Comparative study of Perinatal Mortality, Stillbirths, and Neonatal Mortality from 2010 to 2018 in developing and developed nations with reference to Malaysia

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Review Article

Comparative study of Perinatal Mortality, Stillbirths, and Neonatal Mortality from 2010 to 2018 in developing and developed nations with reference to Malaysia

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Abstract

Background: Malaysia being an emerging economy has done well in the health sector. The perinatal mortality is reduced significantly but a slight upward trend was seen after 2015 in less developed states. This prompted us to conduct a review of perinatal, stillbirth, and neonatal deaths in Malaysia and compare them with other developing and developed countries. **Aims and objectives:** To find out: (1) Perinatal, neonatal and stillbirth rates from 2010 to 2018 in Malaysia, and (2) Compare it with developed and developing countries for the same duration. (3) To study contributary factors responsible for perinatal mortality, stillbirths and neonatal deaths and recommend the action plan to reduce it. **Materials and Methods:** Data related to perinatal, stillbirths and early neonatal mortality was searched from September 2020 to October 2020 using PubMed, Google, Google Scholar, Embase, EBSCO, Elsevier, and NIH/National Library of Medicine. **Statistical Analysis:** Analysis was done using Excel and StatCalc. **Results:** Mean perinatal mortality, stillbirth, and early neonatal mortality rates in Malaysia are 7.8, 4.72, 3 per 1000 respectively, which are almost half as that of Brazil which has PMR 17/1000, SBR 9.11/1000, ENMR 7.15/1000 live births. However, these values are twice as high as Singapore and Netherlands. Singapore has the lowest mortality rates; PMR 3.2, SBR 2.33 and ENMR 1.21 per 1000. Comparatively, India had the highest PMR of 26/1000 and ENMR of 22/1000 live births. Regional variations are seen in Malaysia, Brazil, India, and Netherlands. Main causes of perinatal mortality include pre-term births, hypertensive disorders of pregnancy, asphyxia, prematurity and low birth weight, congenital malformations in developing and emerging countries. Whereas, in developed nations, congenital malformation, aneuploidy, asphyxia and antepartum haemorrhage (APH) constitute the main causes. Major risk factors were maternal age, primigravida, obesity and diabetes. **Conclusion:** PMR, ENMR, SBR are high in low-income states in Malaysia, India, and Brazil. Contributory factors can be low income, poor education, lack of health-seeking behaviour. Mortalities can be reduced by educating women regarding pregnancy, nutrition, spacing of pregnancies, immunisation. Making essential health care in obstetrics and neonatal for all and everywhere.

Key words: Perinatal, Neonatal, Mortality, Stillbirths, Socio-economic status, Emerging economy.

Introduction

Perinatal mortality includes stillbirths of 22 weeks gestation and above and or foetal weight greater than 500 grams and above and or length more than 25 centimetres and live births dying within one week of life.[1] The denominator for stillbirth is the number of births occurring after 22 weeks of gestation and for neonatal deaths, deaths occurring within seven days of live births and the perinatal mortality rate is calculated per thousand births which include stillbirths and live birth in a year. Thus, perinatal mortality includes foetal deaths above 22 weeks and early neonatal deaths. Neonatal deaths include deaths within 28 days of birth and neonatal mortality means deaths in children within 28 days of birth per thousand live births in one year.

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As per WHO [2011], total neonatal deaths were 3.3 million; out of this 3 million were in the first week and 2 million were within 24 hours of life.[2] This declined slowly to 2.6 million neonatal deaths and 2.6 million stillbirths during the Millennium Development Goals [MDG] era of 1990 to 2015.[3] Three quarter of neonatal deaths occur in the early neonatal period. The main causes of perinatal mortality are poor antenatal, intrapartum, postnatal, and neonatal health care and infections. Urbanization, immigration, socio-economic status, education, and health-seeking behaviour of woman does affect perinatal mortality. Perinatal mortality is linked to maternal health and early neonatal deaths are dependent on the mother's health status, and strongly associated with obstetrics and neonatal care. Better maternal health and good health care facilities during the intrapartum period and neonatal period reduces perinatal mortality and improves child survival; conversely increased perinatal mortality causes increased maternal mortality risk due to repeated exposure to pregnancy, anaemia and infections and complications of pregnancy. Hence it is imperative to reduce perinatal mortality.

