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The Effects of Socio-Behavioral and Environmental Factors on Infant Mortality: A Review of the Literature

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Abstract

Background: *Infant mortality is a global problem which the Millennium Development Goals has aimed to reduce by two-third by the year 2015. Several studies have linked social, behavioral and environmental factors to increased infant mortality rates in the past. The objective of this study was to review the existing literature on the effects of socio-behavioral and environmental factors affecting infant mortality.*

Methods: *A search of the literature was carried out. The search was conducted using web browsers like Google scholar, Pub Med, Medline and sociological abstracts. The articles were chosen when they were found to be relevant and were reviewed accordingly. Initially, the search was limited to recent articles not earlier than year 2000. But, when enough materials were not found, the search was extended to older articles because they were found to be highly relevant for the study.*

Findings: *This review revealed that social factors such as poverty, household income, mother's economic status, nature of care for infants, maternal age, breastfeeding, birth orders, birth intervals, place of delivery, income inequality, social policies, health scheme, mother's education and postnatal care were found to affect infant mortality. Similarly, environmental factors such as poor residential conditions, nature of water supply, particulate matter air pollution, poor sanitation, heavy metal poisoning and household environmental characteristics were found in the literature to be linked to infant mortality. Behaviors of pregnant women like cigarette smoking, alcohol drinking, sedentary lifestyle, weight gain, utilization of prenatal care facilities and exercises were found to be closely related to infant mortality.*

Conclusion: *It was concluded that many social, environmental and behavioral factors exist in the literature which were found to affect infant mortality. The knowledge of these factors should be utilized by both governmental and non-governmental organizations in the world to swing into action of arresting and preventing the menace of increasing infant mortality especially in the underdeveloped and developing countries.*

Key words: *Infant mortality, Social factors, Behavioral factors, Environmental factors.*

Introduction

The infant mortality rate which is one of the most important indicators of human development is the number of deaths in children under the age of one year per one thousand (1000) live births in the same year. It can be divided into neonatal and postnatal mortality rates. The neonatal mortality rate can be calculated from deaths occurring in the first four weeks of life, while postnatal mortality rate is calculated from deaths occurring in the remainder of the first year [24]. One of the Millennium Development Goals is the reduction of infant and child mortality by two-thirds by the year 2015. In order to be able to achieve this goal, efforts are geared towards identifying cost-effective strategies as many international agencies have advocated for more resources to be directed to the health sector. A means of getting this done is to identify and rank in order of importance the socio-behavioral and environmental factors that affect infant mortality with the aim of providing solutions so as to reduce infant mortality rate globally.

In the developed countries of the world, neonatal deaths account for almost two-thirds of infant mortality [1].It has been documented that infant mortality rates are far lower in wealthier countries than

poorer ones. Several studies have linked infant mortality to environmental factors in the past. Health behaviors of mothers have been associated with infant mortality rates in the literature. Many authors have attributed high infant mortality to social, behavioral and environmental factors in the past. Many of the countries with relatively high infant mortality rate are either underdeveloped or developing countries. It is therefore intuitive to review the past literature regarding the impact of socio-behavioral and environmental factors on infant mortality so as to have an idea of the achievement so far and to suggest further ways forward. This study is aimed at reviewing the effects of socio-behavioral and environmental factors on infant mortality.

Methodology

A search of the literature was carried out starting with combinations of the following search terms: infant, mortality, rate, social, behavior, and environment. The search was conducted using web browsers like Google Scholar search engine, PubMed, Medline and sociological abstracts. In order to be able to know the extent to which the search includes consideration of the effects of social, behavioral and environmental factors on infant mortality, the search was carried out using search terms like 'social factors and infant mortality', 'behavioral factors and infant mortality', and 'environmental factors and infant mortality'. The articles were chosen when found to be relevant and were reviewed accordingly. Initially, the search was limited to recent articles not earlier than year 2000. But, when enough materials were not found, the search was extended to older articles because they were found to be highly relevant for the study. Altogether, a total of 58 articles were found but, out of these, 30 were found to be highly relevant and were reviewed accordingly.

