The Effect of Premature Births on Language Delay in Children: A Meta-Analysis

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ABSTRACT

Background: Child development problems are problems that need attention. A child can experience developmental delays in one or more developmental domains. It usually occurs in infants who born prematurely. In Indonesia, data from the Ministry of Health states that there are 675,700 premature infants in Indonesia. This study aimed to examine the effect of premature births on language delay in children using a meta-analysis

Subjects and Method: This was a systematic review and meta-analysis. The articles used in this study were obtained from several databases including PubMed, Wiley, Springer Link, Elsevier, BMC Pediatrics and Google Scholar. The articles used in this study were those published from 2000-2020. The article search was carried out by considering the eligibility criteria defined using the PICO model. The population in the study were children with intervention in the form of babies born prematurely, the comparison was that babies born at term, the outcome was language delay. The keywords for searching articles are as follows: (preterm OR "short gestational ages" OR prema-ture) AND "language delay" AND child AND observational AND aOR. The articles included in this study are full text articles with an observational study design. Articles were collected using PRISMA flow diagrams. Articles were analyzed using the Review Manager 5.3.

Results: A total of 8 articles from the Americas, Europe, Asia and Australia were reviewed in this study. The meta-analysis combining 8 cohort studies concluded that preterm infants caused language delay in children 1.65 times as much as non-nomal children (aOR= 1.65, 95% CI= 1.11 to 2.44, p= 0.010).

Conclusion: Infants born prematurely experience delays in language development.

Keywords: premature birth, language development delay

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BACKGROUND

Child development problems are problems that need attention. A child can experience developmental delays in one or more developmental domains. This developmental delay problem usually occurs in children born prematurely. This is because the level of development of premature babies in the first year is generally lower than babies who are born at term on the same day (Putri et al, 2018).

Premature birth occurs when the baby is born at the mother's gestation at less than 37 weeks. A child is considered to have speech and language delays if the development of speech and language is significantly below the milestones of his age (Patterson, 2017). Delays in premature development usually include motor development, social

adaptation, and language (Eisenberg, 2002).

Nearly one million children die each year from complications of preterm birth, with more than 60% of preterm births occurring in Africa and South Asia. Meanwhile, in low-income countries, an average of 12% of infants was born prematurely, while in high-income countries only 9% (WHO, 2014). Ministry of Health data shows that there are approximately 675,700 premature babies in Indonesia (Mariyana, 2018). Taylor et al (2018) stated that there are 67% of babies born prematurely with language disorders occurring in Western Australia. Meanwhile, in Mongolia, 11.7% of babies born prematurely are at risk of experiencing language disorders (Dagvadorj et al., 2018).

The number of primary studies examining the effect of preterm infants on language delay in children has prompted researchers to conduct a more comprehensive study of these primary studies. The data obtained will be analyzed using a systematic review and meta-analysis by synthesizing the results of studies conducted to reduce bias.

SUBJECTS AND METHOD
1. Study Design
This was a systematic review and meta-analysis. The articles used in this study were obtained from several databases including PubMed, Wiley, Springer Link, Elsevier, BMC Pediatrics and Google Scholar. The keywords for searching articles are as follows: (preterm OR "short gestational ages" OR SGA OR premature) AND "language delay" AND children AND observational AND aOR.
2. Inclusion Criteria
The articles included in this study were full paper articles with an observational study design and English. Appropriate articles

should mention preterm infant interventions with language delay outcomes.

The articles are those that use the appropriate population, namely children. The analysis used is the multivariate adjusted Odds Ratio.
3. Exclusion Criteria
The articles published in this study are articles that have been carried out by meta-analysis. The articles are published before 2000 and are not multivariate articles..
4. Operational Definition
The article search was carried out by considering the eligibility criteria defined using the PICO model. The population was children. The intervention was premature infants with comparison was aterm birth infants. The outcome was language delay.

Language delay is language development that is significantly below the milestone of a child of his age (Patterson and Dale, 2017).

Gestational age is one of the things that can affect fetal survival and quality of life. Generally, pregnancy is termed term if it lasts between 37-41 weeks counting from the first day of the last menstrual cycle on the 28 day cycle. Meanwhile, labor that occurs before the gestational age reaches 37 weeks is called preterm labor (Widjayanegara, 2009 in Sulistiarini, 2013).