Incidence of perinatal mortality - Global

Perinatal mortality varies among different countries and regions within the countries. Overall PMR worldwide is 57 per 1000 births. Central and South Asia contribute one-third of the total perinatal deaths. Hospital-based studies in 10 hospitals in Ethiopia showed PMR of 66 to 124/1000 births and the large-scale community-based study found PMR of 37 to 52/1000 births.[4] Studies in the Latin American country of Guatemala observed a decline in perinatal mortality from 43.9 in 2010 to 31.6 per 1000 births in 2013.[5] Turkey which is in the zone of developing and developed nations achieved an NMR of 6.2/1000 live births in 2012; earlier it was 17.2/1000.[6,7] As per WHO, developed countries have PMR less than 10/1000 births.[2] A study on international comparison of foetal and neonatal deaths in high-income countries observed foetal death rate of 1.6-4.7/1000 births, NMR of 1.6-4.3/1000 live births and PM of 3.2-9/1000 births. Here the WHO criteria of > 28 weeks for

foetal loss and weight of 1000gms were considered for comparison.[8] Newsletter of City, the University of London published in November 2018 reported SBR less than 2.3/1000 births in Cyprus, Iceland, Denmark, and Netherlands, and more than 3.4/1000 in Latvia, Slovakia, Romania, Hungary, and Bulgaria for the period of 2010 to 2015. England and Wales, Scotland and Ireland SBR stillbirth ranged from 2.6-3.1/1000 births. NMR was 0.7 in Slovakia and 4.4/1000 in Bulgaria. Other countries such as Czechoslovakia, Denmark, Estonia, Spain, Cyprus, Luxemburg, Austria, Slovakia, and Iceland had NMR < 2 and Bulgaria, Croatia, Malta, Romania, and Northern Ireland > 3/1000. England and Wales had an NMR of < 2.2/1000 live births for 2010-2015.[9] A study in Portugal showed an SBR of 6.26/1000 and ENMR of 3.26/1000 live birth. A steady yearly decline in deaths was observed from 118711 in 1988 to 90557 in 2011. In this study, the ratio of stillbirth to early neonatal mortality was 3.2:1 in 2001 which declined to half over the period of time.[10] A retrospective cohort study in the US on 34236577 singletons from 2007-2015 observed a decline in PMR from 9/1000 to 8.6/1000 births (in foetus > 20 weeks gestation and neonatal deaths less than 28 days),[11] and National Center for Health Statistics data on foetal mortality showed a perinatal mortality rate of 6 in 2014 and 5.9/1000 births in 2017.[15]

Perinatal Mortality – Malaysia

Perinatal mortality in Malaysia was 7.4/1000 births in 2012. The current PMR as per DOSM is 8.4/1000 births.[13,14] NMR and SBR in 2012 were between 3.8-4.1/1000 live births, and 4.3-4.5/1000 births respectively; whereas during 2013-2018 NMR was 4.1-4.5/1000 live births, and SBR was 4.5-5.5/1000 births.[14] A comparative and comprehensive analysis of neonatal and perinatal mortality in 13 states of Malaysia, showed neonatal deaths of 5.44 and 4.17 respectively for males and females. Similarly, perinatal deaths were 1.06 in males and 2.54 in females.[16]

Maternal related causes and perinatal deaths

Variation in perinatal mortality depends on various factors such as quality, quantity, time of

pre-conceptual care and obstetrics care. Perinatal mortality is adversely affected by pregnancies at a very young age, advanced age, pregnancy out of wedlock, poor obstetric history, heavy work, poor nutrition, endocrine imbalance, blood incompatibility between mother and foetus and anatomical defects of genital organs.[23] Late pregnancies are strongly associated with perinatal mortality. Stillbirths are more frequently seen in primigravida and mothers over 35 years of age. Parity has been strongly associated with perinatal mortality. Primigravida had a higher risk of losing newborn babies during the perinatal period compared to multipara who gave birth to more than five children and women with bad obstetric history also carry a greater risk of perinatal death.[16] The possible causes for these perinatal losses could be obstetric complications such as IUGR (Intrauterine growth restriction), LBW (low birth weight) and delivery-related complications occurring in first deliveries and late pregnancies. Often the previous history of perinatal death is strongly associated with the death of subsequent newborn during the perinatal period possibly due to (a) improper handling of newborn babies which goes on in the families; (b) desire to produce another child immediately after the loss of first child leading to the narrow spacing between two pregnancies. History of repeated abortion is found to be another cause for perinatal loss because these women are at the risk of getting bleeding in the first trimester, premature deliveries, and low birth weight babies. Whereas mothers with no history of abortions have fewer chances of losing their babies during the perinatal period.[17] Twin pregnancies lead to prolongation of the second stage of labour, trauma during birth and bleeding. Improper handling by midwives, insufficient equipment in health centres and delay in transportation to hospital increase the chances of neonatal deaths. Girls who become pregnant during puberty and the adolescent period are themselves not anatomically and physiologically matured and preterm births are associated with pubertal and adolescent pregnancies. Increased frequency of deaths is seen in these babies. While a higher level of education reduces perinatal mortality provided pregnancies occur at the right age. But if

childbearing occurs at a later age as seen in most developed countries where women with advanced education postpone pregnancies voluntarily, this leads to a rise in perinatal deaths. The assisted reproductive technology is also correlated with high perinatal mortality.[5]