Review of the literature

Social factors and infant mortality

Many studies have identified various determinants of infant mortality in the past. Similarly, several factors including bio-demographic and socio-economic have been associated with infant mortality. It has also been observed that social relationships whether in quantity or quality affects physical and mental health [2]. It also affects health behavior as well as mortality risk. These authors noted that Sociologists have established the link between social relationships and health outcomes. They also reported that the effects of social relationships on health is both short and long term in nature. These effects used to emerge in childhood and carried along throughout life to bring about resultant advantages or disadvantages in health.

The major findings of sociological stress research are that: the damaging effects on physical and mental health are great when stressors are comprehensively measured, the primary way by which gender, racial-ethnic, marital status and social class inequalities in physical and mental health are produced is through differential exposure to stressful experiences. Discrimination stress also harm minority group members. Furthermore, the proliferation of stressors over life course and across generations has widened the health gaps between the advantaged and disadvantaged group members. Possession of high levels of mastery, self-esteem and social support by individuals leads to reduction of stressors on health and well-being [3]. The author of this article also pointed out that in order to be able to solve the problem of health inequalities, situations that increases stress of the people must be the focus of programs and policies of governmental and non-governmental levels of interventions. Such programs and policies must be made to also target children who are at risk of ill-health and distress as a result of poverty.

Some studies in India and the world in general have suggested that poverty and household income are important upstream determinants of infant mortality [4]. This is why the Government of India at one time targeted unemployment and underemployment (which are predisposing factors for poverty) by providing paid employment to households whose adult members volunteered to do unskilled manual work. This is because improved income brings about many structural and behavioral factors like better housing and living conditions, food security, access to clean water and proper sanitation, access to health care, infant

care and feeding habit practices that influence the immediate risk factors for infant mortality like malnutrition, diarrhea and acute respiratory infections. Once the issue of rural poverty is addressed through provision of employment, the goal of improved infant survival will be achieved [5].

A study was conducted to examine the determinants of child mortality in rural Nigeria. The authors made use of 2008 Nigerian Demographic and Health survey data for the purpose of the study. It was found out that secondary education of mother, age of mother at first birth, place of delivery, type of birth, child ever breastfed, sex of child were among the significant factors influencing child mortality in rural Nigeria [6]. However, in a similar study on the pattern and determinants of infant mortality in rural Nigeria, it was revealed that approximately half of the respondents have experienced infant mortality within the study period. Furthermore, thirty five percent of the infant mortality occurred in the first month of birth. Six determinants of infant mortality were identified by the study. These included mothers' economic status, nature of care for the infant, quality of household infrastructure, maternal age, quality of life of the infant and quality of attention given to the infant. They eventually recommended improvement of health facilities and education of the child to help in the reduction of infant mortality rate in the rural areas [7]. It will be noted that both studies [6],[7]commonly identified maternal age as a determinant of infant mortality. Further identification of mother's education, place of delivery, type of delivery, breastfeeding and child's sex as determinants of infant mortality was made [6] while in addition, other factors such as mother's economic status, nature of care for the infant, quality of household infrastructure, infants' quality of life and attention given to child were identified as being among the determinants of infant mortality in Nigeria [7].

While neonatal mortality rate is related to maternal and obstetric factors such as congenital abnormalities, low birth weight, birth injuries, birth asphyxia and tetanus, post neonatal mortality rate on the other hand is related to varieties of environmental factors. However, poverty, inadequate health care, congenital problems, infectious diseases as well as injuries have been attributed to the causes of infant mortality [25]

In 1988, comparison was done between the approach of the European countries and that of United States of America in lowering infant mortality. While the European countries then were providing more social, financial and educational support to families with pregnant women and infants, the United States was expanding medically-oriented prenatal care as a high priority. The approach of the European countries was far more effective in reducing mortality rates than that of the United States [26]. This is another confirmation of the impact of socio-economic factors on infant mortality.

