about the value of these services. Universal access to immunization and the effort of the health service providers, in addition to the legislative action which binds the issue of the birth certificate

with the completion of basic immunizations, had thus removed the differences that may arise due to education of mothers. This legislative action goes back to 1979 when a royal decree was issued to link the issue of birth certificate with the completion of BCG, oral Polio and triple vaccine during the first year of life. In 1983 measles vaccination was added to the list and in 1988 Hepatitis B vaccine was the last addition to this list.

However, several investigators have shown that immunization alone cannot achieve goals beyond a certain point. In Gambia the IMR and CMR were 142 and 43 respectively where Greenwood et al (1987) showed that even a good immunization programme has its limitations and concluded that it is necessary to find ways of preventing death due to malaria, acute respiratory tract infections and chronic diarrhea/marasmus through a primary health care programme. Judging from the Gambian experience, it can be stated that a highly successful immunization programme alone could not have achieved the lowering of IMR and CMR in Saudi Arabia, where not only a good PHC programme came into place but also improvements in the socio-economic variables and infrastructure took place.

In a study in Nigeria, Adedoyin and Watts (1989) showed that availability of clinical care at nominal cost and the attendance of mothers in clinics for check-ups and immunization resulted in a higher level of health and a lower level of IMR (41.5/1000). A study in Costa Rica showed that public health programs implemented during the 1970s were responsible for three-fourths of the decline in IMR and that the extension of the PHC and community programs were apparently responsible for 40% of the reduction (Rosero-Bixby 1986).

Thus, in the majority of instances, the child mortality differentials compare well with the observations made by different investigators in similar studies conducted around the world. Though, different intervening mechanisms appeared to influence the mortality levels in the aggregate analysis, the multi-variate analysis clearly indicated that "mother's education", is the most important factor affecting childhood mortality in Saudi Arabia.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

The analysis and discussion of the results of the determinants of infant and child mortality in Saudi Arabia lead to the following conclusions and recommendations:

7.1 IMR and CMR levels

Our estimated levels of IMR and CMR (50 & 66) are markedly lower than what is still being reported by international sources. For example, the World Bank reports an IMR of 108 per thousand in 1992, Yet UNICEF utilized an estimate of under five mortality equal to 91 per thousand in 1990.

7.2 The mortality trend

An obvious declining trend is portrayed by the data. 1-4 mortality (4q1) was reduced to around one-fourth in a period of around twelve years and the rate of decline in infant mortality is around 41%. Furthermore, much of the decline has been achieved within a span of about years (from 1973 to 1980), allowing for possible under-registration of mortality at earlier time periods, this implies quite an impressive improvement in mortality level.

7.3 Regional variation

Regional variations in mortality rates are quite marked. Rural infant mortality is around 31% more than that of urban areas (the latter is around 47 per thousand in 1985) and rural childhood mortality (4q1) is around 58% more than the level in urban area (the latter is around 53 per thousand in 1985). The south region (which is around 80% rural) shows the highest levels of mortality followed by north region. The east region fares best followed closely by west, then central and north regions.

In general, the two regions: east and west and central have comparable levels of IMR (around 45 per thousand), the central and north level is only seven points higher (52 per thousand) but the south experiences a much higher IMR (74 per thousand).

7.4 Urban/rural setting

A closer look at the data reveals that the level of IMR in urban south is lower than all the other regions and that the high mortality in the south region is a reflection of the very high IMR in its rural component (80 per thousand). Furthermore, inspite of the overall low level of IMR in the west region, its rural component experiences a level of IMR (62 per thousand) close to that of the south region.

7.5 Health services accessibility & affordability

The survey data reflected an impressive level of health service accessibility and affordability. The existence of health facilities does not seem to pose any constraints in Saudi Arabia and this fact holds on regional basis as well.

7.6 Factors influencing mortality differentials

Social resources as well as region of residence are two significant factors independently influencing mortality differentials.

