



TRENDS IN CEREBRAL PALSY: DEVELOPED VERSUS DEVELOPING COUNTRIES

SHADMA KHAN (B.P.T, M.H.A)

Student

DAVV University, Indore (M.P)

ABSTRACT

Cerebral palsy is a commonest physical disability among children across the world. It affects almost every country of the world however its prevalent rate is higher in low to middle income countries (60% of which is in Sub Saharan Africa and Southeast Asia) than high income countries. Although few high income countries such as USA also shows higher prevalence however recent studies confirmed the decrease in incidence of cerebral palsy. The major cause for cerebral palsy in low income countries is different than in high income countries. Poor obstetric practices (traditional birth attendees or less skilled obstetrician) and post natal infections (cerebral malaria, meningitis and encephalitis) are the main cause in low to middle income countries. Preterm birth and low birth weight (around 48%) are the major cause of cerebral palsy in high income countries. Preterm birth and low birth weight are the consequences of advance neonatal NICUs and medical care and early elective cesarean deliveries. With the advances in medical technology the survival rate of preterm increases in high income countries however majority of them faced neurodevelopmental disorders throughout their lives affecting the quality of life of the children as well as their parents. In Western Australia, USA and many European countries have achieved success in reducing the incidence of cerebral palsy by proper tracking system of cerebral palsy prevalence, their causes and spreading public awareness. In low income countries firstly, the tracking system is required for understanding the exact statistic of the disease and their causes with respect to its geographical location because majority of the study conducted have very small sample size to be considered it as the cause among large population.

KEY WORDS: Cerebral palsy, low birth weight, preterm birth, epidemiology, high income countries, low income countries.

INTRODUCTION

Cerebral palsy is a most common physical disability in children worldwide, affecting quality of life of both the affected children and their families. It makes huge demands on health and social services. It is a non progressive, occurred as a result of static lesion to an immature brain, however the physical disability may progress with time and turned into a more severe movements and posture disorder.

The aim of the study is to identify the different trends in developed and developing countries. To find out the gaps that need to fulfill in an order to deal with the disease.

Cerebral palsy is more prevalent in low income countries than in high income countries.¹ The rate of prevalence is 2-3 per 1000 live births.² The etiology for cerebral palsy is different in developed countries than in developing countries. In this paper we tried to find out those causes that are ignored. Prevalent of cerebral palsy reflects the quality of obstetric practices, which is poor in most of the under developed countries and remote areas. Sub Saharan African countries and southeast Asia is the most affected area with this disease. Developed countries such as USA s also affected with this disease. However in recent study in USA showing decrease in the prevalence of cerebral palsy in low birth category which in turn reducing the overall cerebral palsy prevalence.³ The etiology of cerebral palsy can be divided into 3 categories according to the time of injury of the brain and they are prenatal which means before birth, perinatal which during birth, post natal which mean after birth till 2 years of age. Another theory said that this prenatal. Perinatal and post natal factors act together for causing cerebral palsy.⁴ In this review, only causes that have relationship with developed and developing countries are included.

PREVALENCE

The rate of cerebral palsy in general lies between 1.5 – 2.5 per 1000 live births.⁵ United states, western Australia and Sweden have reported the rate between 2.0 – 2.5 per 1000 live births.⁶⁻⁸ In india the rate of cerebral palsy is 1.5 – 3.5 per 1000 live births.⁹ In Japan it is 1.88 per 1000 live births.¹⁰ In Europe the rate of prevalence has decreased from 1.90 to 1.77 per 1000 live birth with an average annual fall of 0.7 % .¹¹ The rate of cerebral palsy in high income countries is 1.4 per 1000 live births in recent reports.¹²

In Uganda the rate of prevalence is 2.7 per 1000 children.¹ According to a national cerebral register, in Europe, Australia and USA the rate of prevalence is 1.8 – 2.3 per 1000 children.

