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Full Length Research Paper

The impact of intermediate factors on socioeconomic differences and infant mortality in the Gaza Strip

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Infant mortality is a complex problem with no single solution. Numerous social, economic and intermediate issues play a role, rather than there simply being an issue of health care access or health care quality. The aim of the study was to determine the impact of intermediate factors (consanguineous marriage, mother's age and body mass index) on socioeconomic differences in infant mortality in the Gaza Strip. Person to person interviews were carried out with 550 mothers of infants; 275 infant deaths and 275 live births in the Gaza Strip. Binary logistic regression analyses were used to identify the relationship of health behavioral factors and infant mortality. Our study shows a clear positive statistical association between intermediate factors (normal weight, non-consanguineous marriage and mothers aged from 20 to 35) and survival of infants. Consanguineous marriage is the strongest intermediate factor (p-value = 0.000), followed by the mother's age (p-value = 0.005) and then body mass index (p-value = 0.012). In order to reduce infant mortality, governmental policy should give priority to health promotion and education among the public about the risk of early childbearing, consanguineous marriage and unhealthy weight.

Key words: Infant mortality, consanguineous marriage, young mother, older mother, underweight mother, obese mother, Gaza Strip.

INTRODUCTION

The infant mortality rate (IMR) is one of the most important sensitive indicators of the socioeconomic and health status of a community (Adlakha and Suchindran, 1985; Bittles et al., 1991; Chen et al., 2007). Many research studies showed that socioeconomic factors influence infant mortality through a set of intermediate variables (Quddus et al., 2002; Ergin et al., 2010; McGehee, 2005). These intermediate variables may lead directly or indirectly to infant mortality. Measures of intermediate factors thought to be associated with infant mortality include: consanguineous marriage, the mother's age to body mass (Al-Husain and Al-Bunyan, 1997; Kerkeni et al., 2007; Khyat and Saxena, 2005). A higher mortality risk is found for infants born to very young and very old mothers. Young adolescents are at the greatest risk for negative birth outcome, including; preterm delivery, low birth weight, small for gestational age, and neonatal mortality (Fraser et al., 1995; Phipps et al., 2002; Sharma et al., 2008; Titaley et al., 2008). Consanguineous marriage, particularly first-cousin couples, has higher rates of stillbirths and more deaths in infancy and early childhood (National Vita Statistical Report, 2007; Pedersen, 2002; Tamim et al., 2003). Pregnancy outcome is worst in babies born to mothers with low body mass index as compared to healthy weight mothers, with respect to increased incidence of preterm birth, lower birth weight and increased infant mortality (Bringer et al., 2008; Kawachi et al., 1994; Salihu et al., 2008; Stothard et al., 2009). In fact, many proximate determinants are directly influenced by socioeconomic and intermediate factors, such as a mother's education to radically alter the chances of child survival (Abuqamar et al., 2011a; Abuqamar et al., 2011b; Mosely and Chen,

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1984). Improvements in socioeconomic status variables, including income, water supply and maternal education, can also contribute to reduction of infant mortality due to proximate determinants (De Souza et al., 2001).

Our research aims to test the hypothesis that these intermediate factors have an effect on the relationship of socioeconomic factors (income, occupation and educational level) and infant mortality in the Gaza Strip.

METHODS

A case-control study was used to identify intermediate factors (consanguineous marriage, mother's age and body mass index) which contribute to a medical condition (infant mortality) by comparing subjects who have that condition (the 'cases' dead infant) with subjects without that particular condition and who are otherwise similar. This process is called one-to-one matching. Matches are made, based on how well they reduce differences between case and control on a potentially confounding variable. The target population of our study included all children who died between birth and 12 months in the Gaza Strip during 2008; all live births born in the period between 1 June 2007 and 31 May 2008 and were still alive were used as control group. The study was conducted in all governorates of Gaza (North, Gaza, Middle, Khanyounis and Rafah). We used a modified systematic random sampling technique wherein we first identified the required sample size, which were 330 dead infants (300 for the main study, 30 for the pilot study). We subsequently divided the total number of the population (990 dead infants in 2008) with the sample size to obtain the sampling fraction. The sample fraction was 3.

