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Reassuring The Prevalence of Cerebral Palsy in Asian Children and Adolescents

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Abstract

Cerebral palsy is becoming more common as a cause of developmental disorders in children. Several studies in low-income Asian countries found a higher prevalence of CP than in Europe. However, another study discovered the inverse result. The disparity in the results of these studies emphasizes the importance of the current study in updating the prevalence of CP in Asia. A systematic review and meta-analysis approach has been used in this study by searching for articles on three databases: PubMed, Scopus, and ScienceDirect. Eight articles were chosen through several screening stages and subjected to quality assessment. According to the study's findings, the prevalence of CP in Asia is 2.19 per 1000 children and adolescents (95% CI). Children and adolescents from low-income families have the highest incidence rate, with spastic-CP type being the most common classification.

Introduction

Cerebral Palsy (CP) is a non-progressive neurological condition that affects the development of the brain. Most people with this illness are born with it, but some get it later in life. Cerebral palsy can affect muscle mobility, coordination, and strength (Aal-Blowi et al., 2020). Comorbidities such as epilepsy, secondary musculoskeletal disorders, sensory, perception, cognitive, and behavioral impairments are common in people with CP (Rosenbaum et al., 2007; Earde et al., 2018). With an incidence of about 2 per 1000 live births, cerebral palsy is a prominent cause of impairment in children. An estimated 17 million persons live with CP worldwide (Khandaker et al., 2019). According to the global data, the prevalence of cerebral palsy is predicted to be between 2-3 per 1000 live births (Nelson & Ellenberg, 1978; Green & Hurvitz, 2007).

Cerebral palsy, on the other hand, seemed to be more common in low and middle income countries than in high-income ones (Tseng et al., 2018). In Uganda and Egypt, the prevalence of CP was 2.9-3.6 cases per 1000 children, whereas, in Europe, Australia, and the United States, the prevalence was 1.8-2.4 cases per 1000 children, respectively (Hirtz et al., 2007; Arneson et al., 2009; Oskoui et al., 2013; Himmelmann & Uvebrant, 2014; Froslev-Friis et al., 2015; Smithers-sheedy et al., 2016; Robertson et al., 2017; El-Tallawy et al., 2014; Kakooza-Mwesige et al., 2017). Correspondingly, European studies found a decrease in the prevalence of CP among children with a birth weight of less than 1500 g (Sellier et al., 2016).

Most reported overall prevalence rates for the birth-year periods of 1985-2010 showed no significant changes. Nevertheless, Asian children were shown to have a lower prevalence of CP than Caucasian children in studies conducted in the United States (Wu et al., 2011; Lang et al., 2012). Furthermore, according to

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polls in China and Hong Kong, it was found that between 1.3-1.6% of people identified as having CP. The number of cases per 1000 people is lower than in Western countries (Liu et al., 1999; He et al., 2017). The findings of these studies are still unclear and require further study to reassure and update the prevalence of CP in Asian populations.

This study examines the Asian population since Asia has the biggest population, accounting for 60% of the total global population. According to the World Bank's classification by Gross National Income (GNI) per capita, the majority of nations in the area are low- and middle-income (Asian Development Bank, 2015; ADB Briefs, 2020). Social protection is a critical subject that is now occupying the attention of Asian countries. Social protection policies are implemented to ensure that economic prosperity and social development are spread equally. One of the goals is to address disability issues and reduce poverty (Wagle, 2017). Disability and poverty are inseparable (Dalal, 2010). Finding the most recent statistics on the incidence of CP in children and adolescents with CP in Asia is one step toward facilitating the implementation of social protection programs for individuals with disabilities. Based on the rationale above, the authors conducted this study to answer questions about the current data on the prevalence of CP in children and adolescents in Asia; CP prevalence data based on socioeconomic status analysis; and CP prevalence data based on classification type analysis. This study's findings can be used as a reference for other studies that require up-to-date data on the prevalence of CP in children and adolescents throughout Asia, as well as specifically based on gender, socio-economic status, and type of CP classification.

Method

This study was conducted using a systematic review method, meta-analysis. The review follows the item reporting guidelines for a systematic review and meta-analysis from PRISMA 2020 (Page et al., 2021). The authors searched for articles published in various English language databases (PubMed, Scopus, and ScienceDirect) and published between 2000-2022. The selection of this publication year range was chosen to update the findings of previous studies on the prevalence of CP in Asian ethnic groups (Lang et al., 2012). Lang obtained data on the prevalence of CP in children born between January 1, 1991 and December 31, 2001 for his research findings. The search for articles is conducted by the authors using keywords that have been compiled and discussed previously. The keywords used in all databases are: "cerebral palsy", "prevalence", "infant", "child", "children", "adolescent", "Asian", and "Asia". The inclusion criteria were: population-based research; prospective or retrospective, cross-sectional, and cohort studies; involving the participation of children and adolescents under the age of 19; and conducted in Asian countries. The exclusion criteria were: the study used adult participants over the age of 18; CP diagnostics is not explicitly stated; not reporting relevant findings or outcomes; hospital-based research; and data using the same population as the included study. All articles were listed and classified by authors, year of publication, study location, study design, sampling technique, sample size, number of CP cases, and prevalence of CP. The authors also identified the sub-group information required for data analysis, such as participant age, gender, socio-economic status, and CP type classification. The authors conducted a formal assessment of the articles included in this study using the Loney et al. assessment criteria (Loney et al., 1998). Health professionals have widely used this assessment guide to critically evaluate research articles that estimate the prevalence and incidence of a disease or health problem (Chauhan et al., 2019). The quality of an article is assessed from the representativeness of the sample, the assessment, and diagnosis of a disease or disorder, and the interpretation of the results that are linear with the research objectives. This guide is divided into 3 sub-assessments, with a total of 8 question items. Each item receives a score of 1, out of a total of 8 possible scores. Jamovi 2.2.5 software was used to calculate the pooled prevalence. Furthermore, the authors employ Excel 2021 for data management, calculating prevalence using the point prevalence rate formula (Achmadi, 2013), and

performing sub-group analysis of the data obtained, such as socio-economic status and CP type classification.