Mariyana (2018) in analyzing the relationship between the incidence of prematurity and development shows that there are differences in the incidence of developmental delay in prematurity. This is in line with research conducted by Soubasiet al (2014) which states that children who are born prematurely experience neurological delays and low cognitive levels. According to Raybaud et al (2013), brain development in children born prematurely is often unstable.

5. Data Analysis

Data processing was performed using the Review Manager (RevMan 5.3) by calculating the effect size and heterogeneity to determine which research models were combined and formed the final meta-analysis result.

The process of searching for articles by searching through a database with journals can be seen in Figure 1. Figure 2 shows the areas where articles were taken according to the inclusion criteria. Articles obtained from 4 continents, namely Asia, America, Europe and Australia.
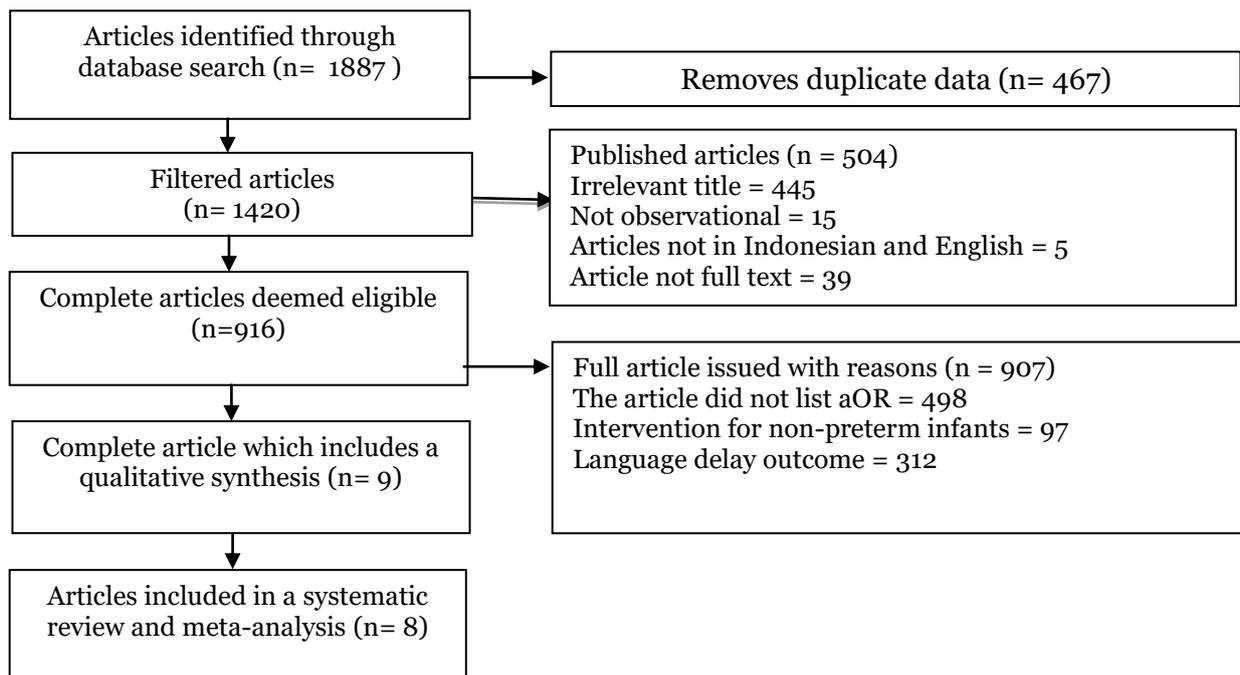
Articles identified through database search (n= 1887)

Removes duplicate data (n= 467)

Filtered articles (n= 1420)

Published articles (n = 504)
Irrelevant title = 445
Not observational = 15
Articles not in Indonesian and English = 5
Article not full text = 39

Complete articles deemed eligible (n=916)

Full article issued with reasons (n = 907)
The article did not list aOR = 498
Intervention for non-preterm infants = 97
Language delay outcome = 312

Complete article which includes a qualitative synthesis (n= 9)

Articles included in a systematic review and meta-analysis (n= 8)