We started with a pilot study, including 60 participants (30 cases and 30 controls) representing 10% of the main study. The pilot study was done in the Gaza governorate, because it is the biggest governorate and the most representative for the sample (including refugees, non refugees, low and high socioeconomic level). The pilot study was conducted in order to assess the workability of the questionnaire and the interviewer's abilities. We also wanted an idea of the obstacles we were likely to face during data collection, such as accessibility of participants, in order to minimize the non-resparticipant during the main study. Four staff members carried out the pilot study over ten days. Every interviewer did one or two interviews a day at the mother's home. As a result of our pilot study, some questionnaire questions were updated and given better explanations. We also added two new questions which yielded important supplementary information to our study. The accessibility of the participants needed a lot of efforts and time, so we recruited one more interviewer for the main study.

For the main study, 300 dead infants were selected as case. We selected equal numbers for control. When the cases and controls are available and when there are more than 100 participants and the cost is the same, the most efficient is to have the same number of cases and controls (Coggon et al., 2003). We did a matching for location of residence, gender, and civilian status. The response rate was 92% (275 cases, 275 controls). Five female qualified staff members with a social and medical background performed the interviews with the mothers at home. Their work was supervised on location by Walid Sabah, Head of the Health Education department of the Ministry of Health in the Gaza Strip. The completed questionnaires were scanned and sent as soft copies via internet to the researcher working at the Department of Medical Sociology of the Free University of Brussels. Hard copies of the questionnaires were printed out in Brussels where the data entry took place.

Variables of interest

The variable consanguineous marriage was categorized as double first cousin, first cousin, same clan of father, same clan of mother and unrelated marriage. Currently, international consensus about the definition of the vulnerable age of a pregnant woman has been lacking. Therefore, our study adopted the definition of the World Health Organization, which considers less than 20 and over 35 as risky ages for pregnant women (WHO, 2009). The age of mother was categorized as young mother (< 20 years), normal age (20 to 35 years) and older mother (> 35 years). The body mass index of the mother was categorized as underweight (< 18.5), normal weight (18.5 to 24.9) and obese (30 or higher)[1]. Both BMI and age of the mother were considered at the beginning of pregnancy.

The educational level of the parents was categorized into two groups: low education (secondary school or less) and higher education (university or above). The parents' income was categorized into two groups: low income (> 300 Euro monthly) an high income (> 300 Euro monthly). The parents' occupational type was categorized into three groups: skilled, semi-skilled and unskilled occupation.

The proximate determinants were defined as the medical cause of infant death that were mentioned in hospital records. There were six main proximate determinants of infant mortality in the Gaza Strip 2008 (Congenital anomaly; prematurity and low birth weight; respiratory diseases; sudden infant death; infectious disease; and septicemia and malnutrition).

Data analysis was performed with the Statistical Package for the Social Sciences (SPSS), version 18. Descriptive statistics (Frequencies, cross tabulation and Chi-square value) were used to describe the main features of the data and to study the first-hand relationship between the variables.

Logistic regression (for binary outcome) was used to model the association between the intermediate factors and the dichotomous dependent variable (dead infant or not). The model included all intermediate factors (consanguineous marriage, mother's age and mother's body mass index) on infant mortality in the Gaza Strip. A significant result means that the p-value for the hypothesis tests is less than 0.05. The confidence intervals (CI) were reported as 95%.

RESULTS

Consanguineous marriage

Table 1 shows the influence of consanguineous marriage on infant mortality in the Gaza Strip. Consanguineous marriage was higher among the parents of dead infant (64%) than among the parents of live birth (47.6%). Consanguineous marriage was a significant determinant of infant mortality (Chi-square value 28.96, p-value = 0.000).

Table 2 gives the binary logistic regression which was used to predict the effect of consanguineous marriage related to infant mortality (p-value = 0.000). The risk of infant death was double among mothers in a consanguineous marriage than among mothers without consanguineous marriage (odds ratio 2.09, P < 0.05).