Result and Discussion

The search strategy produced 493 abstracts: 28 from PubMed, 17 from Scopus, and 448 from ScienceDirect. After eliminating duplicates, 411 abstracts were obtained. In addition, 411 abstracts were screened using the following criteria: type of disability, location, and research type. There are 53 articles were obtained as a result of this screening. Following that, 53 articles were re-examined to determine the diagnostic criteria for CP. The screening results based on these CP diagnostic criteria yielded 29 abstracts. The authors used inclusion and exclusion criteria to determine the eligibility of 29 complete articles. In the final stage, the authors obtained 8 eligible articles that met the requirements for quantitative synthesis and meta-analysis. Figure 1 shows the PRISMA flowchart with the exclusion criteria and their details.

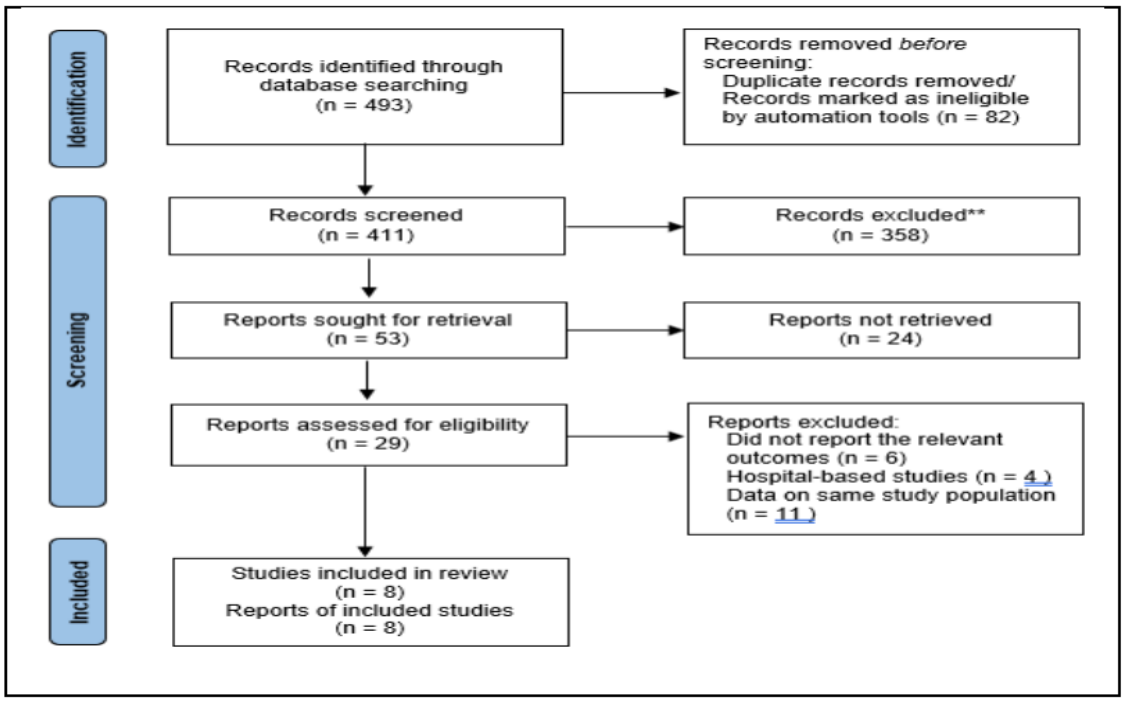

Figure 1. PRISMA Flowchart for Study Selection Process
Source: Primary research data-the framework for systematic review

Based on the overall quality assessment, all articles in this study received a score greater than 5 and were classified as high-quality research. There is only one article that gets a score of 5, the others are 7 (62.5%) and 8 (25%). Articles with a score of 5 have limitations in interpreting research findings in an adequate and detailed manner. Three of the five articles that received a score of 7 did not use standardized measures to determine CP diagnosis. A more detailed description of the measuring instrument can be seen in Table 2.

Between 2000 and 2020, eight studies were published. Data collection took from around 6 months to 6 years. Three studies were completed in less than a year, four were accomplished in one year, and one was accomplished over six years. The participants' ages ranged from 0 to 19, with the majority being children under 6 years old. The studies included in this review discuss the findings based on an analysis of various sub-groups according to their respective research objectives. The authors summarize it broadly based on the sub-characteristics shared by the majority of the research. The sub-characteristics are sample size, the global number of people with CP, the number of people with CP by gender, family socioeconomic level, and CP type classification. Table 1 provides a detailed summary of research characteristics.