Households in Saudi Arabia with favourable infrastructure and mothers having at least primary certificate and fathers in the skilled or professional sectors experience an infant mortality level of around 28 per thousand versus 107 per thousand for households with least favourable infrastructure and social resources.

7.6.1 Social resources of parents

Social resources of parents (education of wife, education of husband and occupation of husband) stand about as important determinants that are operating regardless of the region of residence or the level of infrastructure.

The individual level analysis that provides estimates of independent effects of the investigated determinants implies that:

*Children living in rural south region with least favorable parent social resources (less than primary education for mothers, fathers with less than preparatory education and working in agriculture) have a level of mortality more than twice the overall average for Saudi Arabia, an estimate of around 107 per thousand. Children of mothers with higher education status (primary or more) but with similar father characteristics and living in the same south region experience a much lower risks of dying. Their mortality is lower by around 11 percent, bringing down IMR to 95 per thousand. Children of mothers with higher educational status (primary or more) with fathers having more than preparatory education but still occupied in the agriculture sector and living in the same south region experience an IMR around 86 per thousand. Children of mothers with higher educational status (primary or more) with fathers having more than preparatory education and working as professionals, clerical or salesman experience an even lower IMR of around 61 per thousand.

*On average, children of mothers with improved education (from less than primary to primary or more), with no change in father's social characteristics and region of residence, experience a level of IMR that is lower by around 12 points.

* On average, children with fathers with improved education (from less than preparatory to preparatory or more), with no change in mother's education or father's occupation or region of residence, experience a level of IMR that is lower by around 10 points.

* On average, children whose fathers are engaged in professional, clerical or sales, with no change in mother's education or father's education or region of residence, experience a level of IMR that is lower by around 24 points compared to children whose fathers are engaged in agriculture.

* Children whose parents (both father and mother) enjoy improved education, in addition to being employed as service or skilled, experience a level of IMR that is on average lower by around 51 points. This effect is achieved regardless of the region of residence.

7.6.2 Household infrastructure

Similar implications of the importance of social resources are reached when comparing the differences in children's mortality risks, when parents have improved social resources but similar infrastructure. The only differences are in the magnitude of the effects, which suggest that the education of husband is no more significant, both mother's education and her husband's occupation are significant. This is explained by the fact that region of residence capture the infrastructure variables as well as other differences.

The individual level analysis that provides estimates of independent effects of the investigated determinants implies that:

*Children living in households with least favourable infrastructure (without toilet facility and with well or ponds as main source of drinking water) and least favourable parent's social resources (less than primary education for mothers, fathers with less than preparatory education and working in agriculture) have a level of mortality more than twice that of the overall average for Saudi Arabia, an estimate of around 107 per thousand. Children of mothers with higher educational status (primary or more) but with similar father characteristics and living in similar households with least favourable infrastructure experience a much lower risks of dying. Their mortality is lower by around 19 percent, bringing down IMR to 86 per thousand. Children of mothers with higher educational status (primary or more) with fathers not working in the agricultural sector (implying higher social and material status) experience an IMR of around 62 per thousand.

*On average, children of mothers with improved education (from less than primary to primary or more), with no change in father characteristics and household infrastructure, experience a level of IMR that is lower by around 20 points.

*On average, children whose fathers are not occupied in the agricultural sector, with no change in mother's education or household infrastructure, experience level of IMR that is lower by around 24 points compared to children whose fathers are occupied in the agricultural sector.

The aggregate regional measures point to the particularly weak levels of males and females' education in both rural south and rural west, in rural west around 95% of ever-married women have less than a primary certificate compared to 75% in the urban west. In rural south, 92% of ever-married women have less than a primary certificate compared to 80% in the urban south.

The same two rural communities as well as the north region have the lowest levels of male education.

7.6.3 The regional effect

The detailed analysis revealed that the regional differentials can not only be attributed to the better social resources of parents living in different regions.

For example, children with similar least favourable parents' individual social resources but living in the east region have a level of IMR (57 per thousand) that is 47% lower than those in the rural south (107 per thousand). Comparable children in the urban west experience a level (73 per thousand) that is 32% lower. The closest level to rural south is the level of rural west (89 per thousand) which is only 17% lower.