High focus of interventions on social and economic empowerment of women through education and employment so as to achieve the Millennium Development Goals (MDGs) of reducing infant mortality by 2015 has been recommended in the literature [8]. The work of the authors centered on the socio-economic determinants of infant mortality in Kenya. The outcome of the study revealed infant mortality rate of 79.6 per 1000 deaths in Kenya as of 2003. The major determinants of this were breastfeeding, ethnicity and sex of the child. Birth order and birth intervals were significant variables in the rural areas. It has been pointed out that infant mortality and birth outcomes which are key population health indicators have life-long implications for individuals and they are unevenly distributed globally.

In another study conducted to examine the determinants of child mortality in rural Nigeria, the authors made use of 2008 Nigerian Demographic and Health survey data for the purpose of the study. They found out that secondary education of mother, age of mother at first birth, place of delivery, type of birth, child ever breastfed, sex of child were among the significant factors influencing child mortality in rural Nigeria [6]. Another study conceptualized framework and systematically reviewed the literature on hypothesized social determinants and intermediary determinants within the United States of America and Western Europe. The evidence suggested that income inequality and social policies may help to explain cross-country variations in infant mortality and birth outcomes [9].

Some important determinants of infant and child mortality in a local government area of Oyo state, Nigeria were examined recently. The authors' findings revealed that among the major determinants listed,

poverty, malaria, postnatal care, health scheme and breastfeeding were the major determinants of child mortality in the state. Even though, HIV was found to have catalyzed child mortality, it was not a major determinant in the study [10].

Environmental factors and health

There are many environmental factors that have negative impacts on the health of humans. The literature of five common home environmental health risks namely: lead, carbon monoxide, radon, pesticides and volatile organic compounds was reviewed. The author observed that people spend most of their time indoors and that human exposure to pollutants occur not only outside of buildings but, indoors as well. He further reiterated that indoor air pollution was gaining more public attention and there have been reports of sick building syndrome, mould and death resulting from carbon monoxide poisoning [11].

In 2002, it was noted that environmental health threats were increasing that time throughout the United States of America especially, in low-income populations. Selected lines of evidence which suggested that clinicians should consider interactions between humans and their environments as being basic to providing effective primary care were highlighted. The subject areas included exposure to environmental agents, reproductive toxicity, pulmonary disease, neurobehavioral toxicity, endocrine disruptors, mechanism of environmental disease as well as cultural competence. The authors observed that the biomedical technology and community awareness request that physicians pay greater attention to advances in environmental medicine. They finally reiterated that in order to adequately respond to increasing concerns about the role of the environment in human health, clinicians, researchers, health educators, public policy officials, therapists and the public in general should join together to decrease the risk of environmental health threats and thereby increasing the quality of life [12].

Some researchers have observed in the past that poverty, access to health care, behavior or environmental factors only cannot be used to explain racial disparities. The involvement of genetic factor was also emphasized. They noted that individuals vary greatly in their response to environmental agents. The variability usually overshadows important environmental contributions to disease risk and it poses a barrier to efforts in investigating the etiology of diseases. They also noted that health disparity is a significant public health problem which cannot be addressed using the usual approaches for funding and priority setting. It was again emphasized that the present emphasis on basic and clinical research without the inputs of public health and the social sciences does not provide the interdisciplinary research teams required to address such a complex health disparity problem [13].

Effects of environmental factors on infant mortality

Various environmental factors have been attributed either to an increase or a decrease in infant mortality in the past. A study was conducted in 2008on the role of the environment in the decline of infant mortality as it affects England and Wales. The study tested the proposition that the contribution of environmental factors to the reduction of infant mortality in the early twentieth century was greater than that made by the alleviation of poverty. The outcome of the study showed that infant mortality by father's occupation was averagely reduced by 35% from a peak infant mortality rate of 132 with wide variation. However, the removal of poor residential conditions was associated with the decline [14].