The majority of the research was conducted through a population-based survey of children and adolescents in the city, district, or province. Meanwhile, research in Taiwan and Hong Kong involves a larger population than in other countries because it includes the entire population of children and adolescents in these countries. Each study employed a different instrument to assess and diagnose CP. To avoid measurement bias, the majority of these are performed using standardized measuring instruments by a multi-disciplinary team of assessors. One out of every eight studies, however, did not clearly define the CP assessment and measurement tools used. Table 2 explains the research design, sampling technique, measuring instruments, and assessors.

Table 1. Demographic Characteristics of The Included Studies

Study Label	Geographical Location	Sample Size (n)	N with CP	Prev (*)	Gender	Social-Economic Status	Type of CP
Jahan, *et al* (2020)	Southwest Sumba Regency, Sumba Island, East Nusa Tenggara (NTT), Indonesia, Southeast Asia	152.471	130 <18 years	0,85	*Not defined*	Poor families: 118 Wealthy families: 12	Spastic (n=105), dyskinesia (n=13), ataxia (n=1), hypotonia (n=11)
Yuan, *et al* (2019)	Henan Province, Central China, East Asia	50.596	120 <7 years	2,37	Boys: 76 Girls: 44	*Not defined*	*Not defined*
Khandaker, *et al* (2018)	Shahjadpur, Bangladesh, South Asia	226.114	726 <18 years	3,21	Boys: 449 Girls: 277	Poor families: 706 Wealthy families: 20	Spastic (n=578), Spastic-monoplegia/ hemiplegia (n=198), Spastic-diplegia (n=124), Spastic-triplegia (n=70), Spastic-quadriplegia (n=186). Hypotonic (n=87), Dyskinetic (n=60), Ataxic (n=1)
Tseng, *et al* (2018)	Taiwan, East Asia	1.843.143	4.774 <7 years	2,59	Boys: 2.804 Girls: 1.970	Poor families: 4,558 Wealthy families: 216	Severe CP (n=2.300)
Raina, *et al* (2011)	Pura City, Jammu, Northern India, South Asia	3.966	11 <10 years	2,77	Boys: 8 Girls: 3	*Not defined*	Spastic-quadriplegia (54,5%), Spastic-paraplegia (36,3%). Dyskinetic (9%)
Banerjee, *et al* (2009)	Kolkata, Benggala Barat, India, South Asia	16.979	48 <19 years	2,83	Boys: 26 Girls: 22	Poor families: 25 Wealthy families: 23	Spastic (n=37). Spastic-diplegia (n=35), spastic-quadriplegia, (n=2), Spastic-hemiplegia (n=6). Dystonic (n=3). Hypotonic (n=2)
Yam and Chan (2006)	Hongkong, East Asia	435.572	578 6-12 years	1,33	*Not defined*	*Not defined*	Spastic (n=429). Spastic-hemiplegia (n=132), Spastic-diplegia (n=156), Spastic-triplegia (n=16), Spastic-quadriplegia (n=109), Spastic-unclassified or others (n=16). Dyskinetic (n=38). Ataxic (n=20). Mixed (n=19). Unclassified or others (n=72)

Liu, *et al* (2000)	Jiangsu Province, China, East Timur	388.192	622 <7 years	1,60	*Not defined*	*Not defined*	*Not defined*

Prev: Prevalence
Source: Secondary research data for meta-analysis

Table 2. Research Design and Measurement of The Included Studies

Study Label	Study Design	Sampling Frame	Measurements	Unbiased Assessors
Jahan, *et al* (2020	Survey	A community-based key informant method	The Australian cerebral palsy register and the Bangladesh cerebral palsy register	A multidisciplinary medical assessment team including a pediatrician and a physiotherapist
Yuan, *et al* (2019)	Survey	NA	Magnetic Resonance Imaging (MRI) of the head, electromyography, etc. Potential cases of CP, or subjects who could not be diagnosed or excluded, were referred to senior pediatric neurologists or rehabilitation specialists in the local hospitals	A multidisciplinary medical assessment team including a pediatric physician or neurologist
Khandaker, *et al* (2018)	Survey	A population-based surveillance study, A community-based key informant method	BCPR registration form, a modified version of the Australian CP Register record form, Gross Motor Function Classification System (GMFCS), and Manual Ability Classification System (MACS)	A multidisciplinary medical assessment team comprised of a pediatrician, a physiotherapist, and a counselor
Tseng, *et al* (2018)	Survey	A population-based surveillance study from the Taiwan National Health Insurance Research Database	ICD-9-CM codes 343.x within 1 year	CP diagnosis confirmed by specialists
Raina, *et al* (2011)	Survey	NA	A screening questionnaire was written in the local vernacular that had been prepared by the WHO protocol	All evaluations from the case ascertainment phase were reviewed by a clinical reviewer (neurologist)
Banerjee, *et al* (2009)	Survey	A population-based, cross-sectional, observational study	The measurement using a 'General Screening Questionnaire'divided into two parts – Part I, socio-demographic details and Part II, the screening questionnaire.	The survey team comprised four field workers headed by a neurologist
Yam and Chan (2006)	Survey	A cross-sectional survey	NA	A multidisciplinary medical assessment team including a neurologist and pediatrics