The risk of a low income (< 300 Euro) and an unemployed father was higher within consanguineous marriages than without consanguineous marriages (odds ratio 1.533) as shown in Table 3.

[1] [1] $BMI = W / H^2$, where W is the weight in kilograms and H is the height in meters.

Table 1. Cross tabulation and Chi-Square Tests - Intermediate factors related to infant mortality in Gaza Strip, 2008.

Determinants	Frequency		Percentage		df	Chi^2 value	p-value
	Case	Control	Case	Control			
Consanguineous marriage	275	275	100	100			
Double first cousin	22	4	8	1.5			
First cousin	87	76	31.6	27.6			
Same clan, father	39	40	14.2	14.4	4	28.96	0
Same clan, mother	28	11	10.2	4.1			
Unrelated marriage	99	144	36	52.4			
Age of the mother	2758	275	100	100			
Less than 20 years	61	39	22.2	14.2			
Age from 20 to 35 years	178	215	64.7	78.2	2	12.27	0.002
Age more than 35 years	36	21	13.1	7.6			
Mothers' Body Mass Index (BMI)	275	275	100	100			
Underweight	13	3	4.7	1.1			
Normal weight	224	247	81.5	89.8	2	10.06	0.007
Obese	38	25	13.8	9.1			

Table 2. Logistic regression – intermediate factors and infant mortality.

Intermediate factors	Wald	p-value	Crude OR	Adjusted OR
Consanguineous marriage	16.81	0.000	1.96(1.39.2.75)	2.09 (1.47-2.97)
Unrelated marriage	1	1	1	1
Age of the mother	10.01	0.005	-	-
Young mother (<20yrs)	5.13	0.024	1.89(1.21-2.96)	1.98 (1.13-3.62)
Normal age (20-35)	1	1	1	1
Older age (>35yrs)	6.80	0.009	2.07(1.17-3.68)	1.86 (1.19-3.01)
Body Mass Index of the mother	8.82	0.012	-	-
Underweight	3.98	0.048	1.88(1.08-2.97)	1.81(1.01-3.04)
Normal weight	1	1	1	1
Obese	5.90	0.015	4.78(1.34-16.99)	5.02(1.37-18.47)

Variable(s) entered on Step 1: consanguineous marriage, BMI, age of mother.

Table 3. Odds ratio (OR) of intermediate factors to socioeconomic variables.

Socioeconomic indicators	OR value	Lower	Upper
Young mother / mother education =< secondary school	2.584	1.474	4.531
Young mother / fathers' education =< secondary school	1.352	0.850	2.146
Consanguineous marriage/ unemployed father	1.510	1.050	2.187
Consanguineous marriage/ income<1700 NIS(300 Euro)	1.533	1.090	21.156
Underweight/low income	8.095	1.878	34.927

Figure 1 shows the mutual relationship between consanguineous marriage and low educational level of the parents. It also shows the mutual relationship between consanguineous marriage and other socioeconomic factors, such as jobless fathers and low income.

