PUBLIC HEALTH RESEARCH

Mortality in Children Under 5: Prevalence of Congenital Malformations and its Associated Demographic Variables

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ABSTRACT

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Introduction Congenital malformations (CM) comprise a wide range of abnormalities of body structure or function that are present at birth and are of prenatal origin. It has contributed to a significant proportion of infant morbidity and mortality. The aims of this study were to determine the extent and investigate the relationship between CM and its associated demographic variables.

Methods Data was extracted from Ministry of Health (MOH) database compiled from the reports on Stillbirth & Under 5 Mortality from year 2013 to 2014.

Results Out of 9,827 child death, 2,840 (28.9%) were classified under CM as defined under ICD-10 classification. Majority of those with CMs died at neonatal stage (62.7%) and among mothers aged between 20 to 35 years old (67.3%). The mean age of mothers among CM children was 30.8±6.5 years old. Approximately 5.8%, 6.7% and 3.3 % of total CM were neural tube defects, heart defects and hydrops fetalis respectively. The prevalence of CM in males was 15% higher than females. The difference were evident between CM and age of death of children under 5 years old ($p<0.001$) as well as between CM and maternal age groups ($p<0.001$).

Conclusions CM is responsible for 28.9% of total causes of child death with higher occurrence of malformation in males. A significantly higher risk of CMs among mother aged between 20 to 35 years old was observed. This emphasises the importance of raising awareness and the need to strengthen appropriate response for surveillance and prevention program of common CM in Malaysia.

Keywords Congenital malformations - Child death - Neonatal - Neural tube defects - ICD-10.

INTRODUCTION

Under-five mortality rate is one of an important indicator of the health status of a community and development of a country. It is defined by UNICEF as the probability of dying between birth and exactly five years of age expressed per 1000 live births.[1] According to World Health Organisation (WHO), there were 7.6 million deaths in children younger than 5 years in 2010, 64.0% (4.879 million) were attributed to infectious causes and 40.3% (3.072 million) occurred in neonates. [2] Overall, the under-five mortality rate ranged between 87 per 1000 live birth in year 1990 to 51 per 1000 live birth in 2011.[3] There was a decline of under 5 years old mortality rate in Malaysia ranging from 16.8 per 1000 live births in 1990 to 7.7 per 1000 live births in 2012. In order to meet the objective of the 4th Millenium Development Goals for Health (MDG 4), a two-third reduction in mortality in children younger than 5 years must be achieved from the year 1990 to 2015. Eventually, the targeted child mortality rate in Malaysia must be reduced to 5.5 per 1000 live births by 2015.

According to the World Health Statistics 2012, about 7% of all under-five deaths globally were caused by congenital malformation (CM) or birth defects.[4] WHO defined birth defects or CM as structural or functional anomalies that occur during intrauterine life and can be identified prenatally, at birth, or sometimes may only be detected later in infancy, such as hearing defects. Based on World Bank Report,[5] birth defects or CM are responsible for a greater proportion of infant and childhood mortality. There has primarily been a significant decline in infant and childhood mortality rates in the past two decades as a result of extensive and successful use of immunization, control of diarrhoeal disorders, acute respiratory tract infections and improvement in health-care services through a focus on primary health care. The importance of attainment of MDG 4 target on reduction of child mortality, prevention and management of birth defects issues need to be urgently emphasised and addressed. Despite increasing understanding of the molecular origins of CM it is often difficult to identify the exact causes. Although approximately 50% of all congenital anomalies cannot be linked to a specific cause, there are some known genetic, environmental and other causes or risk factors. CM can contribute to long-term disability, which may have significant impact on individuals, families, health-care systems, and societies. The most common, severe CM are heart defects, neural tube defects and Down syndrome. However, some CM can be prevented by vaccination, adequate intake of folic acid or iodine through fortification of staple foods or supplementation, and adequate antenatal care.[6] Some congenital CM like tracheo-esophageal fistula, diaphragmatic hernia, choanal atresia and intestinal obstruction require urgent medical and surgical interventions for the survival of the patients.[7]