The point prevalence rate calculation revealed that the overall prevalence of CP in children and adolescents in Asia was 2.19 per 1000 people. This means that every child born has a 0.002% chance of having CP. According to the forest plot of statistical analysis using Jamovi 2.2.5 software (figure 2), Taiwan had the highest proportion of CP (13.61%; 95% CI), and India had the lowest (7.90%; 95% CI). However, these findings do not consider variations in the number of population and study samples. Several studies with large populations would almost certainly show a higher proportion, such as research in Taiwan (Tseng et al., 2018) and Hong Kong (Yam et al., 2006) that used the entire population of children and adolescents in both countries as the study population. Studies with smaller populations conducted in a region/city such as in India, on the other hand, will show a lower proportion (Raina et al., 2011; Banerjee et al., 2009). In addition to displaying the proportion of CP in each study, visualization using forest plots can explain the precision and extent to which a study's results

are considered convincing. The accuracy or suitability of the results with the research objectives is one indicator of good research. Three studies conducted in the East Asian region agree on this (Tseng et al., 2018; Yam et al., 2006; Liu et al., 2000). These studies include a more detailed sub-group analysis, such as prevalence by areas (urban, suburban, and rural-urban), socio-economic status, as well as birth characteristics (single or multiple birth and weight birth).

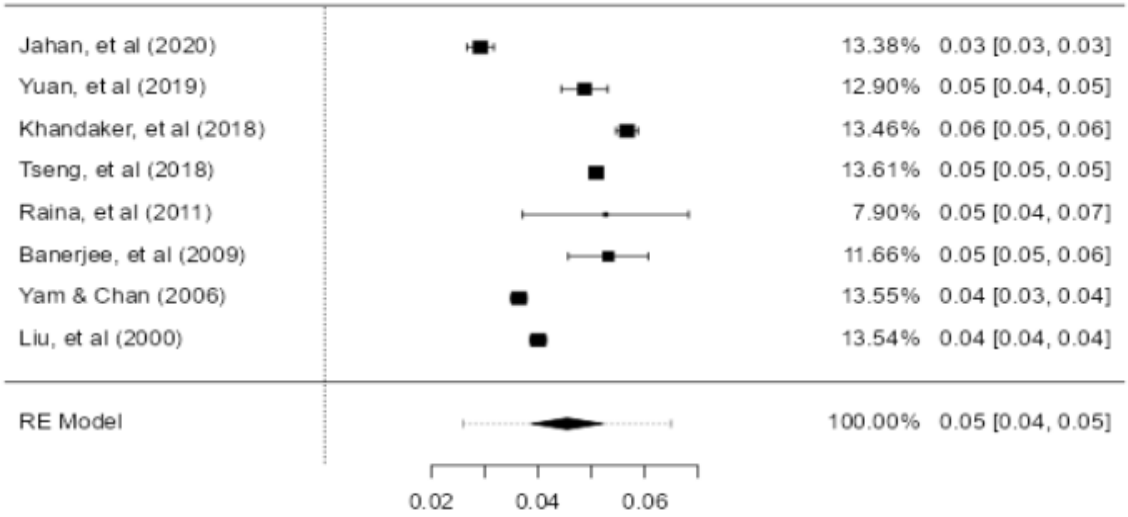

Figure 2. Forest Plot of CP Prevalence in Children and Adolescents in Asia
Source: Statistical data analysis by Jamovi 2.2.5 software

Cerebral palsy appears to affect boys more than girls, with a prevalence of 1.71 per 1000 people. The prevalence of CP was classified into two groups based on the family socio-economic status analysis. The prevalence of CP in families living below the poverty line is 1.46 per 1000 people, while it is 0.91 per 1000 people in wealthy families. In other words, children born into poor families are more likely to have CP than children born into wealthy families. Children and adolescents with CP from low-income families make up 63.67% of the total study population. This review obtained prevalence data based on the classification of CP type in addition to CP type classification. The spastic type is the most common type of CP (1.79 per 1000 people), properly accounting for 80.51% of all children and adolescents diagnosed with CP.

According to the data analysis, the heterogeneity value (I2) is 98.95%. The breadth of the variance in scores owned by the respondent group of the entire study influences the heterogeneity that is classified as high. The remarkably diverse characteristics of all the studies involved also contribute to the review's high heterogeneity. Geographic location, demographic conditions (mean age, education level, family income), and sample size are among these characteristics. Furthermore, heterogeneity is caused by differences in the measuring instruments used to determine CP diagnostics, as well as differences in the analysis of research results based on demographic data available in each study. The funnel plot display in Figure 3 was used to assess the publication bias of this study. This review has significant publication bias because the majority of the included studies are at the top of the plot and the distribution was asymmetric. If at least four studies are in the lower area of the funnel plot, this publication bias may not occur (Chauhan et al., 2019).

