SYSTEMATIC REVIEW ON PREVALENCE OF CEREBRAL PALSY

Khkula Imtiaz[1], Wassam Akbar Khan[2], Ghazanfar Ullah[3], Yasar Yousafzai[4], Haider Darain[5]

Abstract: Aims: The objective of this review is to provide a collective form of data on prevalence of cerebral palsy and the ratio of CP related to birth weight of infants.

Methods: A systematic review was conducted by utilizing PRISMA (Preferred Reporting Items for Systematic Review and Meta-analyses) declarations. Cross sectional retrospective descriptive study and population based CP registry were used and the data were collected in the respective studies of review, using computer records and parental questionnaires. Statistical analysis was carried out by using SPSS version 20.

Results: A total of 10 studies were selected to conduct the review. The overall ratio of CP is 2.5 per 1000 live births. For the infants with very low birth weight of less than 1500g, the CP prevalence showed highest proportion.

[1]Teaching Assistant, Institute of Physical Medicine and Rehabilitation, Khyber Medical University, Peshawar
[2]Physical Therapy Department/ RCRS, Rehman Medical Institute, Peshawar
[3]Teaching Assistant, Institute of Physical Medicine and Rehabilitation, Khyber Medical University, Peshawar
[4]Assistant Professor, Institute of Basic Medical Sciences, Khyber Medical University, Peshawar
[5]Assistant Professor Physical Therapy, Principal/Director Institute of Physical Medicine and Rehabilitation, Khyber Medical University, Peshawar-Pakistan

Address for correspondence:
Dr Khkula Imtiaz (PT)
Teaching Assistant, Institute of Physical Medicine and Rehabilitation, Khyber Medical University, Peshawar
Email: ikhkula@yahoo.com

INTRODUCTION

Cerebral palsy (CP)), a movement and posture disorder, is the most common cause of motor deficit in children. It has been described as non progressive lesion of developing brain that leads to functions' limitation and other related diseases of brain(1). It has been reported that the overall prevalence is 2.5 per 1000 live births. In the past decade, epidemiology of cerebral palsy has been monitored in different study reviews, looked at both the overall prevalence and the prevalence accounted by CP subtypes, risk factors and by birth weight in infants(2). An update on the prevalence of cerebral palsy was published in the year 2013, in Canada, where they reviewed total of 49 studies. The prevalence ratio which they reported was 2.11 per 1000 live births. They focused not only on the overall prevalence of CP but also distribution of CP according to gestational age and birth weight of the infants. For the children weighing 1000g to 1499g, the prevalence was more pronounced of having 59.18 per 1000 births. To categorized CP prevalence in gestational weeks, children born before 28 weeks gestation showed highest value of 111.80 per 1000 live births. This review follows the PRISMA (Preferred Reporting Items for Systematic Review and Meta-analyses) statements and clearly shows search strategy of having inclusion and exclusion criteria. Two bibliographic databases (MEDLINE and EMBACE) were selected for methodology(3). Another systematic review was conducted regarding risk factors identification for cerebral palsy in 2012 Australia. They used MEDLINE and EMBACE databases for their review. By applying inclusion and exclusion criteria, they reviewed 21 articles based on cohort and case control study designs. They recognized ten risk factors which are placental abnormalities, major and minor birth defects, low birth weight, instrumental / emergency caesarean delivery, meconium aspiration, birth asphyxia, neonatal seizers, respiratory distress syndrome, hypoglycaemia, and neonatal infections. This paper finds out risk factors as well as the possible potential for prevention(4). Only these two systematic reviews were performed in the recent years. Looking at the significance of this disease, this review presents an update on the existing data regarding the prevalence and disease factors in CP.

METHODS

Search Strategy

A literature search using Pub Med (Reference) and Google Scholar (Reference) was carried out to identify relevant literature. Additional searcher was conducted by hand searching. The literature searches were performed in November-December, 2015 and updated in June 2016. Keywords were identified based upon the contributing authors' consensus and relevance to the search question.