Contributory factors for early neonatal deaths

Globally, 13 million premature (gestation < 37 weeks) babies are born every year and complications associated with prematurity or preterm birth are leading causes of early neonatal mortality. Disproportionately high burden of prematurity and deaths attributed to premature births is carried by low and middle-income countries compared to developed countries. Preterm births are responsible for neonatal deaths and childhood and adult morbidities compared to term births.[1,58] Most of the early neonatal deaths occur in the first 24 hours.[17] Apart from prematurity, LBW, multiple pregnancies or frequent births have been associated with perinatal deaths and increase in ascending order with low birth weight, very low birth weight and extremely low birth weight. Stillbirths are more common in the male gender compared to girls, on the contrary, Hader et al., observed a higher incidence of stillbirths in female children.[18] A retrospective cohort study in 77,120 deliveries, found 59 female and 39 male stillbirths. Abruptio placentae and placental insufficiency were associated with male and female stillbirths, respectively. Sami and Baloch found a high incidence of early neonatal deaths amongst male babies than females and there was a strong association between male neonatal deaths and antepartum haemorrhage, malpresentation and congenital anomalies.[19] Low birth weight and prematurity are the greatest risk factors for stillbirth.[10] Socio-economic status of the family affects perinatal deaths. Financially sound families are able to spend money on medical care hence children born in wealthy families have a lesser chance of facing perinatal death compared to poor families.[8]

With regards to Malaysia, the NMR was 4 in 2012 and increased to 4.3 in 2015 and 4.2 in 2016 per 1000 live births. About 75% of deaths are seen in the first week of life and among early neonates, maximum

deaths occur in 24 hours of life. The common causes of neonatal deaths are prematurity, complications of pregnancy, congenital malformation, asphyxia, and other specific causes. Neonatal mortality can be prevented by classifying diseases into preventable and non-preventable and taking an approach of early diagnosis and treatment. Maternal screening for congenital malformation has not been made mandatory due to ethical and religious issues but is made available to the public. Towards the attainment of sustainable millennium development goals by 2030, Malaysia has regularized the guidelines for a universal understanding of the classification of preventable and non-preventable deaths.[48]

Perinatal mortality and other variables

Education, occupation, and income are important components of socio-economic status and determine social standing. Low level of education, unemployment in the woman and low family income have a greater chance of stillbirth and an increase in perinatal deaths.[22] Bad obstetrics history poor living conditions and lack of money to cover medical expenses has been linked to perinatal mortality.[23] Joseph et al., found an increased prevalence of gestational diabetes, preterm births and small for a date live births in women from low-income group compared to the high-income group but perinatal mortality was more in HIG [22]. The child born in the household having more than two family members had a lesser chance of perinatal loss compared to the family of two or less. Longer distance of hospital or health care facility from residence adversely affect perinatal outcome especially in primigravida who require more care as complications are often seen in the prenatal, intra-natal and post-natal period.[24,25] A study by Hugo Pilkington in France observed higher foetal mortality in women staying above 45 km away from maternity centres compared to 5 to 45 km distance. On the contrary, those staying less than 5 km had higher neonatal mortality. The justification given had been a migratory population with multiple social problems.[24]

Delivery at home was found to adversely affect perinatal mortality. The incidence of perinatal mortality is generally less compared to home deliveries.[27] But Yirgu Robel et al., a study found lesser perinatal deaths in-home deliveries compared to institutional deliveries in women who regularly attended ANC and had a normal delivery at home conducted by a trained woman health worker.[17] Studies have shown that bacterial sepsis, birth asphyxia, obstructed labour, antepartum haemorrhage and hypertensive diseases of pregnancy have been found to be leading causes of perinatal mortality.[28] Perinatal mortality is a sensitive indicator of the health care system and high perinatal mortality is a matter of concern, hence there is a need to find why certain countries and states have more perinatal deaths than others so that effective measures can be taken.

The major causes of stillbirth have been macerated stillbirths, lethal congenital malformation, prematurity, and asphyxia. From 2012 to 2016, nine out of fifteen states in Malaysia recorded an increase in stillbirths. Review of action plan and evaluation of the effectiveness of obstetrics care in hospitals and MCH centers helped in the control of rising stillbirths.[59] Colour coding of high-risk patients, early diagnosis and treatment, good referral system, deliveries in hospital help in reducing stillbirths and early neonatal deaths.

Aims and Objectives

To find out the perinatal mortality rates, stillbirth rates and early neonatal mortality rates in Malaysia and other developing and developed nations from 2010 to 2018.

To compare the perinatal mortality, stillbirths, and early neonatal deaths of Malaysia with other developing and developed nations.

To study contributary factors responsible for perinatal mortality, stillbirths, and neonatal deaths.

Materials and Methods

Place and Period: The study was carried at Melaka-Manipal Medical college, Melaka Malaysia. It is a review study on perinatal deaths, stillbirths, and neonatal mortality. The data was searched and retrieved using various search engines such as Google, Google Scholar, PubMed. Medline, NIH/ national medical library database. Data on health and

deaths from the department of statistics Malaysia, census data of Government of India on birth and deaths; World Bank, WHO and UNICEF data on PMR, SBR and ENMR of various developing and developed countries was accessed and used for the study. Articles on Perinatal Mortality, Neonatal deaths, and stillbirths of developing countries of Asia, Africa Latin America and developed counties such as the Netherlands, England, Russia, USA, Singapore etc. were searched, retrieved, and studied. The results and discussion part of these articles were used for the current study.