The method used in the second paragraph is per 1000 children and not per 1000 live birth. This rate of prevalence has remained stable on 2-3 per 1000 live births since three decades.¹³

The rate of cerebral palsy is decreasing in western Australia and Europe.^{10,11}

FACTORS RESPONSIBLE FOR CEREBRAL PALSY IN DEVELOPED VERSUS DEVELOPING COUNTRIES.

The timing of brain injury is important to understand the cause of cerebral palsy. Based on timing of brain insult it can be divided into prenatal, perinatal and post natal. The post natal timing is from 0 to 2 years.

The causes are different for developing countries and for developed countries.

Children with cerebral palsy do not show a single cause for cerebral palsy but shows a cascade of interdependent events that result in brain damage which culminates this disability, concept known as causal pathway. In the absence of clear evidence the cause is considered to be of prenatal origin.⁶ The prevalence of perinatal caused cerebral palsy is higher in low income countries than in high income countries.¹⁴ In Saudi Arabia the causes of cerebral palsy are prenatal 23.5%, perinatal in 48%, and postnatal in 28-4% of cases.¹⁵

Earlier it was thought that perinatal asphyxia is the cause for cerebral palsy. Recent study shows that perinatal asphyxia is responsible for cerebral palsy in 6-8% of cases.⁶ In developing countries perinatal

asphyxia is responsible for 20-40%¹⁶⁻¹⁷ of cerebral palsy while in Australia it is responsible for 7-10%¹⁷ In developed countries asphyxia is responsible for a small amount of cases.¹⁸⁻²⁰ Another study shows that in 78% of cases asphyxia was not present and rest of the majority of the cases who had history of birth asphyxia did not developed cerebral palsy. The minority of the case who had history of perinatal asphyxia and developed cerebral palsy also shows a history of birth defect or gestational risk factors.¹⁹ Low 10 minute Apgar score is often associated with congenital disorder rather than asphyxia in cerebral palsy cases. Hence one cannot consider cerebral palsy of asphyxia origin by simply relying on Apgar score.^{18, 21}

Asphyxia is a result of poor obstetric practices and its prevalence is higher in low income countries than high income countries. In high income countries the change in obstetric practice and neonatal care results into decrease in brain injury cause by the asphyxia. As told earlier the cerebral palsy is not cause by a single cause but a cascade of interdependent events. Once these series of event has stopped within a window of opportunity, further damage to the brain can be stopped and preserved. These series of events have proximal factors and distal factors. Distal factors are including placental abnormalities, low birthweight, reasons for hypoglycaemia whereas proximal factors are meconium aspiration, birth asphyxia, neonatal seizures, respiratory distress syndrome, and neonatal infections.²² Spastic cerebral palsy is a result of asphyxia. In developing countries rate of spastic cerebral palsy is 36-71%¹⁶

Developed countries have high number of babies born preterm as compared with developing countries. Preterm born infants is a major cause of cerebral palsy in developed countries than in developing countries probably because of the high mortality of preterm born babies in developing countries.^{1-2,10,23} In low income countries the rate of preterm born is higher followed by middle income countries and rate decreases with high income countries. However USA being a high income country also affected with preterm born babies which is a major cause of cerebral palsy in USA. The reason might be a high rate of mortality of these infants in low income countries because of poor neonatal care and management. However the higher rate in high income countries is a result of provider initiated cesarean section which makes half of babies born less than 25 weeks of gestation survived but with high rate of neurodevelopmental and other disabilities.^{1,10,12,14,16,24,25,43} whereas in low income countries few percent of these babies survive. Cerebral palsy has a direct relationship with gestational age.²⁰ However in other studies shows that with extremely preterm birth(<25weeks) and very preterm birth (25-32 weeks) shows a dramatical drop in rate of cerebral palsy.^{6,12,24} Preterm born infants are more vulnerable to cerebral palsy in the first postnatal month because of the cerebral malaria which is endemic in most of the developing countries. 45% of cerebral palsy cases are preterm born. However in extremely preterm infants, cerebral palsy is not prevalent.^{12,24} In USA rate of preterm born infants is higher whereas Australia shows low rate of preterm born infants. Rate of cerebral palsy is also high in USA and low in Australia.