Effects of the health service and environmental factors on infant mortality in Sri Lanka were studied in 1980 [15]. The major findings of the study revealed that regional variations in the infant mortality rates of Sri Lanka are large, ranging from 26 per 1000 to 91 per 1000 live births. The differences are more strongly associated with regional variations in environmental determinants of mortality than with regional variations in public health expenditure. The most significant environmental factor associated with interregional infant mortality rates was found to be the nature of water supply.

Air pollution has been linked to infant mortality in the literature. The attributable risk of post neonatal infant mortality in 23 United States of America metropolitan areas related to particulate matter has was assessed in the literature. Following the assessment, it was discovered that ambient air pollutions measured by particulate matter contributes to a substantial fraction of infant death especially for those due

to sudden infant death syndrome and respiratory disease [16]. The relationship between cause-specific post neonatal infant mortality and chronic early-life exposure to particulate matter and gaseous air pollutants across the United States was evaluated in 2008 [17]. At the end of the study, the result supported that particulate matter air pollution is a risk factor for respiratory-related post neonatal mortality and suggested that ozone may be associated with sudden infant death syndrome in the United States.

Similarly, in a recent article which discussed the impact of environmental factors on birth outcomes during the last two decades, the author reiterated the correlation between air pollutants and adverse pregnancy including low birth weight and infant mortality. The result showed a positive correlation between air pollution and infant mortality. The article also supported the association between some air pollutants and low birth weight which is also a predisposing factor for infant mortality [29].

Investigation has been conducted on the impact of three key pollutants on infant mortality rates. These pollutants are carbon monoxide, particulate matter and ozone. It was revealed that although, particulate matter and ozone have no impact on infant mortality, exposure to higher levels of ambient carbon monoxide elevates the infant mortality rate [30].

Child mortality rates still remains unacceptably high in sub-Saharan African countries as approximately half of childhood deaths takes place in sub-Saharan Africa despite the region having only one fifth of the world's children population [18]. In a study conducted by the authors in 2012, they examined the environmental determinants of child mortality in Nigeria using principal component analysis as a data reduction technique. The result showed that household environmental characteristics do have significant impact on mortality.

The joint effects of air pollution exposure and measures of socio-economic status in a population level analysis of pregnancy outcomes in North Carolina was examined in 2014 [19]. The researchers calculated daily measurements of particulate matter in aerodynamic diameter and ozone through a spatial hierarchical Bayesian model which produced census-tract level point predictions. The outcome of their study revealed that maternal race and education as well as neighborhood household income were associated with adverse birth outcomes. Predicted concentrations of ozone were also associated with an additional effect on reduction in birth weight and increased risks of being born low birth weight which is a predisposing factor to infant mortality.

Behavioral factors and health

Long ago, certain behaviors have been associated with increased risk of specific diseases. Examples are: tobacco use, alcohol consumption, inadequate physical activity, certain sexual practices and diets. Cigarette-smoking has been identified as a major cause of preventable morbidity and mortality in the United States of America. Smoking causes an increased risk of heart disease and cancer. Smoking during pregnancy has also been associated with negative pregnancy outcomes [20].

Obesity is a major risk factor for diabetes. Hypertension, coronary heart disease and certain forms of cancer have also been linked to overweight in adults. These adults are also at risk of developing gallbladder disease, osteoarthritis, sleep apnea and respiratory problems. It has been observed that as important as the genetic factors are, the contribution of diet and physical activity to maintenance of appropriate body weight cannot be overlooked. Inactivity and poor dietary patterns has been ranked as the second leading factor contributing to mortality in the United States of America after tobacco use [20]. Therefore, the practice of regular physical exercises under the supervision of a health expert like a Physiotherapist is a very good health behavior. Such a healthy behavior is capable of improving the health status of individuals while preventing the development of many health problems.