In Malaysia, a national prospective study which was conducted in 2006[8] reported that the leading causes of deaths in children aged between 29 days and 5 years were congenital malformations, deformations and chromosomal abnormalities (25.1%) followed by infectious and parasitic diseases (18.8%), diseases of the respiratory system (13.0%), diseases of the nervous system (8.2%) and injuries and poisoning and external causes (7.5%) Surveillance and monitoring of CM is important for identifying patterns of malformations. A nationwide surveillance is essential as it can recognize the disease burden in pre and post-natal period and related risk factors. This is helpful for strategic planning to improve the pregnancy related outcomes and also help to strengthen an appropriate response for surveillance and prevention of common CM in the country. The objective of this study was to determine the prevalence and investigate the existence of a relationship between the type of CM and the child demographic variables (gender, age of death, maternal age and education) recorded in 2013 to 2014.

METHODS

A descriptive, cross-sectional, retrospective study was carried out using the database compiled by Ministry of Health (MOH) obtained from the reports on Stillbirth & Under 5 Mortality from year 2013 to 2014. The data was collected via the PNM1/97 (Amended 2000) which was submitted by both public and private facilities in Malaysia from year 2013 to 2014. For the purpose of this study, only variables pertinent to the causes of death, such as congenital malformations and demographic parameters of children under 5 years old were extracted and examined.

This study was conducted with an approval from National Medical Research and Ethics Committee (MREC) of the Ministry of Health (MOH), Malaysia via the National Medical Research Registry (NMRR) with assigned number NMRR-14-1677-22986.

Definition

ICD-10 is the 10th revision of the International Statistical Classification of Diseases and Related Health Problems, a medical classification list by WHO. It contains codes for diseases, signs and symptoms, abnormal findings, complaints, social circumstances and external causes of injuries or diseases.[9] Early Neonatal deaths are death occurring in a newborn baby at less than 7 days of life. Late Neonatal deaths are death occurring in a newborn baby at less than 28 days of life

Statistical Analysis

Analyses were performed with the SPSS statistical software package version 15.0. Descriptive statistics and Chi-square ($\chi 2$) analysis were computed to express the distribution of types of congenital malformations (CM) by demographic characteristics. P-value of less than 0.05 was considered as significant associated.

RESULTS

The causes of death among children under 5 years old from the database compiled by MOH according to ICD-10 classification is as depicted in Figure 1. The prevalence of child death arising from the condition from perinatal period were found to be the most common (33.8%) and followed by congenital malformations (28.9%). About 60% of those with congenital malformations died at less than 28 days of life.

The age and causes of child death are as shown in Table 1 and Figure 2. Highest child death occurred among the neonatal group (54.3%) and followed by infant of 28 days to under one year group (27.7%). Table 2 showed the classification of types of CM by demographic variables of children under 5 years old. The mean age of mothers with CM children was 30.8±6.5 years old. CM was slightly more prevalent in males than females. The ratio of male to female was 1.15 to 1. Among the CM, approximately 5.8%, 6.7% and 3.3 % were neural tube defects, heart defects and hydrops fetalis respectively. Other congenital defects accounted for about 68.4% of total CM. The difference were evident between types of CM and age of death of children under 5 years old ($p<0.001$) as well as between types of CM and maternal age groups ($p<0.001$). The largest proportion of CM was found among neonatal group (62.7%) and mothers aged between 20 to 35 years old (67.3%). No association between maternal education attainment and CM was observed.