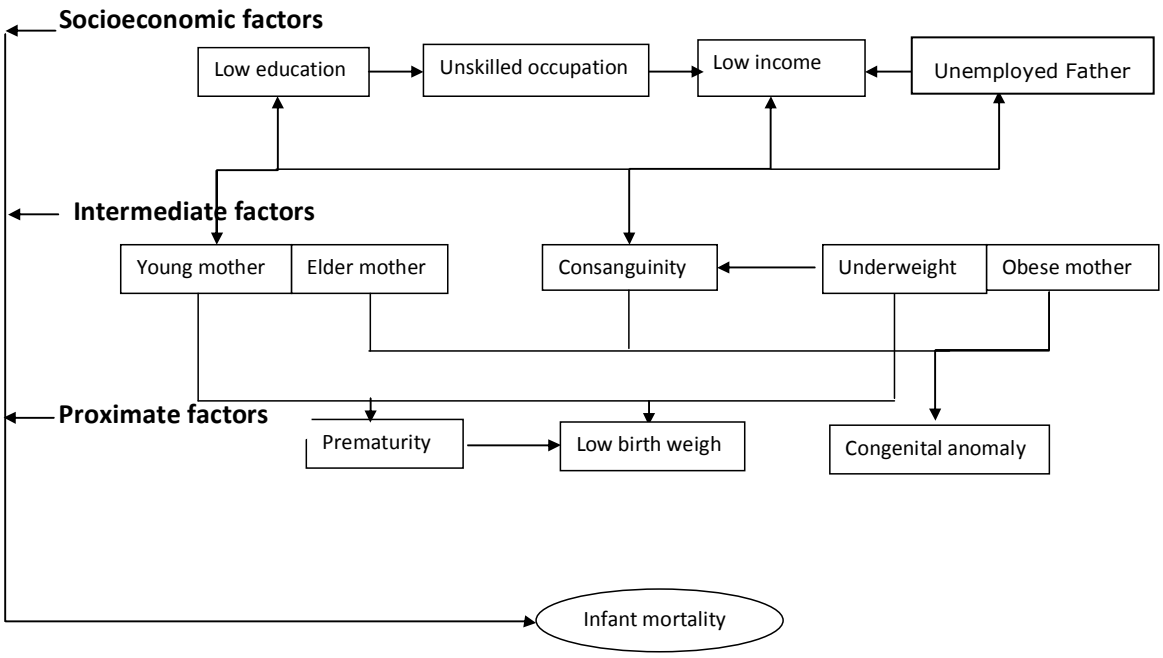

Figure 1. The influence of intermediate factors on socioeconomic factors and infant mortality.

Age of the mother

Table 1 shows the influence of mother's age factor on infant mortality in the Gaza Strip. Over 35% of the mothers of dead infants were in the risk age group (< 20, > 35), whereas 21% of the live births mothers were in the same category. The age of the mothers was a significant determinant of infant mortality (Chi-square 12.271, p-value = 0.002).

In Table 2, the age of mothers was a significant determinant of infant mortality (p-value = 0.005). We saw that the risk of infant death was twice as high among young mothers than among normal age mothers (odds ratio 1.98, P< 0.05). The risk of dead infant was also double higher among older mothers than normal age mothers (odds ratio 1.86, P < 0.05).

Table 3 represents the relationship between age of the mother and socioeconomic factors. The risk of low educational level was higher among young mothers than among normal age mothers (odds ratio 2.584, P < 0.05). The risk of low educational level of fathers was higher among young mother than among normal age mothers (odds ratio 1.352, P < 0.05).

The young mother factor had a mutual relationship with low educational level of the parents and low income as shown in Figure 1.

Body mass index of the mother (BMI)

Table 1 shows the influence of mother's body mass index (underweight, normal weight and obese) on infant mortality in the Gaza Strip. Both vulnerable weights (underweight and obese) were higher among mothers of dead infant (18.5%) than among mothers of live birth (10.2%). The body mass index of mothers was a significant determinant of infant mortality (Chi-square 10.065, p-value = 0.007).

In Table 2, the body mass index of mothers was a significant determinant of infant mortality (p-value = 0.012). The odds ratio of underweight mothers was double, which is higher compared to the healthy weight mothers (odds ratio 1.81, P < 0.05). The risk of a dead infant was five folds higher among obese mothers compared to healthy weight mother (odds ration 5.02, P < 0.05).

Table 2 represents the relationship between the body mass index of the mother and socioeconomic factors. The risk of underweight mothers was higher among low income families than among high income families (Odds ratio 8.095, CI = 95%).

Body mass index factor was affected by low income, where underweight mothers had a positive relationship with low income, as shown in Figure 1.

In Figure 1, the body mass index factor was a predisposing factor of the proximate factors, which led to infant mortality. Underweight of the mother had a positive relationship with low birth weight. The obese mother also had a positive relationship with congenital anomaly, which was considered the main cause of infant mortality in the Gaza Strip 2008.