The initial search terms 'cerebral palsy' and 'prevalence' were used to collect relevant research articles. Boolean logic was used to combine the search terms.

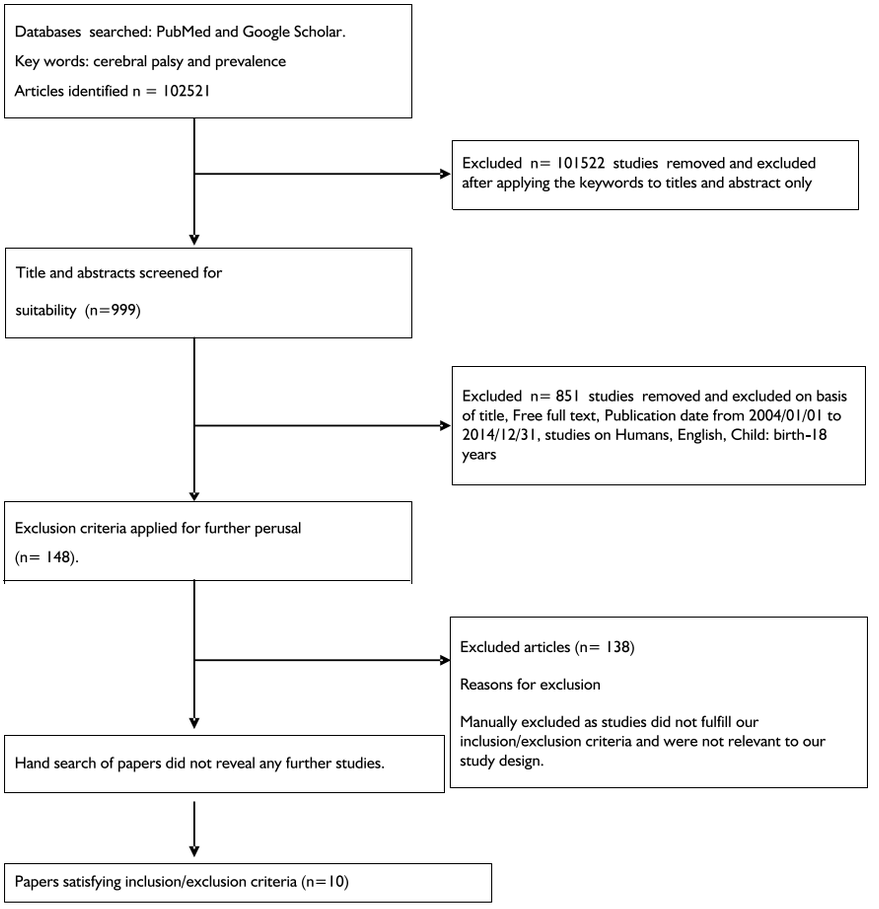
Inclusion Criteria

Studies published about the prevalence of CP were included in the search. Studies of systematic reviews and meta-analyses (level I evidence) as well as primary research (crossectional studies) were included in the search.

Exclusion Criteria

After including the studies, studies performed on patients above the age of 18 years (adults) were excluded. Due to institutional restraints on publication downloads, articles with restricted access were removed. Since this is an update, older articles (published before 1st January, 2004) were also excluded. Studies published in languages other than English were also removed.