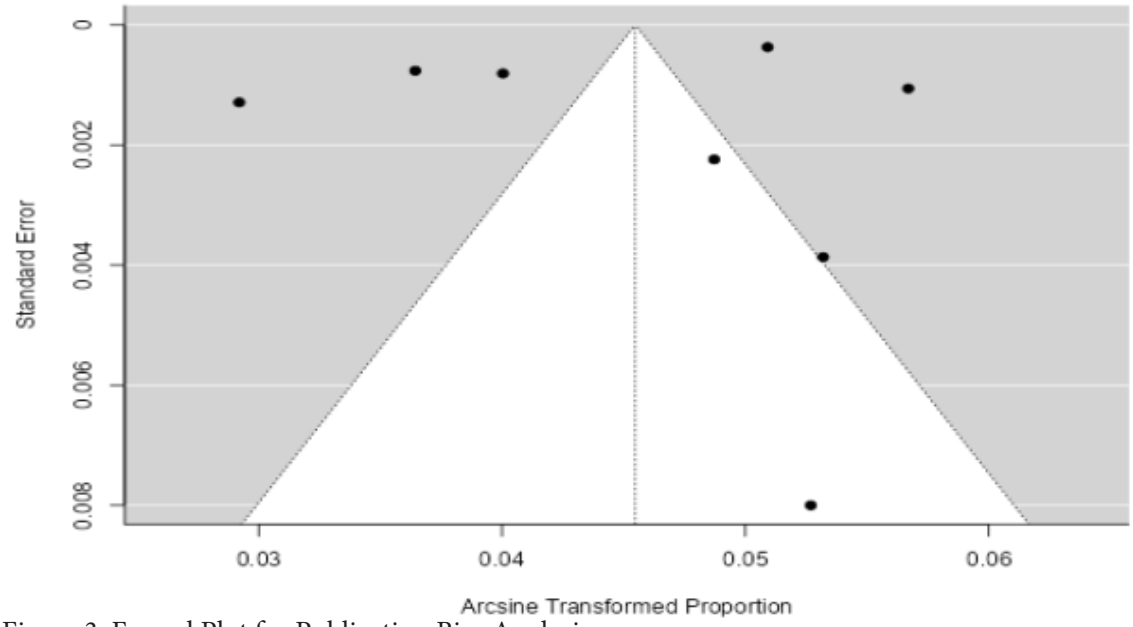

Figure 3. Funnel Plot for Publication Bias Analysis
Source: Statistical data analysis by Jamovi 2.2.5 software

This study is a single systematic review of the prevalence of CP in Asia. Highlighting the prevalence of children and adolescents in Asia, this study found that the incidence rate of CP in countries in the Asian region was 2.19 per 1000 children and adolescents (95% CI). This figure is nearly identical to the global prevalence of CP in the world, which is 2.21 per 1000 (Oskoui et al., 2013). However, these statistics show an increase in the prevalence of CP during the last 10 years, from 1.09 per 1000 children to 2.19 per 1000 children (Lang et al., 2012).

The current study's findings differslightly from previous studies that found that the number of CP cases per 1000 people in Asia was lower than in Western countries (Liu et al., 1999; He et al., 2017). In Europe, Australia, and the United States, the prevalence of CP is 1.8-2.4 cases per 1000 children, respectively (Hirtz et al., 2007; Arneson et al., 2009; Oskoui et al., 2013; Himmelmann & Uvebrant, 2014; Froslev-Friis et al., 2015; Smithers-sheedy et al., 2016; Robertson et al., 2017; El-Tallawy et al., 2014; Kakooza-Mwesige et al., 2017). In comparison to these figures, the prevalence of CP in Asia and Europe is not significantly different. These findings imply that governments in various nations continue to focus on this topic to alleviate societal burdens that arise as a consequence of handicap situations.

According to this study, males had a 30% greater risk of having CP, with a case prevalence of 1.71 per 1000 live births. These findings confirm the previous study, which found that in prematurely born children, boys had a greater prevalence of brain-based developmental impairments such as mental retardation, autism, Attention Deficit Hyperactivity Disorder (ADHD), and cerebral palsy, than girls (Tioseco et al., 2006; Johnston & Hagberg, 2007; Romeo et al., 2022). Many contributing causes have been identified as biological vulnerability, neurodevelopmental abnormalities such as brain disorganization, genetic predisposition, and distinct hormonal impacts between males and females (Vasileiadis et al., 2009; Chen et al., 2013; Bi et al., 2014).

Five of the eight studies included in this review found a high percentage of CP prevalence among poor children and adolescents. They outnumber children and adolescents from wealthy families. (Jahan et al., 2020; Yuan et al., 2019; Khandaker et al., 2019; Tseng et al., 2018; Banerjee et al., 2009). According to the findings of studies conducted in the United States and the United Kingdom, socioeconomic deprivation is associated with an increased risk of having a child with CP. Malnutrition, premature birth, low birth weight, postnatal injury, and risk factors for CP are all caused

by low socioeconomic status (Himpens et al., 2008; Taguri et al., 2008; Solaski et al., 2014; Oskoui et al., 2016; Pacheco et al., 2017).

This review discovered that the prevalence of spastic type CP was the highest based on the classification of CP type. According to the findings of several studies, spasticity is the most common motor disorder in children with cerebral palsy and can be classified based on the area of the body affected: hemiplegia, diplegia, tetraplegia, or the type of movement disorder: spastic cerebral palsy, athetoid, ataxic, and hypotonic (Reeuwijk et al., 2006; Shea et al., 2018; Reilly et al., 2020). Spasticity is a significant barrier to the rehabilitation of children with cerebral palsy. Spasticity can impair or inhibit activity, cause discomfort, disrupt sleep, bring unneeded problems, and make life difficult for caregivers (Birns & Irani, 2015; Reilly et al., 2020). Appropriate treatments are critical in helping a CP person function and live more efficiently (Tilton, 2004).