Alcohol consumption is another behavioral factor related to health. It has been identified as top contributor to death in the United States of America after tobacco use, diet and activity patterns. Hypertension, arrhythmias, cardiomyopathy and stroke have been linked to long-term excessive alcohol drinking. The effects of poor sexual relationship and practices on health are enormous. Both infectious

diseases and unwanted pregnancies have always been possible outcome of sexual relationships. These two are crucial public health issues in the recent times. It has been noted that women are at higher risk than men for many of these sexually transmitted diseases and that young women are more susceptible than older ones [20].

Behavioral factors and infant mortality

The association between health behaviors of mothers and infant mortality rates have been established. Investigation have been conducted on how health-seeking behavior of mothers was affecting infant and child mortality in Bangladesh. It was noted that despite availability of health centers at lowest administrative level, the utilization of health center was poor with only 27.4% of the mothers utilizing antenatal care services. The result of the study identified some important determinants of child survival of different components of under-five mortality including neonatal, infant and child mortalities [28].

In 1998, researchers investigated the degree to which four behavioral risk factors explained the observed association between socio-economic characteristics and all-cause mortality. The behavioral risk factors include cigarette smoking, alcohol drinking, sedentary lifestyle and relative body weight. It was reported that the risk of dying was significantly raised for the lowest income and the middle-income groups when health risk behaviors were considered [21]. The mother's health-seeking behavior and childhood mortality in Pakistan was also examined in 1996. The result revealed that neonatal, infant and child mortality rates were the highest among children of mothers aged twenty years and below. It was further revealed that infant mortality reduced as the length of the birth interval increases. Similarly, the mother's education had positive effects on the neonatal, infant and child survival. Factors such as antenatal care, place of delivery, assistance during delivery and immunization also influenced neonatal, infant and child mortality in Pakistan [22].

The role of behavioral factors in explaining racial/ethnic disparities in infant mortality has also been investigated [23]. The focus was on weight gain during pregnancy, prenatal care utilization, exercise, vitamin use and substance use during pregnancy. The result suggested that behavioral factors were partially responsible for the observed race/ethnic differentials in infant mortality. In addition to the identified behaviors of pregnant mothers causing infant mortality, the use of unprescribed drugs (self-medication) during pregnancy can contribute to infant mortality. The unguided use of local herbs especially by pregnant women in the rural communities can as well predispose to infant mortality. All these unhealthy health behaviors should be checked through appropriate policies and health campaign programs.

Mortality has been found in the literature to be significantly associated with breastfeeding duration, total health care visits and low birth weight [27]. The authors of the study however concluded that complex and multiple factors may be involved in mortality of under 5-year-old children and that combined efforts would be necessary to improve child health indicators.

Conclusion

This review revealed that there are many research works in the literature that have tried to find out the effects of social, behavioral and environmental factors on infant mortality globally. Among the social factors that were found to affect infant mortality are poverty, household income, mother's economic status, nature of care for infants, maternal age, quality of life of infants, breastfeeding and birth orders. Others include birth intervals, place of delivery, income inequality, social policies, malaria, health scheme, mother's education and postnatal care. Similarly, environmental factors such as poor residential conditions, nature of water supply, particulate matter air pollution, poor sanitation, heavy metal poisoning and household environmental characteristics have been found in the literature to be linked to infant mortality in the underdeveloped, developing and developed countries of the world. Behaviors of pregnant women like cigarette smoking, alcohol drinking, sedentary lifestyle, weight gain, utilization of prenatal care facilities and exercises were found in the literature to be closely related to infant mortality. Therefore, based on the findings from this study, both governmental and non-governmental organizations

in the world should swing into action of preventing the menace of increasing infant mortality especially in the underdeveloped and developing countries. This will assist in the achievement of the Millennium Development Goals of achieving reduction of infant mortality globally by the year 2015.

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