Figure 1: Flow Diagram of Systematic Search Process and Paper Selection



- **Evidence Table of the Articles Reviewed**

Author	Country	Publications Date	Study Design	Age	Diagnostic info	Measures used
Yeargin-Allsopp M, Braun KV, Doernberg NS, Benedict RE, Kirby RS, Durkin MS(5).	3 areas of the United State, (northern Alabama, metropolitan Atlanta, Georgia and southeastern Wisconsin)	Aug 15, 2007	Cross-sectional descriptive (retrospective) study	0-8 years	ADDM networks (Autism and Developmental Disabilities Monitoring)	retrospective record review
Dolk H, Parkes J, Hill N(6).	Northern Ireland	Sept 27, 2005	Population based survey	0-14 years	Gross Motor Function Classification System (GMFCS)	CP registry
Serdaroglu A, Cansu A, Tezcan S(7).	Turkey	Aug 4th , 2005	Cross-sectional study	2- 16 years	Selfmade questions and by general practitioners	parental questionnaire
Oskoui M, Joseph L, Dagenais L, Shevell M(8).	Quebec (Canada)	Sept 20, 2012	Cross-sectional study	9- 11 years	GMFCS (5 levels), MAC systems	Cp registry
Mongan D, Gaffney G(9).	West of Ireland	May 30, 2006	population-based register of cerebral palsy (CP)/ prospective cross sectional survey	Children were only included if they were at least 5 years of age	On the basis of walking ability	Records from child developmental organization

• Evidence Table of the Articles Reviewed Continued						
Author	Country	Publications Date	Study Design	Age	Diagnostic info	Measures used
Smith L, Kelly KD, Prkachin G, Voaklander DC(10).	British Columbia	Feb 8th, 2008	population-based record linkage study	0-8 years	the International Classification of Diseases, Version 9 (ICD-9)	CP records
Himmelmann K, Hagberg G, Uvebrant P(11).	Sweden	July 30, 2004	Population based surveillance	4-8 years	Neuro imaging study(CT scan and MRI) and APGAR score	
Tsui KW, Yiu BP, Cheng CY, Chan CW(12).	Hong Kong	June 3rd, 2006	Cross-sectional survey	6-12 years		CP registry
Himmelmann K, Hagberg G, Beckung E, Hagberg B, Uvebrant P(13).	Sweden	Mar 26, 2010	Cross-sectional survey	4-8 years	Neuro imaging study(CT scan and MRI) and APGAR score	

Data Abstraction:

All the selected articles were saved electronically for data abstraction. Abstracts identified from searches were screened by three authors independently. Data extracted from included studies comprised the authors, date of publication, country/region where research was conducted, study design, age of study population, measurement tool used for diagnosis of CP, and any notable remark by the authors.

Ethical approval

This study did not involve any interaction with people, a treatment or involve publication of confidential patient identifiers. Therefore, this study did not require prior ethical approval. Administrative approval from the Institute of Physical Therapy and Rehabilitation Medicine, Khyber Medical University was sought. The systematic review was not registered.

RESULTS

A total of 102521 articles were identified by searching Pub Med and Google Scholar databases. Initially, 101522 articles were excluded when the key words 'cerebral palsy ' and 'prevalence ' are applied to the database. Upon screening for exclusion criteria, 999 article were left for further screening. Application of exclusion criteria resulted in reduction to a total of 148 articles. These were excluded when checked for title, free full text, Publication date from 2004/01/01 to 2014/12/31, studies on Humans, English, and Child: birth-18 years. Finally 138 articles were excluded due to the reason of non fulfilment of the exclusion criteria. A total of 10 articles were included in the review (Fig. 1)

In the study of Northern Ireland done by Helen Dolk and his team, they mentioned the group of high prevalence rate and that was the infants with very low birth weight. They clarified the birth weight groups in the following sessions, very low birth weight of less than 1500g, moderately low birth having weight of 1500 to 2499g and CP among the normal weight infants of equal to or more than 2500g. The very low birth weight group showed the prevalence rate as 0.85% when compared with the other two groups which have low prevalence data. The Helen Dolk criteria were tracked by the study of British Columbia, a four year birth cohort of Les Smith. The figures accounted for children with CP were 66.5% in low birth weight, 53.1% in moderate cases and 10% in the infants with weight of 2500gm. The results of Deirdre Mongan prevalence study agreed with the recent studies discussed. They defined the birth stages clearly as in the former study and demonstrated that the prevalence of very low birth weight newborns were 39 per 1000 cases. Again another study of K Himmelmann in Sweden notified the ratio in newborn infants as more in the low birth weight of less than 28 weeks of gestation that was 55.6%. Whereas, the ratio was 43.7% for 28 to 31 weeks of gestation and a lower value of 1.43% for the gestational weeks more than 36. The same author published his ninth report earlier in the Sweden from the recent report study, the outcomes of this study once more related to the studies discussed above. The ratio of CP was higher in low gestational age infants that were 77% as measured up to the figures of other age groups.