Figure 1. PRISMA diagram

4 studies in North America

1 study in Europe

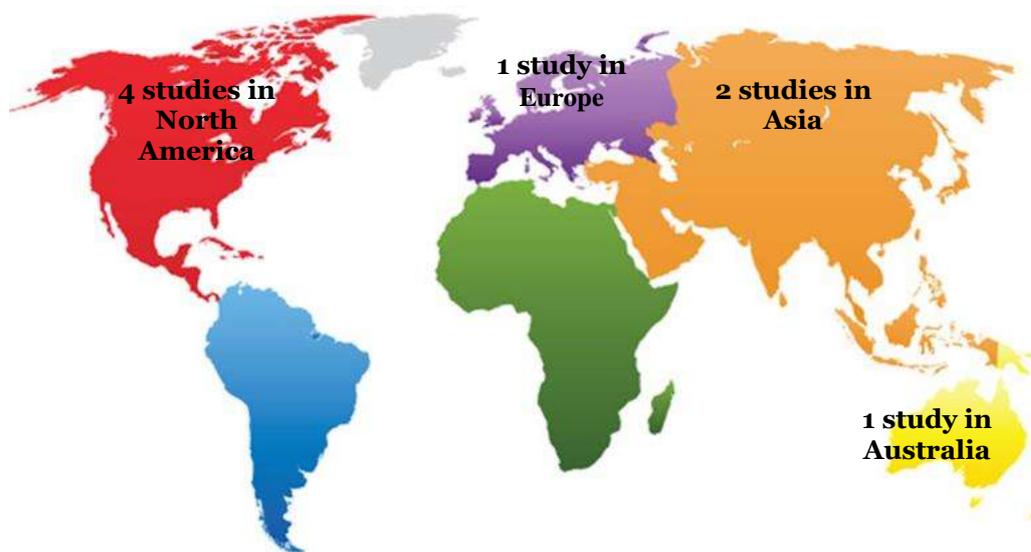2 studies in Asia

1 study in Australia

Figure 2. Research area

Based on the results of the forest plot (Figure 3) in the cohort study, preterm babies could cause language delay in children 1.65 times compared to children who were born nominally which was statistically significant (p= 0.010). The heterogeneity of the research data shows I^2= 85%. So that the distribution of the data is heterogeneous (random effect model). The
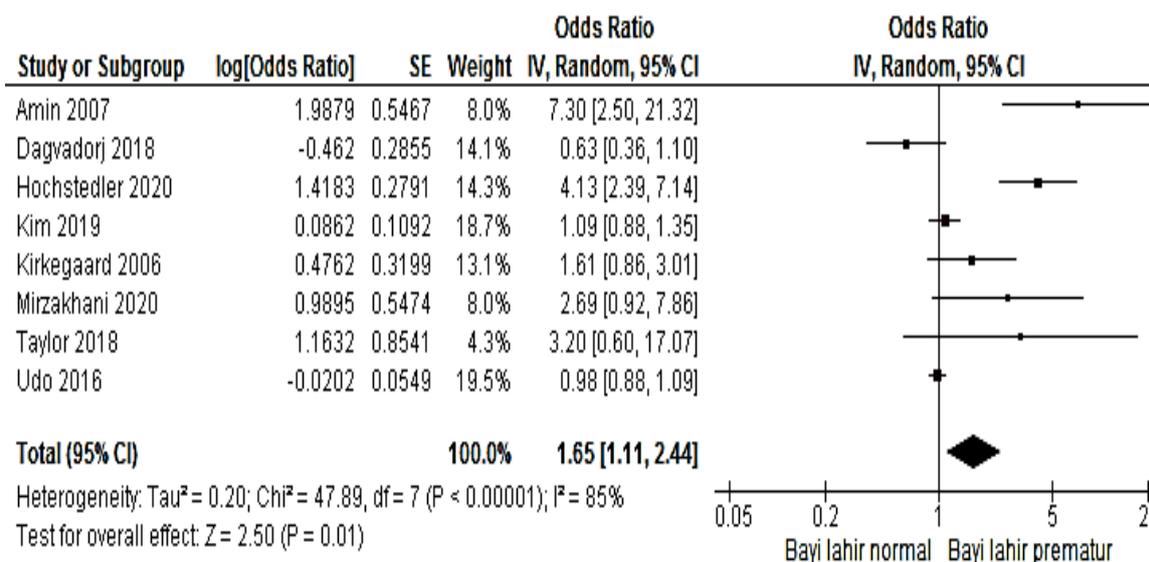
funnel plot (Figure 4) is characterized by asymmetry of the right and left plots where 3 plots are on the left, 4 plots are on the right and 1 plot is in the middle. The plot on the left of the graph appears to have a standard error between 0 and 1 and the plot on the right has a standard error between 0.2 and 20.