Figure 1 also shows that the intermediate factors are

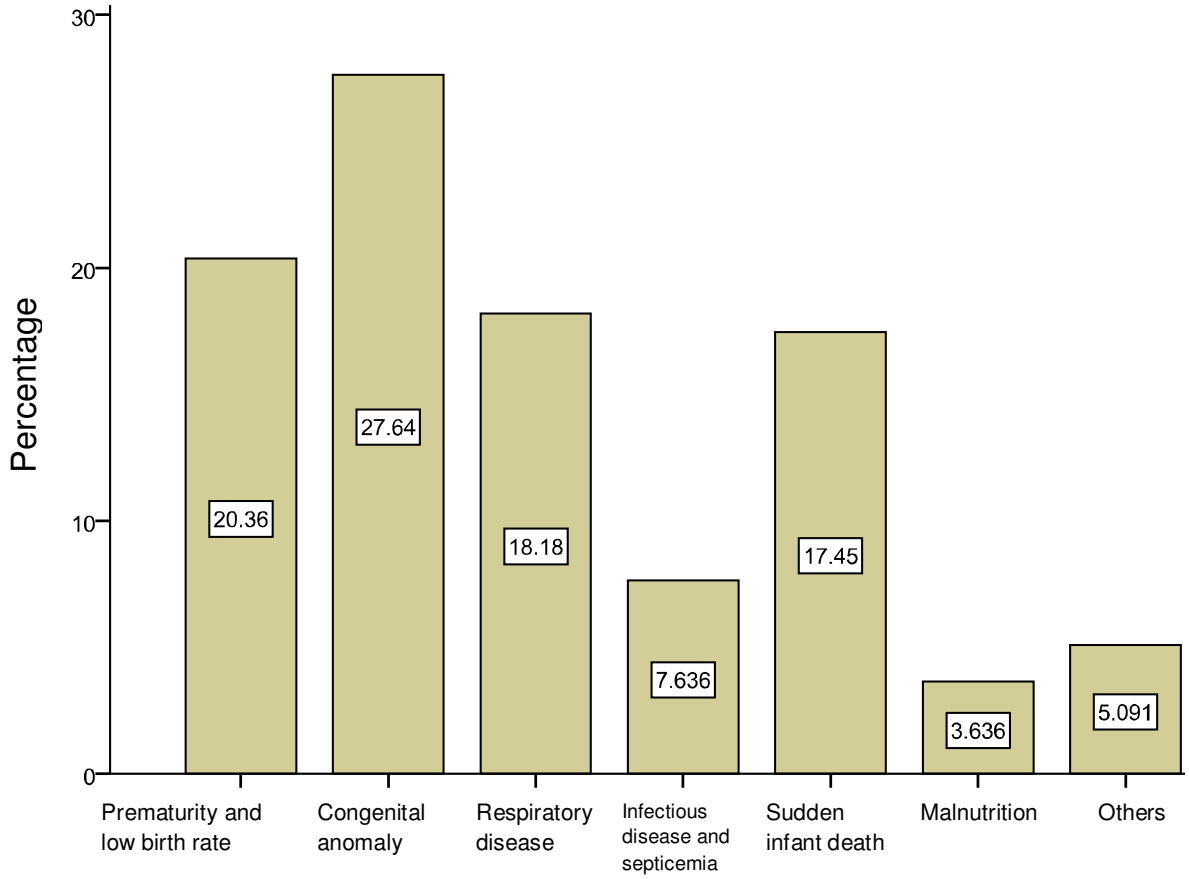

Figure 2. Proximate determinants of infant mortality in Gaza Strip 2008.

predisposing factors for the proximate factors (congenital anomaly, low birth weight and prematurity), which were considered as the main causes of infant mortality in Gaza Strip.

Figure 2 presents the main proximate determinants of infant mortality in the Gaza Strip 2008. The main determinants were congenital anomaly (27.6%), prematurity and low birth weight (20.4%), respiratory diseases (18.2%), sudden infant death (17.6%), infectious disease and septicemia (7.6%) and malnutrition (3.6%).

Figure 3 showed that congenital anomaly was higher among consanguineous marriage (79%) than non-consanguineous marriage (21%).