Inclusion criteria: Perinatal Mortality includes foetal deaths occurring at 22 weeks gestation or more or infant weighing more than 500 grams or body length of 25 cm or more (crown to heel) and infant deaths occurring within seven days of birth. Determination of gestational period was on the basis of last menstrual period (LMP) and if the patient did not remember LMP, then first ultrasonography (USG) was taken for determining gestational period.

Neonatal mortality includes deaths within four weeks after birth. Stillbirth includes dead babies born after 22 weeks of gestation.

Data for the period of 2010-2018 were included in the study.

Exclusion criteria

Retrospective studies or data which does not include years before 2010 and years after 2018 were excluded. Perinatal mortality with a gestation period of 28 weeks and above was excluded.

Study duration: September – October 2020.

Statistical Analysis

Processing and analysis were using StatCalc statistical tools.

Results and Analysis

After searching for perinatal, stillbirths and neonatal deaths using various search engines we could get the data of Malaysia, Singapore, India, Brazil, and Netherlands. Thus, we have three developing nations of Malaysia, Brazil, and India and two developed nations of Singapore and Netherlands.

We used the data derived from the department of statistics Malaysia, the government published data of Singapore, census India data. For Brazil and Netherlands, we used data that was searched from various research articles. Cohen's D effect size for student's 't-test' was calculated to find statistically significant differences in the mean values. Cohen's D value 0.2 or less is to be taken as a small effect or statistically not different. The value 0.5 is to be considered as medium effect and 0.8 and above as significant.

Table 1: Perinatal mortality rates (per 1000) in different developing and developed countries 2010-2018.

	Malaysia[59]	Singapore[49,50,51]	India[20,42]	Brazil[37]	Netherlands[35]
2010	7.8	3.5	32	19.29	5.55
2011	7.5	3.9	30	17.48	5.34
2012	7.3	3.3	28	18.27	4.98
2013	7.3	2.8	26	17.7	4.71
2014	7.2	2.9	28	17.6	4.57
2015	7.7	2.8	23	14.6	4.58
2016	7.8	3	23	16.2	4.96
2017	8.7	3.4	23	17	4.9
2018	8.9	3.2	22	15.7	5.02
Mean	7.8	3.2	26.11	17.09	4.95
SD	0.61	0.36	3.58	1.41	0.32
Cohen's D		9.18	7.12	8.55	5.85

India data is as per census.

Perinatal Mortality

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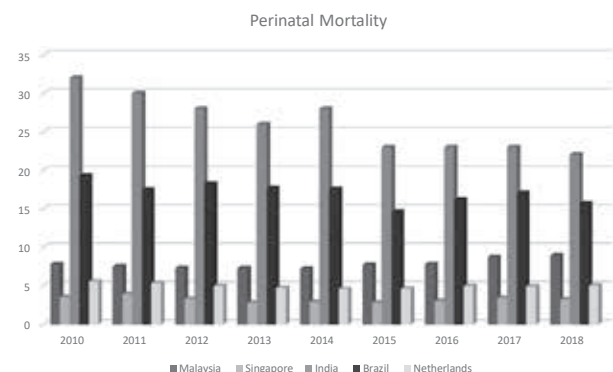
From Table 1, we observe that the mean value of perinatal mortality of Malaysia is 7.8, Singapore 3.2, Brazil 17.42, and Netherland 4.95 per thousand. India has a very high perinatal mortality rate of 26.11/1000. Considering Malaysia with other developing nations, PMR is significantly low, it is less than half the PMR of Brazil and less than a quarter of Indian PMR. When compared to the developed states of Singapore PMR of Malaysia is more than double. Netherlands has a significantly high PMR than Singapore.

The bar chart shows steady PMR for Singapore and Netherlands; a slight increasing trend in 2017-2018 for Malaysia and fluctuations for Brazil. It also tells us that though a decline in India it has the highest perinatal mortality followed by Brazil.

Table 2 shows a mean stillbirth rate (SBR) of 4.72 for Malaysia, 4.9 for India, 8.75 for Brazil; Singapore and Netherlands have the SBR of 2.33 and 3.15, respectively. Comparing stillbirths of Malaysia with India, there is no statistically significant difference between the two (Cohen's D 0.21). However, when compared with other countries the differences are significant. Compared to Singapore, Malaysia's PMR is more than double and with Brazil, it is almost half.

This bar chart shows the elevation in stillbirths after 2015 in Malaysia. Singapore shows a steady stillbirth rate with a dip in 2014. Netherlands shows a marginal increase after 2015; India and Brazil have significantly high SBR. Like Malaysia, Brazil also shows a slight increase after 2015.

Table 2: Still birth rates (per 1000) in developing and developed countries 2010-2018.