The three studies in this review categorized CP into three types: spastic, dyskinetic, and ataxic (Jahan et al., 2020; Khandaker et al., 2019; Yam et al., 2006). Other studies only distinguish between two types: spastic and dyskinetic (Chauhan et al., 2019; Banerjee et al., 2009). There was also a study in Taiwan that only determined the prevalence of CP based on the degree of disability, namely severe and mild (Tseng et al., 2018), whereas two other studies did not (Yuan et al., 2019; Liu et al., 2000). The majority of the studies employed a population-based survey design, two were cross-sectional studies, and the remaining two were not specified in their articles. The study was carried out in Asia, including Indonesia (Southeast Asia), China (East Asia), Bangladesh (South Asia), Taiwan (East Asia), India (South Asia), and Hong Kong (East Asia). Several studies in the same country (China and India) used different populations.

Based on the results of the article quality assessment, the majority of the research included in this review can be classified as high-quality research. This classification refers to quality assessment guidelines for healthcare prevalence and incidence research (Loney et al., 1998). There is only one study with a moderate quality rating because it lacks adequate and detailed interpretation of research findings (Raina et al., 2011). Furthermore, in two other articles that received a score of 7, there were limitations related to the use of non-standardized measuring instruments in establishing the diagnosis of CP. These articles, however, remained in the good category.

This review also emphasizes the high clinical heterogeneity across studies as a result of sample size variations and the use of various screening tools for the assessment and diagnosis of CP. Standardized questionnaires have been used as a measuring tool in several studies. Several studies use more than one measurement method, such as questionnaires and clinical observations, and are supported by machine assessment accuracy. In addition to the high heterogeneity, publication bias was discovered using the funnel plot diagram. More studies with different results are required to break down the analysis of the findings of this study.

The framework of this systematic review, which refers to the flowchart of the PRISMA 2020 guide to reporting items (Page et al., 2021), is the study's strength. Furthermore, the authors created detailed inclusion and exclusion criteria to screen the articles. The authors also reported the screening process and the final results obtained systematically using the PRISMA diagram. However, if the high heterogeneity value is highlighted, this study can be expanded into a meta-regression study. This limitation can be used as a starting point for future research. Jamovi 2.2.5 was chosen by the authors for practical reasons. However, the analysis has some limitations. As a result, the authors complete it with Excel 2021 for data management, calculating prevalence using the point prevalence rate formula (Achmadi, 2013) and performing sub-group analysis of the data obtained, such as family economic level and CP type classification. However, the authors are well aware that using other software, such as STATA, can be more efficient.

Conclusion

This review found that the prevalence of CP in children and adolescents in Asia was not significantly different from that in Europe or even the global prevalence of CP. These

findings address the controversy surrounding previous studies that compared the prevalence of CP in Asia and Europe. The high prevalence of CP in Asia has certainly been concerning because there is still a support and quality of service gap between Asia and Europe for people with disabilities and their families. One interesting fact is that the majority of children and adolescents with CP come from low-income families. The authors recommend to many related parties be concerned about prioritizing the poor so that they have better access to health services. The health services in question are socio-educational services that serve as prevention or protection against disability, as well as rehabilitation for better handling of CP cases. Suggestions for the next researchers are expected to be able to develop this research by relating it to other variables such as malnutrition and family quality of life.

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References

Aal-Blowi, A., Aal-Mutairi, R., Ghabbany, R.M., Manaa, A.M., Aloufi, M.M., Ternati, G.K., Al-Raddady, B.H., & Al-Rufai, A., 2020. The Prevalence of Malnutrition and the Nutritional Status in Children with Cerebral Palsy and Its Causes in Madinah Maternity and Children Hospital. *Current Pediatric Research*, 24(7), pp.273–280.

Achmadi, U.F., 2013. *Kesehatan Masyarakat Teori dan Aplikasi.* Jakarta: PT Raja Grafindo Persada.

ADB Briefs., 2020. Disability and Social Protection in Asia. *Asian Development Bank Briefs,* 4(100), pp.1–7.

Arneson, C.L., Durkin, M.S., Benedict, R.E., Kirby, R.S., Yeargin-Allsopp, M., & Van Naarden, B.K., 2009. Prevalence of Cerebral Palsy: Autism and Developmental Disabilities Monitoring Network, Three Sites, United States, 2004. *Disabil Health J*, 2, pp.45–48.

Asian Development Bank., 2015. *The Social Protection Indicator for Asia: Assessing Progress (Issue July)*.

Banerjee, T.K., Hazra, A., Biswas, A., Ray, J., Roy, T., Raut, D.K., Chaudhuri, A., & Das, S.K., 2009. Neurological Disorders in Children and Adolescents. *Indian Journal of Pediatrics,* 76(2), pp.139–146.

Bi, D., Chen, M., Zhang, X., Wang, H., Xia, L., Shang, Q., Li, T., Zhu, D., Blomgren, K., He, L., Wang, X., Xing, Q., & Zhu, C., 2014. The Association Between Sex-Related Interleukin-6 Gene Polymorphisms and the Risk for Cerebral Palsy. *Journal of Neuroinflammation*, 11(1), pp.1–12.

Birns, J., & Irani, T.S., 2015. Management of Spasticity. *Management of Post-Stroke Complications*, 2015, pp.227–240.

Chauhan, A., Singh, M., Jaiswal, N., Agarwal, A., Sahu, J.K., & Singh, M., 2019. Prevalence of Cerebral Palsy in Indian Children: A Systematic Review and Meta-Analysis. *Indian Journal of Pediatrics*, 86(12), pp.1124–1130.