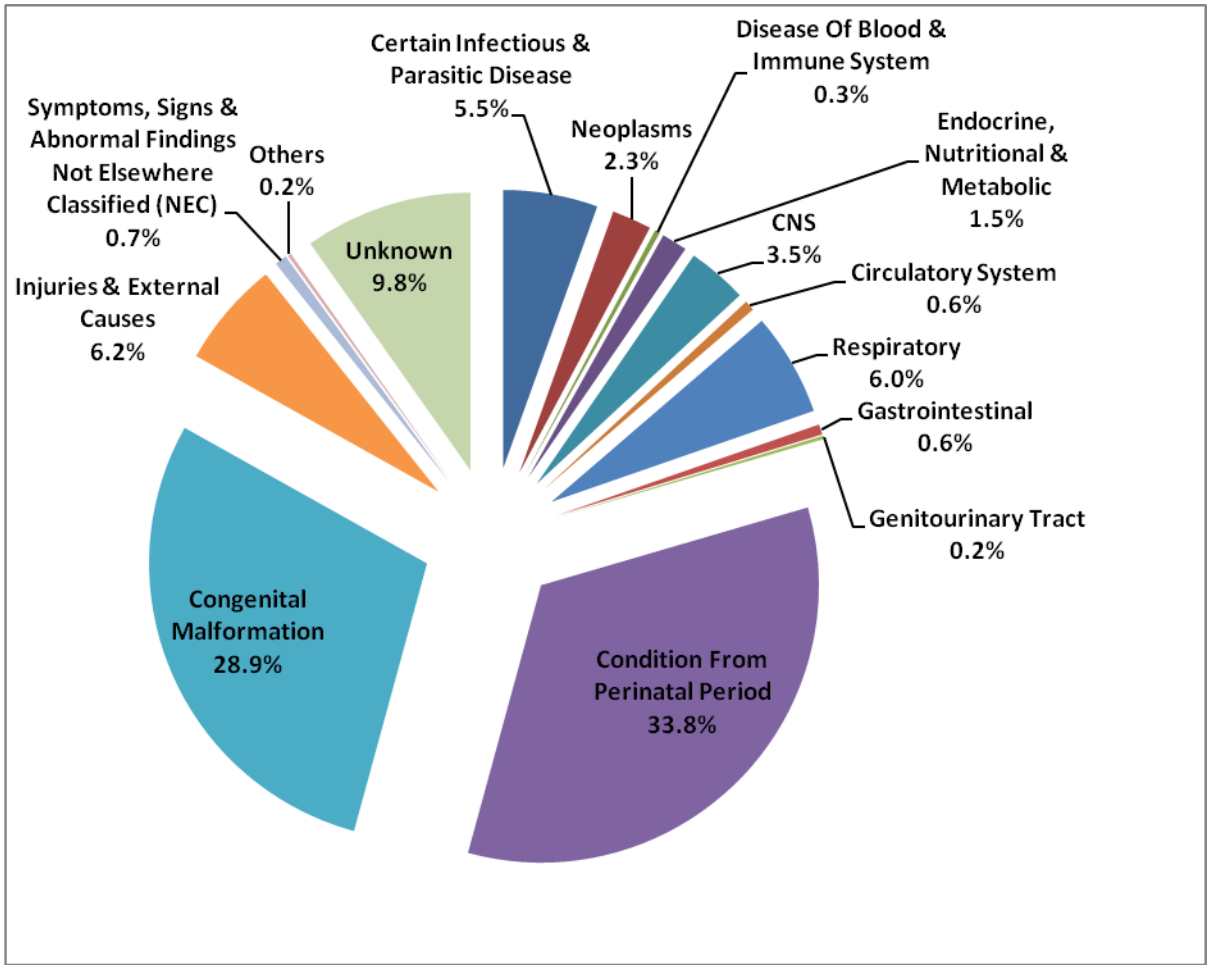

Figure 1 Causes of child death by ICD-10 classification

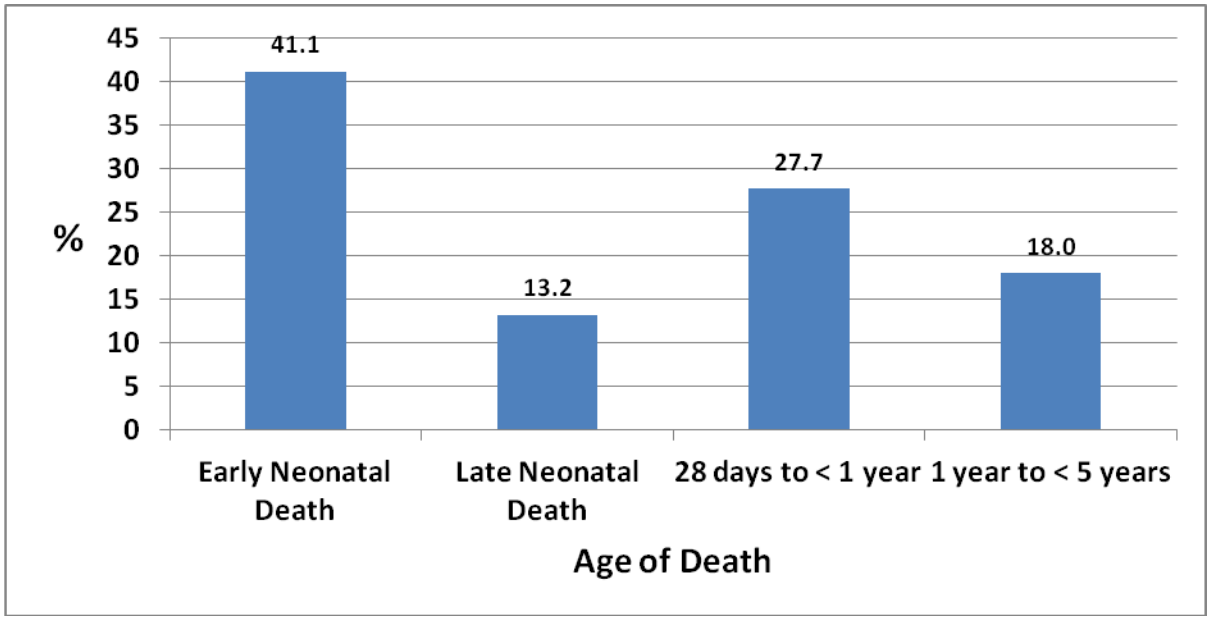

Figure 2 Distribution of child death by age groups

Table 1 Causes of child death (ICD -10 classification) by age groups

Causes of Death (ICD-10)	Age of Death, n (%)				
	Early Neonatal Death	Late Neonatal Death	28 days to < 1 year	1 year to < 5 years	Total
Certain Infectious & Parasitic Disease	17(0.4)	22(1.7)	291(10.7)	212(12.0)	542(5.5)
Neoplasms	1(0.0)	2(0.2)	42(1.5)	177(10.0)	222(2.3)
Disease Of Blood & Immune System	1(<0.1)	1(<0.1)	14(0.5)	13(0.7)	29(0.3)
Endocrine, Nutritional & Metabolic	13(0.3)	12(0.9)	71(2.6)	50(2.8)	146(1.5)
CNS	2(<0.1)	5(0.4)	157(5.8)	181(10.2)	345(3.5)
Circulatory System	0(0.0)	0(0.0)	24(0.9)	30(1.7)	54(0.5)
Respiratory	4(0.1)	6(0.5)	339(12.5)	243(13.7)	592(6.0)
Gastrointestinal	0(0.0)	0(0.0)	40(1.5)	21(1.2)	61(0.6)
Genitourinary Tract	1(<0.1)	0(0.0)	3(0.1)	11(0.6)	15(0.2)
Condition From Perinatal Period	2336(57.8)	692(53.5)	278(10.2)	12(0.7)	3318(33.8)
Congenital Malformation	1376(34.0)	406(31.4)	820(30.1)	238(13.5)	2840(28.9)
Injuries & External Causes	12(0.3)	13(1.0)	187(6.9)	397(22.5)	609(6.2)
Symptoms, Signs & Abnormal Findings Not Elsewhere Classified (NEC)	12(0.3)	7(0.5)	49(1.8)	1(0.1)	69(0.7)
Others	2(<0.1)	1(<0.1)	11(0.4)	5(0.3)	19(0.2)
Unknown	266(6.6)	126(9.7)	396(14.5)	177(10.0)	965(9.8)
Total	4043(100.0)	1293(100.0)	2723(100.0)	1768(100.0)	9827(100.0)