	Malaysia[13,14]	Singapore[49]	India[42]	Brazil[57]	Netherlands[29,35]
2010	4.6	2.6	7	8	3.6
2011	4.4	2.7	6.1	9.5	3.47
2012	4.3	2.6	5	8.7	3.29
2013	4.3	2	4	9.4	2.93
2014	4.3	2	4	8.9	2.73
2015	4.4	2.1	4	9.5	2.86
2016	5.2	2.2	5	8.2	3.15
2017	5.5	2.5	5	9	3.08
2018	5.5	2.3	4	7.6	3.23
mean	4.72	2.33	4.9	8.75	3.15
SD	0.52	0.27	1.06	0.69	0.28
Effect Size Cohen's D		5.76	0.21	6.59	3.75

Table 3: Early neonatal death rates (per 1000) in developing and developed countries – 2010-2018.

	Malaysia[13,14]	Singapore[49,50,51]	India[31,40,]	Brazil[36,37,39,57]	Netherlands[35,29]
2010	3.2	1.3	25	7.1	1.96
2011	3.1	1.3	23.9	6.5	1.88
2012	3	1.3	23	6.4	1.69
2013	3	1.2	22	6.4	1.79
2014	2.9	1.3	24	6	1.85
2015	3.3	0.8	19	6.3	1.73
2016	2.6	1.3	18	8	1.82
2017	3.2	1.2	18	8.5	1.82
2018	3.4	1.2	18	8.1	1.82
Mean	3.07	1.21	21.21	7.03	1.81
SD	0.24	0.16	2.57	0.93	0.058
Cohen's D		8.5	9.94	5.84	7.5

Still Birth

■ Malaysia ■ Singapore ■ India ■ Brazil ■ Netherlands

Early Neonatal Deaths

■ Malaysia ■ Singapore ■ India ■ Brazil ■ Netherlands
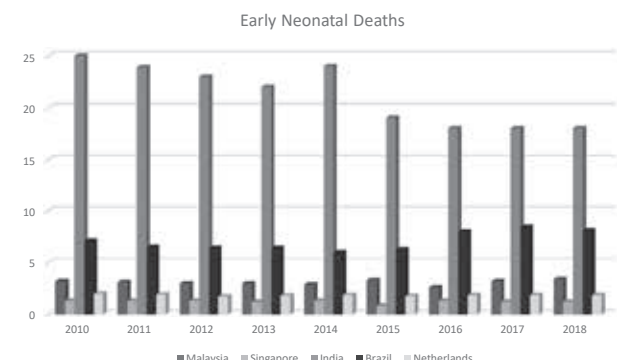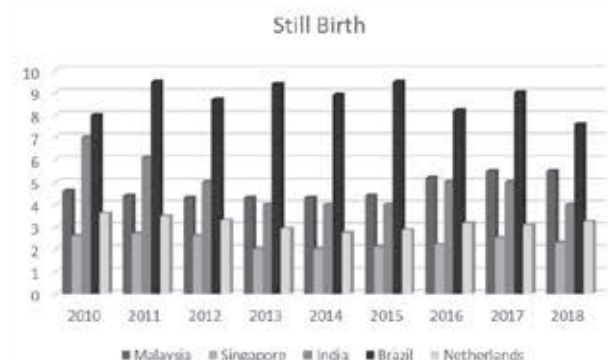
From the table above, we observe the highest ENMR of 22.2 in India followed by Brazil at 7.03. Malaysia has an ENMR of 3, Netherlands 1.81 and Singapore lowest at 1.21. Malaysia's ENMR is quite low compared to India and Brazil and almost double that of Singapore and Netherlands.

In Malaysia, a significant reduction in perinatal mortality is associated with improved socio-economic status, increased level of education and improvement in maternal and child health services. PMR was 5.6 in the year 2000 and 5.2 in 2016. Reduction in neonatal deaths in Malaysia is correlated well with socio-economic and infrastructure development, increased access to health care facilities, education of mothers and their increased health-seeking behaviour, improvement in MCH and obstetrics, neonatal and post-natal care.[27]

Socio-economic development, advancement in obstetric care, development of neonatal care and sound primary maternal and child health services are contributory factors for low NNMR in Singapore.[51,55]

In Netherlands, reduction in perinatal deaths is correlated with 1) active management of preterm births at 24 weeks of gestation, 2) Launching perinatal audit programme and participation of primary care midwifery in it, 3) Establishment of College of perinatal care and allowing stakeholders participation, 4) Integrated obstetrics care, 5) Structural Ultrasound Scan at 20 weeks of gestation to find out congenital abnormalities and possible termination of pregnancies.[29]

The stillbirth rates, perinatal mortality and neonatal rates are declining in Brazil and variables contributing include improvement in socio-demographic characteristics and MCH services, reduction in social inequalities, reduction in intrauterine growth retardation especially for neonatal and infant mortality, and improved perinatal care.[30]

The decline in neonatal deaths is seen in India and contributing factors include a) Fall in infection rate, b) Birth asphyxia, c) Tetanus neonatorum. However, an increase in prematurity and deaths associated with it were observed in poorer states and rural areas.[31]

The graph above shows the highest ENMR of India with a gradual declining trend, followed by Brazil which has an upward trend after 2015. Singapore and Netherlands have nearly steady but low ENMR. Malaysia's ENMR is also steady from 2010-2018 with a marginal upward trend after 2016.