Chen, C.M., Hsu, H.C., Chen, C.L., Chung, C.Y., Chen, K.H., & Liaw, M.Y., 2013. Predictors for Changes in Various Developmental Outcomes of Children with Cerebral Palsy-A Longitudinal Study. *Research in Developmental Disabilities*, 34(11), pp.3867–3874.

Dalal, A.K., 2010. Disability-Poverty Nexus: Psycho-Social Impediments to Participatory Development. *Psychology and Developing Societies*, 22(2), pp.409–437.

Earde, P.T., Praipruk, A., Rodpradit, P., & Seanjumla, P., 2018. Facilitators and Barriers to Performing Activities and Participation in Children with Cerebral Palsy: Caregivers' Perspective. *Pediatric Physical Therapy,* 30(1), pp.27–32.

El-Tallawy, H.N., Farghaly, W.M., Shehata, G.A., Rageh, T.A., Metwally, N.A., & Badry, R., 2014. Cerebral Palsy in AI-Quseir City, Egypt: Prevalence, Subtypes, and Risk Factors. *Neuropsychiatr Dis Treat*, 10, pp.1267–1272.

Froslev-Friis, C., Dunkhase-Heinl, U., Andersen, J. ., Stausbol-Gron, B., Hansen, A., & Game, E., 2015. Epidemiology of Cerebral Palsy in Southern Denmark. *Dan Med J,* 62, pp.A4990.

Green, L.B., & Hurvitz, E.A. 2007. Cerebral Palsy. *Physical Medicine and Rehabilitation Clinics of North America,* 18(4), pp.859–882.

He, P., Chen, G., Wang, Z., Guo, C., & Zheng, X., 2017. Children with Motor Impairment Related to Cerebral Palsy: Prevalence, Severity and Concurrent Impairments in China. *J Paediatr Child Health*, 53, pp.480–

484.

Himmelmann, K., & Uvebrant, P., 2014. The Panorama of Cerebral Palsy in Sweden XI. Changing Patterns in the Birth-Year Period 2003-2006. *Acta Paediatrics,* 103, pp.618–624.

Himpens, E., Van Den Broeck, C., Oostra, A., Calders, P., & Vanhaesebrouck, P., 2008. Prevalence, Type, Distribution, and Severity of Cerebral Palsy in Relation to Gestational Age: A Meta-Analytic Review. *Developmental Medicine and Child Neurology,* 50(5), pp.334–340.

Hirtz, D., Thurman, D.J., Gwinn-Hardy, K., Mohamed, M., Chaudhuri, A.R., & Zalutsky, R., 2007. How Common are the "Common" Neurologic Disorders? *Neurology,* 68(5), pp.326–337.

Jahan, I., Al Imam, M.H., Karim, T., Muhit, M., Hardianto, D., Das, M.C., Smithers-Sheedy, H., Badawi, N., & Khandaker, G., 2020. Epidemiology of Cerebral Palsy in Sumba Island, Indonesia. *Developmental Medicine and Child Neurology,* 62(12), pp.1414–1422.

Johnston, M.V., & Hagberg, H., 2007. Sex and the Pathogenesis of Cerebral Palsy. *Developmental Medicine and Child Neurology,* 49(1), pp.74–78.

Kakooza-Mwesige, A., Andrews, C., Peterson, S., Mangen, F.W., Eliasson, A.C., & Forssberg, H., 2017. Prevalence of Cerebral Palsy in Uganda: A Population-Based Study. *Lancet Glob Health,* 5, pp.1275–1282.

Khandaker, G., Smithers-sheedy, H., Muhit, M., Novak, I., Karim, T., Jones, C., & Badaw, N., 2019. Epidemiology of Cerebral Palsy in Bangladesh a Population-Based Surveillance. *Developmental Medicine & Child Neurology,* 61, pp.601–609.

Lang, T.C., Fuentes-Afflick, E., Gilbert, W.M., Newman, T.B., Xing, G., & Wu, Y.W., 2012. Cerebral Palsy among Asian Ethnic Subgroups. *Pediatrics,* 129(4).

Liu, J.M., Li, S., Lin, Q., & Li, Z., 1999. Prevalence of Cerebral Palsy in China. *International Journal of Epidemiology,* 28(5), pp.949–954.

Liu, J.M., Li, Z., Lin, Q., Zhao, P., Zhao, F.L., Hong, S.X., & Li, S., 2000. Cerebral Palsy and Multiple Births in China. *International Journal of Epidemiology,* 29(2), pp.292–299.

Loney, P.L., Chambers, L.W., Bennett, K.J., Roberts, J.G., & Stratford, P.W., 1998. Critical Appraisal of the Health Research Literature: Prevalence or Incidence of a Health Problem. *Chronic Diseases in Canada,* 19(4).

Nelson, K.B., & Ellenberg, J.H., 1978. Epidemiology of Cerebral Palsy. *Advances in Neurology,* 19, pp.421–435.

Oskoui, M., Coutinho, F., Dykeman, J., Jetté, N., & Pringsheim, T., 2013. An Update on the Prevalence of Cerebral Palsy: A Systematic Review and Meta-Analysis. *Developmental Medicine and Child Neurology,* 55(6), pp.509–519.

Oskoui, M., Messerlian, C., Blair, A., Gamache, P., & Shevell, M., 2016. Variation in Cerebral Palsy Profile by Socioeconomic Status. *Dev Med Child Neurol,* 58, pp.160–166.