As preterm birth covering a majority of cerebral palsy causes in USA, if the rate of preterm decrease it will result in decrease in cerebral palsy incidence. In western Australia and Europe preterm birth has been reduced.^{1,12}

According to a study²⁴ conducted in 2010, the average preterm birth born was 11.1% (14.09 million) worldwide. 60% out of which born in south Asia and sub Saharan Africa, where 52% of total global birth occur. USA among the top ten countries with preterm births(12.0%), because of the high number of provider initiated cesarean trend in high income and middle income countries and the neonatal management which decreases the rate of preterm mortality but increasing morbidity. Now half of the babies with less than 25 weeks of gestational age can survive but with high rate of disability. Preterm birth is common in male than in female so does cerebral palsy.

Low birth weight is the commonest risk factor for cerebral palsy. It is responsible for 17-48% of cerebral palsy cases.²⁶ Risk of cerebral palsy is increase with decrease in weight of the infant. Cerebral palsy is inversely related to both gestational age and birth weight.^{2,6,8,10,27-30} In Europe, USA and Australia the rate

of survival increases in low birth weight because of the advances in NICU and quality of care during perinatal period however many studies considering its association with cerebral palsy and other morbidities.^{2,7,11, 19,31} The decline of cerebral palsy in very low birth weight infant has been noticed in a study conducted in Europe and Japan.¹⁰⁻¹¹ Reduction in prevalence of cerebral palsy under low birth weight category and preterm born has reduced. The overall prevalence of cerebral palsy falls from 3.5 in 2006 to 2.9 in 2010 under the vision of health public 2020 (HP2020) in USA.³

A controlled case study on 125 children was done in India out of which 2% were born with low birth weight.²⁶ Another study in Saudi Arabia on 102 children shows 16.7% of children with low birth weight have cerebral palsy.¹⁵ A study in Japan shows 72.1% of children had birth weight less than 2500g.¹⁰ According to world health organization 90% of the low birth weight infants born in less developed countries. Out of which 50% born in south Asia and only 7% born in developed countries.³² However in developing countries it is not a major cause of cerebral palsy because of the high mortality rate of low birth weight.¹⁶⁻¹⁷ Low birth weight accounts for 30-40% of all cases of cerebral palsy and covers 70% of perinatal cases causing cerebral palsy in developed countries.¹⁵ whereas in developing countries it is responsible for 13-20% of cases.¹⁷ A postnatally acquired cerebral palsy decrease with increase in birth weight.³³

INDIRECT RISK FACTORS

Traditional birth attendant

47% of births are assisted by traditional birth attendant or by a family member in developing countries. Rural and remote areas are more dependent on tba than urban areas. Poor population out of necessity chooses home delivery because of the high cost of hospitals.³⁴ 58% women in sub Saharan Africa chooses home deliveries.³⁵ They are not skilled enough to handle a critical condition if face during perinatal period and their unhygienic practices leading to infant and maternal mortality and morbidity.^{15,34,35,36-37}

Home deliveries and deliveries assisted by unskilled women in developing countries is a major obstacle in providing pregnant women and infant hygienic and disease free delivery. On the other hand this traditional birth attendants are also helpful for providing care and assisting women who residing in remote areas and where health care facilities cannot reach.

CONSANGUINEOUS MARRIAGE

A study in Turkey shows 23.8% of the infants with cerebral palsy associated with consanguineous marriage.^{15,38} In countries such as Turkey , Saudi Arabia and in some cultures where consanguineous marriage is common have cerebral palsy as a risk factors. It should be avoided. However in this area more research is needed.