DISCUSSION

This study provides the updated systematic review on prevalence of cerebral palsy and its distribution according to the birth weight of infants by categories 10 selected articles related to the theme. According to their results, the CP prevalence was more in the very low birth of less than 1500g as compared to other groups. Marshalyn Yeargin-Allsopp performed a population based survey to conclude the prevalence of CP among the three areas of United States. In this review, they described CP as an umbrella term, a group of non progressive disorders that damaged the infant immature brain, not fully

developed and result in neuromuscular problems(5). The same definition of CP was used by the following four studies Helen Dolk in his study of trends in the prevalence of CP, KW Tsui conducted a cross sectional survey in Hong Kong children, Sunil Kumar Raina study on CP prevalence and K Himmelmann in his report regarding origin of CP in Sweden children(6, 11-13). In the fore mentioned studies, they applied the word umbrella for CP suggesting that it is a collection of different motor impairments e.g, spasticity, dyskinesia and ataxia(6, 11-14). Les Smith carried out a four year birth cohort study to calculate the ratio of CP, he defined the term CP as motor disorders of childhood that affect the developing brain, causing functional activities limitation and is accompanied by disturbances of musculoskeletal problems, communication, sensory and cognition troubles(10). Ayse Serdaroglu conducted another cross sectional survey of CP prevalence, where they classified the types of CP. On the basis of clinical diagnosis, the three main forms are spastic CP (subtypes are hemiplegia, diaplegia and tetraplegia), dyskinetic CP (further subdivided into athetosis and dystonia) and ataxic CP(7). Another classification was made by causative factors and the categories are prenatal, perinatal and postnatal. The same criteria was followed by Deirdre Mongan in his epidemiological study used a population based register of CP(9). Coming toward the next report study of CP origin done by K Himmelmann in Sweden, they utilized not only the classification system but also provided the calculated values of each specific type. The hemiplegic type showed the maximum ratio of 38% and second one was the diplegic with 32% value. One more report study was achieved by K Himmelmann earlier from the recent review, in which they elaborated CP types with the help of APGAR scores and radiographic judgment and yet again the dominant one was hemiplegic form(11). A very detailed arrangement of CP kinds by Tsui K was presented in Hong Kong schools children, with mixed and unidentified types as well. And they clearly give the results of two groups among children with special needs schools and mainstream schools. The leading form of CP was dyskinetic in special needs school, whereas hemiplegia and diplegia were familiar in mainstream schools(12). Sunil Kumar Raina in his surveillance system estimated the prevalence of CP subclasses and found the spastic quadriplegia with elevated value of 54.5%(14). Bringing into consideration the risk factors or causative agents associated with the pathology. The ninth and tenth reports regarding cross sectional study of CP prevalence conducted by K Himmelmann and their colleagues broadly classified the events into prenatal stage, children born at term and before 38 weeks of gestation. According to the findings of MRI and CT scan, they considered perventricular leukomalacia or white matter injury to be more pronounced with a ratio of 42%. While in the perinatal period, the hypoxic ischaemic encephalopathy was common in children born at term. Birth asphyxia happened to be due to less oxygen and nutrient delivery to the brain, and the criteria for this was the low APGAR scores, confirmation of cerebral abnormality through MRI, and following the mechanical ventilation. Some of the cases remained unclassifiable to inadequate information. The subsequent three surveys provided the idea of CP diagnosis and their confirmation in the patients(13). Les Smith and his colleagues recognized the CP by using international classification of diseases, version 9 (ICD-9) codes for diagnosis as 343(10). In the study of Canada by M.Oskoui, the similar classification system was used. Simultaneously, they checked the severity of disease by measuring through two major scales the Gross Motor Function Classification System and the Manual Ability Classification System(8). The similar GMFCS five level scales were applied by Helen Dolk in his population based survey(6).