Differentials between regions of children with similar parent's social resources are influenced by two significant factors: infrastructure and norms.

The individual level analysis that provides estimates of independent effects of the investigated determinants implies that:

Households with least favourable conditions (without toilet facility and with well or pond as main source of drinking water, their mothers have less than a primary certificate and their fathers have less than a preparatory certificates and are occupied in the agricultural sector) have a mortality level more than twice

the average in the sample, as estimate of around 107 per thousand. Children in households with flush toilets but with no piped or bottled water and with least favourable social resources for parents experience an IMR that is lower by around 18%. This brings IMR down to around 87 per thousand. Children living in households with flush toilets and piped or bottled water but with parents with least favourable social resources would have an IMR of around 72 per thousand. The implications of these results are that improvement in infrastructure has the potential of reducing IMR by around 35 points. The overall level of infrastructure setting is quite favourable in Saudi Arabia, but regional variations are portrayed in the data. Rural west stands out with its low percentage of household using piped or bottled water for drinking (18%) and having flush toilets (51%) followed by rural south.

7.6.4 Child and reproductive care

The investigation of other (in addition to education and infrastructure) features that may have contributed to the mortality differentials showed that child care is favourable in all regions and hence confirmed the finding that it is not influencing this differentials (but of course reducing the overall levels). Reproductive health care, on the other hand, shows wide variations. Uneducated women fare markedly better in certain regions than others. This finding support the existence of area features (possibly norms and information) that play an additional influencing role on reproductive practices.

7.7 Intervening mechanisms

The major intervening mechanism through which infrastructure is hypothesized to exert its effect on mortality is the level of environmental contamination. The analysis illustrates that households with low infrastructure, but similar level of female education, experience higher prevalence of diarrhoea.

The intervening mechanisms through which female education is hypothesized to exert its effect on mortality is through better health practice, more favourable (from health perspective) reproductive care, feeding and better utilization of health services. Information on health practices were not collected and the proxy (prevalence of diarrhoea in different educational level but similar infrastructure) utilized did not support this hypothesis. It seems that women with

higher education reported better the existence of diarrhoeal episodes. Data on feeding patterns, apart from breast-feeding, were not collected. The data reflected a high practice of breast-feeding, but more educated women tend to breastfeed for shorter durations. The major mechanisms through which education shaped mortality differentials in Saudi Arabia is the more favourable reproductive pattern and reproductive health care (antenatal, delivery and postnatal) utilization. Surprisingly, the education mechanism was not reflected in child health care. This is explained by the fact that both the uneducated and educated women fared very well in preventive child care. This result is of an important policy implication as it suggests that certain intervening mechanisms could be manipulated in spite of the constraints of social resources. Reproductive care stands as the most likely candidate for such manipulation. The success in child health care utilization need to be paralleled in reproductive health care. More efforts should be directed to improving reproductive health care.

7.8 Final conclusion

To sum up, the study identified the need for further investment in infrastructure and female and male education. It highlighted one of the intervening mechanism (reproductive health care) that is playing an influential role in the recent differentials. The study inferred that while such mechanism is influenced by education, other forces (for example, health education campaigns) could be instigated to overcome the constraint of low educational status.

SPECIFIC RECOMMENDATIONS:

1. Education:
    - Establishing more schools in areas with less education (male & female), hilly and rural areas.
    - Declaring education compulsory for male up to preparatory and for female up to primary.
2. Establishment of more PHC in inaccessible areas, hilly areas and rural areas.

3. Provision of more job opportunities in selected areas by establishing;
    - industries
    - offices
    - schools
4. Supply piped water to areas still not covered.
5. Intensify health education for:
    - installing flush toilets
    - using piped water
    - improving personal hygiene
    - using mosquito curtain in malarial areas
    - avoiding use of stagnant water of wadis
6. Further research: Organize more indepth studies in areas of interest.

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