Finally, we found that consanguineous marriage was the strongest intermediate factor (p-value = 0.000, Chi-square = 28.96), followed by age of the mother (p-value = 0.008, Chi-square = 12.27) and body mass index (p-value = 0.013, Chi-square = 10.06), as shown in Tables 1 and 2.

There was also an intra-relationship between the intermediate variables: a positive relationship was found between consanguineous marriage and young mothers as shown in Figure 1 (correlation = 0.855).

DISCUSSION

In this study, intermediate factors were considered in assessing the relationship between socioeconomic factors and infant mortality in the Gaza Strip. Intermediate factors such as consanguineous marriage, the mother's age and body mass index were significantly associated with infant mortality and socioeconomic status.

This study highlighted the influence of the socioeconomic on the intermediate factors and their effect on the proximate factors that lead to infant mortality. Consanguineous marriage, vulnerable age of the mother and unhealthy weight of the mother were risk factors for having dead infants. The results of this study were consistent with previous research studies that showed the impact of intermediate factors on socioeconomic aspects and infant mortality (Mustafa, 2008; Sohler et al., 2003; Shawky and Milaat, 2000; Tuncbilek and Koc, 2007).

Consanguineous marriage was one of the most significant intermediate determinants of infant mortality. Regarding the association between consanguineous marriage and infant mortality, many research studies

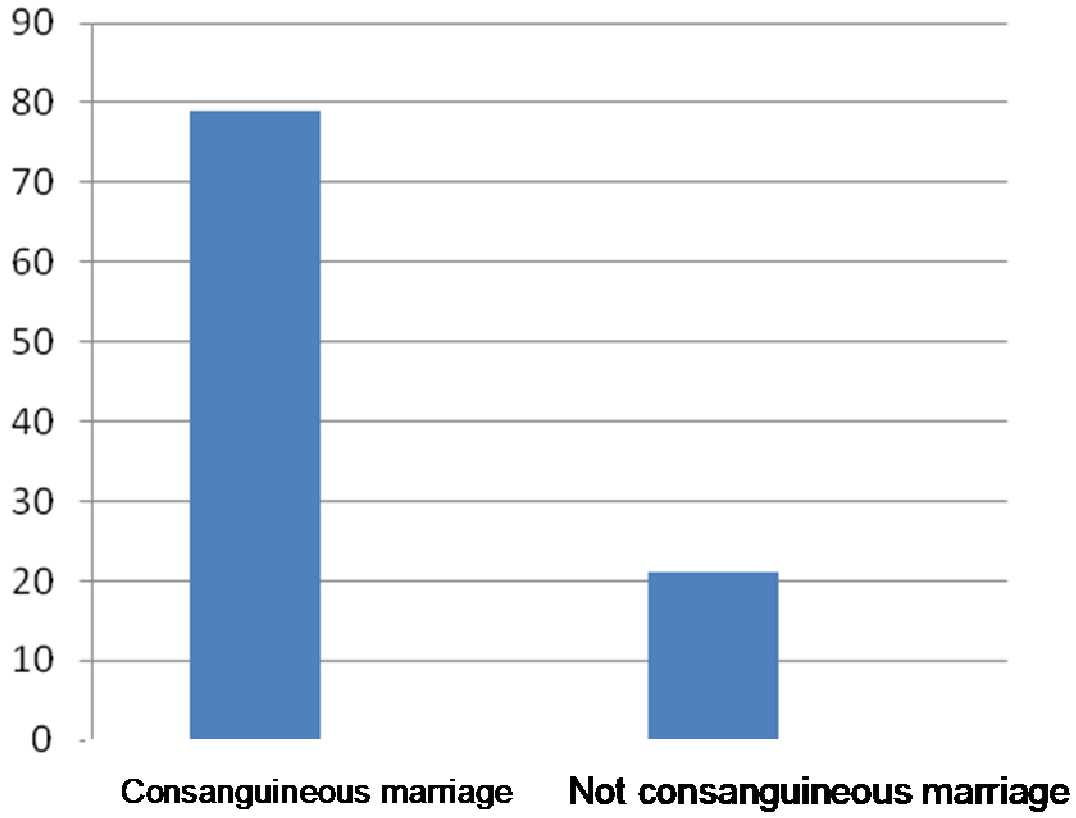

Figure 3. Consanguineous marriage related to congenital anomaly.

supported our findings and the reported effect of consanguineous marriage (particularly first cousin) on child mortality (Ergin et al., 2010; Majumder et al., 1997; Pedersen, 2002; Tamim et al., 2003).