Table 4: Reporting by various study groups on PMR, Stillbirths and ENMR in different geographical regions.

Author country and Year	Publication	Study design	Period covered	Results	Limitations
Ana M B Menezes et al., Brazil 2019 [36]	Int J Epidemiol	Cohort	1982-2015	High PMR in black and brown race and in low SES	Small number of foetal deaths, and deaths due to specific causes. Change in definition of stillbirth > 28 weeks.
Anita C. J. Ravelli et al., Netherlands 2020 [29]	BMC Public Health	Cohort	2010-2015	With advancing gestational age decline in PMR. ENMR, Stillbirths. Increased PMR in women with parity two and above and low SES	Lack of information on smoking and obesity.
Maria Alice de Moraes Machado Brito et al., Brazil 2019 [37]	Revista Brasileira de Saúde Materno Infantil	Retrospective cohort	2010-2014	High ENMR in Preterm and extremely low birth weight. Similarities in mortalities in sociodemographic profile.	Data only from Maternity Hospital.

Author country and Year	Publication	Study design	Period covered	Results	Limitations
Noon Altijani et al., India 2018 [20]	BMJ Open	Cross-sectional study on 886505 women data from an annual health survey	2010-2013	High stillbirths in very young mothers, and above 40 years of age Socioeconomically deprived section, unemployed. illiterate women, tobacco chewing. Regional variations are seen high in UP, Bihar, Jharkhand Assam.	This data is from the Registrar general and census commissioner office. Stillbirths in rural areas may not be recorded.
Seet Wymen et al., 2014 Malaysia [13]	Malaysia Health and Health care performance report 2014, General health status of Maternal and child mortality.		2014	Regional variations with high PMR, SBR, ENMR in low per capita income states.	Government data
Published by Malaysian Healthcare Performance Unit National Institute of Health c/o Deputy Director General (Research and Technical Support) [59]	Malaysian Health at Glance, 2018		2018	High PMR, Stillbirths, ENMR in Terengganu, Kelantan, and Perlis.	Government data

Discussion

Perinatal deaths include stillbirths and early neonatal deaths. In developed countries, non-preventable causes of death, are more common. The major causes of stillbirth are abruptio placentae, antepartum haemorrhage, intrauterine growth retardation, aneuploidy, congenital malformation, such as trachea oesophageal fistula, pulmonary hypoplasia, and asphyxia (42.5%). Early neonatal deaths occur mostly due to congenital malformation, asphyxia, prematurity, low birth weight and infection whereas maternal smoking, advanced maternal age, grand multiparity and obesity are widely recognized as contributory factors for antepartum stillbirths.[32]

In developing countries, preventable diseases are more common causes of perinatal deaths because most of the deliveries in rural areas take place outside the hospital and health care facilities. The main causes of death include hypertensive disorder of pregnancy, antepartum haemorrhage associated with stillbirths, premature rupture of membrane, prematurity, and congenital malformation. Contributory factors include low socioeconomic status and illiteracy, lack of health care facilities, grand multiparity, late booking and late referrals to hospitals. Women from rural, and semi-urban areas get the maximum brunt.[5,12]

Stillbirth causes include foetal distress, obstructed labour, foetal anomalies, and aneuploidy. Early neonatal deaths are mostly caused by immaturity, asphyxia, infections, and congenital malformation. About one-fourth of the total neonatal death occurs in the late neonatal period and common causes include sepsis, gastroenteritis, pneumonia, and tetanus. The contributory factors are lack of ante-natal care, non-supervised deliveries, unsafe delivery practices, lack of exclusive breastfeeding, prematurity, low birth weight, delay in recognition of warning signs and referral.[33]

As per DOSM data, PMR in Malaysia ranges from 7.2 to 8.9 per 1000 births from 2010 to 2018. Decline is seen from 2010 to 2014 thereafter increase from 2015 to 2018 [DOSM],[14,15] SBR declined from 4.6 in 2010 to 4.3 up to 2014, thereafter increase to 5.5 per 1000 [Table 2]. From Table 3, Malaysia maintained a steady NMR of 3 to 3.2/1000 with a dip of 2.6 in 2016. Malaysia is considered by the World Bank as an emerging economy, and the International Monetary fund classifies it as an emerging economy and developing county. It has a GDP of $9766 and High development index of 0.78. Malaysia shares common characteristics of an emerging economy with that of Brazil, China, and Indonesia. It did well in the health sector and its data on perinatal, stillbirths and early neonatal death rates are much lower than Brazil and other developing countries. However, data on PMR, SBR and ENMR is not like developed nations but is highly commendable. Less developed states in Malaysia has high PMR, e.g. Terengganu 10.44, Kelantan 9.58, and Perlis 9.10 per 1000.[13,14] This could be associated with low per capita income in these states, lack of spacing between two pregnancies, poor knowledge on family planning and contraceptives and inadequacy of health care personnel.[36] Stillbirth rates which are an important component of perinatal mortality are also high in Terengganu 6.30, Kelantan 5.3, Perlis 5.3 per 1000.[14] The probability of socio-economic association cannot be ruled out because the income of these states is quite low compared to other developed states of Malaysia. Regional differences in terms of socio-economic development, education infrastructure facilities, transportation, improved medical, obstetrics, MCH and preventive health care influence neonatal mortality, stillbirths, and perinatal mortalities in both developed and developing countries and decline in these parameters are seen with a reduction in disparities in different states and regions.[31,37,38]