Table 2 Classification of types of congenital malformations by demographic variables of children under 5 years

	Variable	Types of Congenital Malformation, CM							
		Neural Tube Defect	Complex/Cyanotic Heart Disease	Recognisable Syndrome	Not Recognisable Syndrome	Hydrops Fetalis	Others	Total n	*p-value
Sex, n (%)	Male	82(5.5)	115(7.8)	191(12.9)	31(2.1)	43(2.9)	1019(68.8)	1481	0.002
	Female	77(6.0)	74(5.8)	185(14.4)	21(1.6)	47(3.7)	881(68.6)	1285	
	Indeterminate /Unknown	5(6.8)	1(1.4)	15(20.3)	7(9.5)	3(4.1)	43(58.1)	74	
	Total	164(5.8)	190(6.7)	391(13.8)	59(2.1)	93(3.3)	1943(68.4)	2840	
Age of Death, n (%)	Early Neonatal Death	145(10.5)	87(6.3)	293(21.3)	48(3.5)	78(5.7)	725(52.7)	1376	<0.001
	Late Neonatal Death	18(4.4)	87(21.4)	82(20.2)	8(2.0)	13(3.2)	198(48.8)	406	
	28 days to < 1 year	0(0.0)	16(2.0)	15(1.8)	3(0.4)	2(0.2)	784(95.6)	820	
	1 year to < 5 years	1(0.4)	0(0.0)	1(0.4)	0(0.0)	0(0.0)	236(99.2)	238	
	Total	164(5.8)	190(6.7)	391(13.8)	59(2.1)	93(3.3)	1943(68.4)	2840	
Maternal Education Level, n (%)	Non Tertiary	101(6.1)	120(7.3)	206(12.5)	24(1.5)	61(3.7)	1141(69.0)	1653	0.36
	Tertiary	27(5.9)	29(6.4)	75(16.5)	5(1.1)	15(3.3)	304(66.8)	455	
	Total	128(6.1)	149(7.1)	281(13.3)	29(1.4)	76(3.6)	1445(68.5)	2108	
Maternal Age Group, n (%)	<20 years	11(12.1)	7(8.1)	9(9.9)	5(5.5)	5(5.5)	54(59.3)	91	<0.001
	20.0-34.9 years	116(7.1)	133(8.2)	203(12.5)	38(2.3)	66(4.0)	1074(65.9)	1630	
	≥35 years	32(4.6)	41(5.9)	169(24.1)	15(2.1)	21(3.0)	422(60.3)	700	
	Total	159(6.6)	181(7.5)	381(15.7)	58(2.4)	92(3.8)	1550(64.0)	2421	

*p-value derived from Chi-square ($\chi 2$)

DISCUSSION

The prevalence of child death arising from CM was 28.9%. CM is responsible for approximately 60% of neonatal death. The high proportion of child death attributed to CM could be due to a significant decline in the overall childhood mortality rates which resulted from extensive use of immunization, improved control of infections, control of diarrhoeal disorders, acute respiratory tract infections and improvement in health-care services through a focus on primary healthcare in Malaysia. As revealed in World Bank report in 1993, CM have become known important causes of child mortality contributing to around 30-35% of perinatal, neonatal and child mortality in developed countries.[5]