SOCIOECONOMIC STATUS

Socioeconomic status plays a major role in predisposing the factors that can lead to cerebral palsy. Factors associated with cerebral palsy increases with decreasing in socioeconomic status. For example- preterm birth, low birth weight, asphyxia, maternal and infant infections.^{1,22,27,28,40} According to birth weight category and gestational age category relationship studies shows, among normal birth weight and term born babies a significant association is found with decreasing socioeconomic status and increasing cerebral palsy. However in extremely low birth weight and extremely preterm born remains same in both classes.^{27,41} Low birth weight and preterm babies are strong risk factors for cerebral palsy and strongly associated with socioeconomic status.^{41,22} Environmental factors are responsible for the higher occurrence of cerebral palsy during prenatal period than in low socioeconomic status.²⁷ A study found that 70.6% of

birth assisted by traditional birth delivery and 80.4% were malnourished belongs to low socioeconomic status.¹⁴ Postnatally acquired cerebral palsy is higher in developing countries because of the socioeconomic relation of cerebral palsy. Whereas perinatal cause is also high because of poor education, less infrastructure and limited care available during delivery.²⁸ Prevalence of cerebral palsy is 1.5- 1.6 times higher in low socioeconomic status as compared to high socioeconomic status. In low birth weight and preterm born baby socioeconomic status have no influence for cerebral palsy. The reason behind this might be because of the factors responsible for cerebral palsy in normal birth weight might not be a reason of cerebral palsy in babies with low term and low birth weight but might be it clinically correlates.⁴¹

POSTNATAL

Unlike developed countries where preterm birth is a cause for cerebral palsy, the reason in developing country is post natal infection where infections such as cerebral malaria, meningitis and encephalitis are endemic.^{17,20}

A study on 102 children in Saudi Arabia shows the following data: prenatal 23.5%, perinatal 48% and 28.4% post natal. Out of which 26% is because of the postnatal infections.¹⁵ Post natal cerebral palsy is 5 times higher in Uganda than in developed countries.¹ low placental weight and low Apgar score (0-3 at 5 minutes) had 81 folds risk for cerebral palsy.^{6,40} Respiratory disease, sepsis and seizures along with preterm strongly a risk factor for cerebral palsy.⁶

OTHER FACTORS

Age of mother have U shaped relationship with preterm, with both high and low values it becomes a risk factor for preterm. Low maternal weight also shows a strong risk factor for preterm born babies, Whereas low maternal height might be associated with a low birth weight. Antepartum haemorrhage often makes an early delivery.

One study reported that acute inflammation in antenatal period shows no relation with neurodevelopment in 6 year old children.⁴²

Birth spacing, anaemia, smoking, tobacco consumption and antenatal care have an impact on the birth weight of infant in south Asian countries.³²

One study shows no association of cesarean section with cerebral palsy. Some study reported an association of cerebral palsy with cesarean section. Twin delivery is not associated with cerebral palsy while in some studies it is a risk factor for cerebral palsy²⁶ however twin

Preeclampsia in terms is a risk factor however in preterm it is not a risk factor probably because of the release of catecholamine in preterm infants as a result of preeclampsia which leads to maturation of fetus. Preeclampsia can also be a reason of an elective preterm birth because of the inflammatory responses and precipitate labour.⁶ Interestingly in preterm born due to preeclampsia shows less risk of cerebral palsy than other preterm born infants without preeclampsia giving impression that preeclampsia itself is protective for cerebral palsy.²⁰

DISCUSSION

The decline in prevalence of cerebral palsy in Europe, Sweden and western Australia ^{12,1} and even in USA ³ shows that cerebral palsy can be reduced by improving the obstetric and advances in neonatal management. In developing countries the need for maintaining cerebral palsy registers and surveillance for tracking the exact percentage and causes of cerebral palsy is needed. As many studies reported the paucity in evidences and lack of documentation for tracking of causes and exact number of cerebral palsy in developing countries especially in sub Saharan Africa and southeast Asian countries. This surveillance

or register should be based on the universally accepted criteria for diagnosing cerebral palsy as many studies have using total number of children as denominator while cerebral palsy that can occur once in life time and at specific time that is from 0 to 2 years. Using denominator more than 2 year is on zero risk of acquiring cerebral palsy, so it should be considered⁴³. Large sample size studies are required as most of the studies are based on secondary data and those studies which are based on primary data have small sample size which may show error if considering as community level.