Brazil showed a declining trend from 2010 with a spike in 2012 and 2017.[37] Stillbirth rates were 8.4 to 10/1000 births with high rates in rural and urban slums and NMR 6-8/1000 live births.[38] This decline may be attributed to the higher allocation of finance per capita in the health sector. More money had been spent on primary health centres and pharmaceuticals - drugs, vaccines, blood products and centralization. This is a step towards the realization of SDG. More attention is being paid to infant mortality and premature deaths.[39]

Neonatal mortality rate in India declined from 53.9 (1990) to 34.3 (2010) per 1000 live births. It was further declined to 28/1000 live births in 2013, but it is still very high and constitutes about one-fourth of the total global neonatal deaths.[40,41] High literacy states of Kerala and Goa show low NMR of 9-10/1000 compared to underdeveloped states of Uttar Pradesh, Bihar, Madhya Pradesh, and Rajasthan which has NMR of 46/1000 live births. Studies have shown high perinatal mortality of 26/1000 births in India with relatively low in high literacy state of Kerala at 9/1000 and highest of 35-37/1000 births in low literacy rate state of Rajasthan 2012.[20] As per the census, India has a stillbirth rate of 4.9/1000 for the period 2010 to 2018, but this may not be actual figure because most of the stillbirths are unreported in rural areas. Atlijani N et al., study [2018] on 886505 women aged 15-49 years in nine states of India observed a stillbirth rate of 10/1000 births. The main causes were adverse maternal and foetal complications and associated factors were socio-economic deprivation tobacco chewing and female illiteracy.[20] Study at Post Graduate Institute of Medical Education & Research, Chandigarh found a very high stillbirth rate of 71.1/1000 in (2010 and 2011), 69.6/1000 in (2012), 64.8/1000 in (2013 and 2014), 65.7/1000 in (2015) which declined to 62.4/1000 in 2016. These high stillbirths could be due to the fact that PGI Chandigarh being a tertiary level hospital getting complicated cases and a good hospital record system.[42]

The urban-rural differences are seen in all developing countries of Asia, Africa, and Latin America because of lack of health care facilities, trained health care professionals and transportation problems, especially in rural, tribal, and semi-urban areas.

Regional variation in PMR is seen due to urbanization, socio-economic and demographic changes. High PMR is seen in low-income countries and people having a low per capita income.[43]

Stillbirths constitute roughly 50% of the perinatal deaths. Higher the stillbirths more will be PMR. High stillbirths indicate poor antenatal and obstetrics care. Combined stillbirths and early neonatal deaths increase with decreasing gestational age. Prevalence of stillbirths is found to be more common in rural areas; associated with advanced maternal age. About one-third of stillbirths have no known causes or are of unexplained ethology. Macerated stillbirths are associated with intrauterine insults whereas fresh stillbirths and early neonatal deaths are associated with problems during labour and delivery.[44]

Early neonatal deaths which occur within a week of birth is an important component of perinatal mortality and a decrease in early neonatal morality will significantly help in reducing perinatal mortality. Preterm births, prematurity, poor quality of post-natal and neonatal care increase the risk of early neonatal mortality (ENMR) and constitute three-fourth of total neonatal deaths.[45] This is true about all developing countries and emerging economies. Maternal complications, such as abruptio placentae, uterine rupture, preeclampsia, eclampsia, and severe anaemia increase the chances of macerated late stillbirths, fresh late foetal deaths, and early neonatal deaths. Poverty, illiteracy, and poor income are covariates that are commonly seen as contributory factors in perinatal deaths. Preterm births and low socio-economic status are associated with IUGR and low birth weight.[42] In women with low socio-economic status invariably suffers from chronic stress, overcrowding at home, unemployment, single parent, low social support, and scarce financial resources. All these factors and especially extreme poverty affects pregnancy outcome.[46] Socio-economic status (SES) determine the health status, morbidity, and mortality in an individual. Perinatal mortality is correlated with SES.[22]

In India, socio-economic classification is based on occupation, education, and income, in Brazil, SES is based on class categories in Brazilian society and income gap. In Malaysia, socio-economic classification is based on the department of statistics' household income and basic amenities survey 2016, the median per month income for bottom 40 (B40) or low income group is RM3000,

middle income (M40) RM 6275 and for high income or top 20 (T20) is RM13148; the median income for the year 2014 it was RM 3000/month for B40, RM 5465/month for M40 and 11620/month for T20.[47] Considering the inflation rate; the median income cut off point is increased by 3.15%, 2.1%, 2.09% and 4.1% respectively for the year 2014, 2015, 2016 and 2017. The absolute poverty line is defined as income below which family is unable to maintain a basic minimal standard of living. As per the department of statistics Malaysia poverty line income raised from RM 980 in 2005 to RM 2208 in 2019 based on the spending pattern of the B20 group. Though median income increased from 2016 to the year 2019 in all states but considering the rise in the cost of living, the purchasing power remains the same or marginally reduced. It appears that states having low median income such as Kelantan, Perlis, Perak, and Pahang have higher perinatal mortality, stillbirth, and neonatal death rates.