Pacheco, C.D.R., Picauly, I., & Sinaga, M., 2017. Health, Food Consumption, Social Economy, and Stunting Incidency in Timor Leste. *Jurnal Kesehatan Masyarakat*, 13(2), pp.261–269.

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., & Mulrow, C.D., 2021. The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. *BMJ Open*, 372(71).

Raina, S.K., Razdan, S., & Nanda, R., 2011. Prevalence of Cerebral Palsy in Children <10 Years of Age in R.S. Pura Town of Jammu and Kashmir. *Journal of Tropical Pediatrics,* 57(4), pp.293–295.

Reeuwijk, A., van Schie, P.E.M., Becher, JG., & Kwakkel, G., 2006. Effects of Botulinum Toxin Type A on Upper Limb Function in Children with Cerebral Palsy: A Systematic Review. *Clinical Rehabilitation,* 20(5), pp.375–387.

Reilly, M., Liuzzo, K., & Blackmer, A.B., 2020. Pharmacological Management of Spasticity in Children with Cerebral Palsy. *Journal of Pediatric Health Care*, 34(5), pp.495–509.

Robertson, C.M.T., Ricci, M.F., O'Grady, K., Oskoui, M., Goez, H., & Yager, J.Y., 2017. Prevalence Estimate of Cerebral Palsy in Northern Alberta: Births, 2008-2010. *Can J Neurol Sci,* 44, pp.366–374.

Romeo, D.M., Venezia, I., Pede, E., & Brogna, C., 2022. Cerebral Palsy and Sex Differences in Children: A Narrative Review of the Literature. *Journal of Neuroscience Research,* 2021, pp.1–13.

Rosenbaum, P., Paneth, N., & Leviton, A., 2007. A Report: The Definition and Classification of Cerebral Palsy. *Dev Med Child Neurol Suppl,* 109, pp.8–14.

Sellier, E., Platt, M.J., Andersen, G.L., KraÈ geloh-Mann, I., De La Cruz, J., & Cans, C., 2016. Decreasing Prevalence in Cerebral Palsy: A Multi-Site European Population-Based Study, 1980 to 2003. *Dev Med Child Neurol,* 58, pp.85–92.

Shea, T.M.O., Preisser, J.S., Klinepeter, K.L., &

Dillard, R.G., 1998. Trends in Mortality and Cerebral Palsy in a Geographically Based Cohort of Very Low Birth Weight Neonates Born Between 1982 to 1994. *Pediatrics,* 101(4).

Smithers-sheedy, H., McIntyre, S., Gibson, C., Meehan, E., Scott, H., & Goldsmith, S., 2016. A Special Supplement: Findings from the Australian Cerebral Palsy Register, Birth Years 1993 to 2006. *Dev Med Child Neurol,* 58(2), pp.5–10.

Solaski, M., Majnemer, A., & Oskoui, M., 2014. Contribution of Socio-Economic Status on the Prevalence of Cerebral Palsy: A Systematic Search and Review. *Dev Med Child Neurol,* 56, pp.1043–1051.

Taguri, A.E., Betilman, I., Mahmud, S.M., Ahmed, A.M., Goulet, O., Galan, P., & Herceberg, S., 2008. Risk Factor for Stunting Among Under Five in Libya. *Public Health Nutrition*, 12(8), pp.1141–1149.

Tilton, A.H., 2004. Management of Spasticity in Children with Cerebral Palsy. *Seminars in Pediatric Neurology*, 11(1), pp.58–65.

Tioseco, J.A., Aly, H., Essers, J., Patel, K., & El-Mohandes, A.A.E., 2006. Male Sex and Intraventricular Hemorrhage. *Pediatric Critical Care Medicine,* 7(1), pp.40–44.

Tseng, S.H., Lee, J.Y., Chou, Y.L., Sheu, M.L., & Lee, Y.W., 2018. Association between Socioeconomic Status and Cerebral Palsy. *PLoS ONE*, 13(1), pp.1–9.

Vasileiadis, G.T., Thompson, R.T., Han, V.K.M., & Gelman, N., 2009. Females Follow a More "Compact" Early Human Brain Development Model than Males. A Case-Control Study of Preterm Neonates. *Pediatric Research*, 66(5), pp.551–554.

Wagle, U.R., 2017. How Much do Social Protections Matter to Poverty and Inequality? An Insight from Asian Experiences. *Global Social Policy,* 17(2).

Wu, Y.W., Xing, G., Fuentes-Afflick, E., Danielson, B., Smith, L.H., & Gilbert, W.M., 2011. Racial, Ethnic, and Socioeconomic Disparities in the Prevalence of Cerebral Palsy. *Pediatrics*, 127, pp.674–681.

Yam, W.K.L., Chan, H.S.S., Tsui, K.W., Yiu, B.P.H.L., Fong, S.S.L., Cheng, C.Y.K., & Chan, C.W., 2006. Prevalence Study of Cerebral Palsy in Hong Kong Children. *Hong Kong Medical Journal,* 12(3), pp.180–184.

Yuan, J., Wang, J., Jieqiong, M. A., Zhu, D., Zhang, Z., & Li, J., 2019. Pediatric Cerebral Palsy Prevalence and High-Risk Factors in Henan Province, Central China. *Journal of Rehabilitation Medicine,* 51(1), pp.47–53.