In the present study it was found that incidence of CM was higher in males. Ratio of malformed males to females was found at 1.2 to 1.0. Similar finding was also reported in other studies conducted in India where a higher incidence of CM occurred in males than in female babies. There is a possibility that the females were afflicted with more lethal congenital malformations and could not survive to be born with signs of life.[10-11]

Maternal education was considered in this study in order to examine its possible association with the development of fetal malformations. It must be emphasised that educational guidance is of paramount importance for the acquisition of knowledge that assists in daily decisions making. However, in this present study, no association between maternal education attainment and types of CM was observed. In one of the studies conducted in China, a higher level of maternal education was associated with a better discernment of the mother in relation to the need to monitor her pregnancy and care for the child, including those that may have resulted in malformed fetuses. Also it was demonstrated that higher level of education was positively related to quality prenatal care.[12] Furthermore, lack of maternal education may be reflected in lack of understanding of how to care for an infant, implement prevention measures, and recognize early signs of serious illness.

Maternal age is an important parameter in the birth of a congenitally malformed fetus.[13] In this study, a statistically significant association was found between maternal age and types of CM. The largest proportion of CM was found among mothers aged between 20 to 35 years old (67.3%). This is in contrast with other studies where a high occurrence of congenital abnormality among women who are older than 35 years of age.[13-14] It has been suggested that increasing age of the mothers is associated with an increase in chromosomal meiotic errors and probably is the only non genetic risk factor for trisomies in human beings.[15-16] However, another study conducted by Dutta et al.[17] revealed that statistically insignificant association of increased maternal age and congenital anomalies was noted.

The results of this study showed that the proportion of deaths due to CM has become a more important cause of child mortality. As known, CM contributes to lifelong disabilities with an enormous economic and social burden on society. Hence, it is crucial to strive to educate the public by providing comprehensive guidance, information and awareness-raising to prevent or reduce congenital malformations especially to women of child bearing age. However, it should be noted where the occurrence of CM resulting from environmental causes could be decreased through primary prevention. For example, immunisation against rubella in adolescence is a preventive measure to ensure women do not contract rubella while pregnant. Active immunization against rubella was the only effective way of preventing and subsequently eliminating congenital rubella syndrome. Measures like isolation of infected persons to segregate them from infecting a pregnant woman are not feasible. This is because a large majority of infections remain sub-clinical, and the symptoms vary and are generally mild if at all manifested. With regards to neural tube defects, increasing the consumption of multivitamins and folate prior to conception and throughout the first trimester of pregnancy can decrease the likelihood of its occurrence in the newborn. There is some evidence that folic acid and/or multivitamins may reduce the prevalence of limb reduction defects too.[18] As such, public health awareness campaigns on the need for folic acid supplementation is very important or essential. Other prevention programs such as avoidance of pregnancy after 35 years of age and avoidance of certain medications or recreational drugs (even if not proven to be teratogenic) or X-rays or environmental hazards during early pregnancy (first trimester) should be addressed during antenatal care counselling.

LIMITATION

The data on congenital malformation was not classified by organ system. As such, it is not feasible to identify which was the most common system involved in the CM for this study. The underlying causes for most of CM still remain obscure. Another limitation was that the association between types of CM and maternal education attainment or maternal age was analysed based on the available data.

CONCLUSION

The most common prevalence of child death was from the condition from perinatal period (33.8%) and followed by CM (28.9%). Majority of those with CM died at neonatal stage (62.7%) and among mothers aged between 20 to 35 years old (67.3%). The prevalence of malformed males was 15%

higher than females. The difference were evident between type of CM and age of death of children under 5 years old ($p<0.001$) as well as between types of CM and maternal age groups ($p<0.001$). These findings underscore the importance of highlighting to the public by raising awareness of the causes and consequences of congenital malformations and the need to strengthen appropriate response for surveillance and prevention of common birth defects in Malaysia.

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