Bittles et al. (1991) also showed that congenital malformations and death in the first year of life are significantly higher in children of consanguineous parents. Again, social factors affect this statistic, as most consanguineous parents come from a lower socioeconomic background, where infections and malnutrition are common (Bittles et al., 1991). In a study in Tunisia Kerkeni et al. (2007) reported that higher rates of neonatal and post-neonatal deaths were observed in consanguineous couples (Khawaja et al., 2008). Other research studies showed the influence of the socioeconomic status on consanguinity. In Saudi Arabia, al Husain and al Bunyan reported a significant association between the level of education and consanguinity (Al Husain and Al Bunyan, 1997). They showed that the mothers who were either illiterate or had completed only primary education were married to a relative.

A difference in the infant mortality rate may also be seen when considering the age of the mother. Younger and older mothers who got pregnant have a higher risk to get dead infants than mothers in the desirable age (20 to 35 years). This finding is also supported by previous research studies, when they found that infant mortality was higher among births to teenage mothers and to mothers older than 35 year (Mturi and Curtis, 1995; Mustafa, 2008; Reichman et al., 1998). In New York State, Gage et al. (2009) indicate that maternal age significantly influences the birth weight distribution and that maternal age also affects infant mortality directly or indirectly (very preterm and preterm delivery, low birth weight). In contrast with our findings, the study of Sharma et al. (2008) found no relationship with the age of the mother over 15 years. They only found that infants born to mothers aged 12 to 15 years were at a higher risk of neonatal mortality.

Research studies also support our findings that the age of the mother influences the socioeconomic aspect. The youngest mothers are at the greatest risk for low educational level, unskilled occupation and unemployment (Chen et al., 2007; Egerbladh and Bittles, 2008; Gage et al., 2009).

The body mass index of the mother had a substantial independent influence on the infant mortality rate as well. The study of Kalk et al. (2009), showed that pregnancy outcome is worst in babies from mothers with low body mass index, as compared to healthy weight mothers, with respect to increased incidence of preterm birth, lower

birth weight and increased neonate mortality.

Salihu et al. (2008) study showed that infant mortality, particularly neonatal mortality, increased with higher obesity subclass, with the greatest risk registered among morbidly obese mothers.

Our findings are in a line with recent studies that reported the relationship between obese mothers and congenital anomaly. They indicate that obese women have a higher incidence of adverse fetal outcomes (macrosomia, neural tube defects) (Bringer et al., 2008; Kalk et al., 2009; Satpathy et al., 2008; Galtier-Dereure et al., 2000).

To our knowledge, our study was the first of this kind in the Gaza Strip. The study is original in the sense that social, economic and intermediate factors are considered together in a global assessment of the infant mortality rate.

Although our findings offer important insights into maternal age, consanguineous marriage and body mass index and their effect on the mortality of infants in Gaza Strip, they must be interpreted in the light of certain study limitations. The majority of outcomes were based on self report, which is liable to social desirability and recall bias. An additional issue concerns the measurement of birth weight. Birth-weight data was not available for all participants; only 80% of the mothers were able to provide these data. Birth-weight data were predominantly based on infant medical record cards held by mothers, though maternal recall was used for some participants.

Conclusion

Mortality, especially in the first year of life, was significantly higher in consanguineous marriages, young mothers, older mothers, underweight mothers and obese mothers. Further studies are needed to confirm whether maternal overweight is also implicated.

In order to reduce infant mortality, governmental policy should give priority to health promotion and education among the public about the risk of early childbearing, consanguineous marriage and unhealthy weight. Pre-conception counseling, careful prenatal management, and long-term follow-up might minimize the risk of infant mortality.

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