Disparities in perinatal, stillbirths and neonatal death rates between developing and developed nations appear to be due to inequitable distribution of resources. Reproductive and child health, obstetrics, neonatal and childcare do not get due share hence high mortality. This is proved by the fact that when higher financial resources were allocated to the health sector in Brazil and Turkey, a significant reduction in perinatal, stillbirths and neonatal deaths were seen. Malaysia invested well in the health sector. MCH services are well organized and linked to the obstetrics department in the hospital with transportation/ambulance services. Pregnancy is considered as a risk factor and all the deliveries are conducted in the hospital. And followed up after delivery. There is a colour coding system in antenatal clinics in family health polyclinics and hospitals and pregnant women with a red flag is referred to an obstetrician for consultation. Sustainable development goal 3.2, states that for newborns and children under 5 years of age, deaths must be prevented. All nations should aim to reduce neonatal mortality to atleast 12/1000 live births and children under 5 years of age mortalities to at least, as low as 25/1000 live births by 2030. Malaysia already achieved these goals. It has a record of neonatal mortality rate of 4.2, 4.4 and 4.6 per 1000 live births

for the years 2016, 2017, and 2018, respectively.48 It also achieved the goal of universal health coverage and universal health access.

The perinatal mortality rate in Singapore was 27.9/1000 in 1960 which declined to less than 5/1000 in 2001 and remained low at 3.8 in 2018.[51] The neonatal mortality rate declined from 17.1 in 1960 to less than 10 in 1985 thereafter further decline to 1.5 in 2000.[51] The United States has the perinatal mortality rate of 6.1 per thousand from 2010 to 2017,[52] with a high prevalence of 12/1000 in blacks and high foetal deaths compared to whites (5.4/1000) and Asian (4.7/1000).[54] The developed countries of Singapore and Netherlands show PMR of 2.8-3.5 and 4.5-5.5 per thousand, respectively. In the US, the early foetal deaths were 2.9 and late foetal deaths 3.2 per thousand for the period of 2010-2017. Singapore and Netherland showed a stillbirth rate of 2-2.7 and 2.73-3.47 per thousand, respectively [Table 2]. As far as early neonatal mortality is concerned US had an NMR of 3.9/1000, which has been stated to be high compared to other developed countries such as Belgium 2.2 Japan 0.9/1000.[54] Singapore recorded the NMR of 1.2-1.3 per thousand between 2010-2018 with a dip NMR at 0.8/1000 in 2015.[55]

The Netherland data shows an NMR of 1.73-1.98/1000 live births.[29] During 2010-2018, PMR, Stillbirths and NMR significantly reduced. Factors contributing to the reduction in perinatal deaths could be good obstetrics care, the introduction of perinatal audit. Involvement of all stakeholders in perinatal audit, improvement in PHC and early neonatal care.

The significant reduction in perinatal, neonatal and stillbirth rates in Singapore is due to socio-economic development, improved obstetric, primary health and improved neonatal resuscitation facility.[55]

Limitations

1. Not many studies have been conducted by academic bodies in Malaysia before and during the study period hence we had to rely on government published data. Hence intra-country comparison was difficult.
2. Consistent data during the study period have not been available for India and Brazil hence

government published data from the census was taken for consideration.

Conclusion

The perinatal, neonatal and stillbirth rates of Malaysia are comparable to that of developed nations as defined by WHO [2] and quite low compared to Asian countries such as India, Pakistan, Nepal, Sri Lanka, Thailand, Philippines, and South American country of Brazil.[54] The states having low per capita income have relatively high perinatal, neonatal and stillbirth rates. Though reduction is seen over time; PMR, ENMR, SBR are high in poorer states in Malaysia, India and Brazil. Contributory factors can be lack of education among women, low income, lack of health care facilities, understaffing of staff especially those managing essential health care in obstetrics and paediatrics, high parity/frequent pregnancies associated with lack of spacing and other maternal causes, which needs to be addressed.

Perinatal mortality rates, stillbirth rates and early neonatal mortality rates can be reduced by –

Action Plan: -
1. Educating women regarding pregnancy, make women aware of the importance of attending ANC clinics.
2. Health education on nutrition and supplementation of micronutrients.
3. Spacing pregnancies by using contraceptives.
4. Essential health care in obstetrics and neonatal care for all.
5. Immunisation during pregnancy to prevent tetanus.
6. Skilled medical personnel to conduct delivery.
7. Financial investment in the health sector.
8. Equitable distribution of resources and equity of access to health system and policy.

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