CONCLUSION

This systematic review has been performed following these articles regarding the prevalence of CP in different localities of the world. These studies outlined some variables which enhances the knowledge about different aspects of CP. This systematic review declared that the overall burden of CP is more and there is high potential risk for the infants with low birth weight. Although not without limitations, this systematic review is the first of its kind to be performed in Pakistan on the prevalence of CP in children. This review sheds light on paucity of any research data on CP prevalence in Pakistan.

REFERENCES

1. Andersen GL. Cerebral palsy in Norway–subtypes, severity and risk factors. 2011.
2. Bangash AS, Hanafi MZ, Idrees R, Zehra N. Risk factors and types of cerebral palsy. JPMA The Journal of the Pakistan Medical Association. 2014;64(1):103-7.
3. Oskoui M, Coutinho F, Dykeman J, Jetté N, Pringsheim T. An update on the prevalence of cerebral palsy: a systematic review and meta-analysis. Developmental Medicine & Child Neurology. 2013;55(6):509-19.
4. McIntyre S, Taitz D, Keogh J, Goldsmith S, Badawi N, Blair E. A systematic review of risk factors for cerebral palsy in children born at term in developed countries. Developmental Medicine & Child Neurology. 2013;55(6):499-508.
5. Yeargin-Allsopp M, Braun KVN, Doernberg NS, Benedict RE, Kirby RS, Durkin MS. Prevalence of cerebral palsy in 8-year-old children in three areas of the United States in 2002: a multisite collaboration. Pediatrics. 2008;121(3):547-54.
6. Dolk H, Parkes J, Hill N. Trends in the prevalence of cerebral palsy in Northern Ireland, 1981–1997. Developmental Medicine & Child Neurology. 2006;48(06):406-12.
7. Serdaroglu A, Cansu A, Ozkan S, Tezcan S. Prevalence of cerebral palsy in Turkish children between the ages of 2 and 16 years. Developmental medicine and child neurology. 2006;48(6):413.
8. Oskoui M, Joseph L, Dagenais L, Shevell M. Prevalence of cerebral palsy in Quebec: alternative approaches. Neuroepidemiology. 2013;40(4):264-8.
9. Mongan D, Gaffney G. Prevalence of cerebral palsy in the West of Ireland 1990–1999. Developmental Medicine & Child Neurology. 2006;48(11):892-5.
10. Smith L, Kelly KD, Prkachin G, Voaklander DC. The prevalence of cerebral palsy in British Columbia,

1991-1995. Canadian Journal of Neurological Sciences. 2008;35(3):342-7.
11. Himmelmann K, Hagberg G, Uvebrant P. The changing panorama of cerebral palsy in Sweden. X. Prevalence and origin in the birth-year period 1999–2002. Acta paediatrica. 2010;99(9):1337-43.
12. Tsui K, Yiu B, Cheng C, Chan C. Prevalence study of cerebral palsy in Hong Kong children. Hong Kong Med J. 2006;12(3):180-4.
13. Himmelmann K, Hagberg G, Beckung E, Hagberg B, Uvebrant P. The changing panorama of cerebral palsy in Sweden. IX. Prevalence and origin in the birth-year period 1995–1998. Acta paediatrica. 2005;94(3):287-94.
14. Raina SK, Razdan S, Nanda R. Prevalence of cerebral palsy in children< 10 years of age in RS Pura town of Jammu and Kashmir. Journal of tropical pediatrics. 2010:fmq095.