As it is explained earlier, that a single event does not cause cerebral palsy however a cascade of events. There are distal factors and proximal factors in this chain of events.^{22,38,42} There are modifiable factors and non modifiable factors. For instance, placental abnormalities cause antepartum haemorrhage which cause asphyxiation in the neonate and resulting in to hypoxic ischemia in part of brain leading to damage which in turn is responsible for cerebral palsy. This chain need to be broke. The earlier the identification and correction of the distal factor better and less harm it will impose. Modifiable factors are preventable such as vaccines against infections and measures to rule out malaria where it is endemic. While non modifiable factors cannot be modify such as the factors that are unknown.

In developing countries the causes of cerebral palsy are the result of poor obstetric practices and lack of facilities. Public programs for awareness regarding care and diet during antenatal period of mother, hygiene and vaccination against TORCH (toxoplasmosis, rubella, cytomegalovirus, and herpes simplex virus) infection can result in primary prevention from the risk factors of prenatal and perinatal period. Public awareness program has to be based on the risk factor present in the community. For instance, if the cause is lack of weight gain than awareness should be based on regarding diet and need for nutrition and if antenatal infection is the cause than the need for vaccination against infection should be included. The problem of lack of skilled obstetrician can be addressed by providing continues training to the traditional birth attendant as banning traditional birth attendees may only left mothers with no approach to any kind of health as traditional birth attendees are born out of necessity in such areas.

On the other hand only mobilizing these mothers to hospital rather than home delivery is not sufficient but providing them that competent health facility is necessary.^{34,35}

45% of preterm born babies develop cerebral palsy. With the reduction in this percentage, reduction in cerebral palsy incidence can be achieved. Magnesium sulphate and corticosteroids are reported to be effective in reaching this goal by administrating in antepartum period.^{12,20,44} in one study no correlation is found between antenatal corticosteroids and cerebral palsy¹⁶ Dexamethasone administered in early postnatal infant with respiratory distress syndrome reported to have an association with cerebral palsy.^{45,46}

Introduction of hypothermia within 6 hours of postnatal showing wonderful results to dealt with hypoxic ischaemic encephalopathy post severe asphyxia.^{11,12,22,47}

Low dose aspirin reduced the rate of preeclampsia although in few studies it is failed to prove it.⁴⁸

Cesarean delivery should be limited to health providers advise only to take a hold on provider initiated cesarean delivery without medical condition to give birth to a preterm born. Cesarean section is associated with cerebral palsy reported by some studies. Instrument assisted deliveries are beneficial or associated with cerebral palsy is a topic of debate.^{19,22,26} electronic foetal monitoring reported to be valuable in asphyxiation according to some report however most of the studies reported its failure in achieving this goal and causing more harm to the infant.¹⁸

Cerebral palsy is more prevalent in males than in females^{7,9,10,15,18,24,26,33,49} Rate of preterm born in males is also higher than in females.²⁴ The male preterm born is more susceptible to cerebral palsy than girls. The question that rises is why boys are more vulnerable than girls have not much answer yet and needs to be addressed. Cerebral palsy is reported to be associated with paternal age and a result of a fresh genetic mutation which causes athetoid or hemiplegic type of cerebral palsy.⁵⁰

Use of surfactant and management of nosocomial infections to minimize the risk of cerebral palsy in preterm and low birth weight babies.¹¹

Neurodevelopmental impairments are the result of Periventricular leukomalacia and intraventricular hemorrhage in preterm and low birth weight infants.¹⁰

Some studies reported that advances in NICU have increases the survival of babies who were prone to death and also increases the neurodevelopmental impairments. In contrast some studies reported that it is benefitted more than it harmed. A solution require for these preterm and low birth weight survivals to be morbidity free as well

No doubt this excellent obstetric practice, advance NICU technologies and public health awareness program has helped many developed countries in reducing the rate of cerebral palsy.

Conclusion

Complete elimination of cerebral palsy for now is not possible as 20% of cerebral palsy is of idiopathic etiology. In developing countries such as Uganda, Nigeria and South Asian countries can prevent cerebral palsy to a greater extend as most of the causes that results in cerebral palsy can be prevented by proper health model and services planning as done by the western Australia and many other developed countries.

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