a. Funnel plot

Figure 3. Funnel Plot of Influence of Premature Birth on Language Delay in Children

Study or Subgroup	log[Odds Ratio]	SE	Weight	IV, Random, 95% CI
Amin 2007	1.9879	0.5467	8.0%	7.30 [2.50, 21.32]
Dagvadorj 2018	-0.462	0.2855	14.1%	0.63 [0.36, 1.10]
Hochstedler 2020	1.4183	0.2791	14.3%	4.13 [2.39, 7.14]
Kim 2019	0.0862	0.1092	18.7%	1.09 [0.88, 1.35]
Kirkegaard 2006	0.4762	0.3199	13.1%	1.61 [0.86, 3.01]
Mirzakhani 2020	0.9895	0.5474	8.0%	2.69 [0.92, 7.86]
Taylor 2018	1.1632	0.8541	4.3%	3.20 [0.60, 17.07]
Udo 2016	-0.0202	0.0549	19.5%	0.98 [0.88, 1.09]
Total (95% CI)			**100.0%**	**1.65 [1.11, 2.44]**

Heterogeneity: Tau² = 0.20; Chi² = 47.89, df = 7 (P < 0.00001); I² = 85%
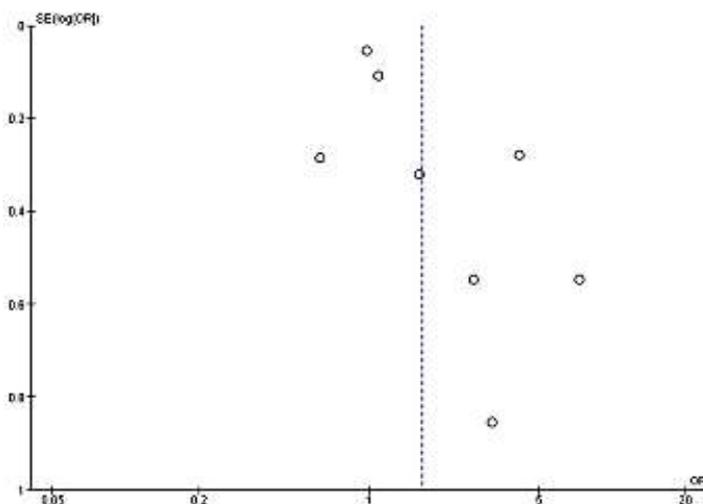Test for overall effect: Z = 2.50 (P = 0.01)

b. Forest plot

Figure 4. Funnel Plot of Influence of Premature Birth on Language Delay in Children

Table 1. Critical Appraisal Skills Programme (CASP) for Cohort Study

Questions in the checklist	Publication (Author and year)							
	Kirkegaard et al. (2006)	Amin et al. (2007)	Udo et al. (2016)	Taylor et al. (2018)	Dagvadorj et al. (2018)	Kim et al. (2019)	Mirzakhani et al. (2007)	Hochstedler et al. (2020)
Does this research address clearly focused issues?	1	1	1	1	1	1	1	1
Was the group included in an acceptable way?	1	1	1	1	1	1	1	1
Is exposure measured accurately to minimize bias?	1	1	1	1	1	1	1	1
Are the results measured accurately to minimize bias?	1	1	1	1	1	1	1	1
Have the authors identified all the important confounding factors?	1	1	1	0	1	1	1	1
Was the follow-up to the subject of this study complete?	1	1	1	1	0	1	0	1
What are the results of this study?	1	0	1	0	1	1	1	1
How precise is the result?	1	1	1	1	1	1	1	1
Do you believe in the results?	1	1	1	1	1	1	1	1
Can the results be applied to the local population?	1	1	1	1	1	1	1	1
Are the results of this study consistent with other available evidence?	1	1	1	1	1	1	1	1
What are the implications of this study for practice?	1	1	1	1	1	1	1	1
Total	12	11	12	10	11	12	11	12

Note: Yes = 1, No = 0

Table 2. Descriptions of primary studies included in the meta-analysis

Author (year)	Title	Country	Study Design	Sample	P Population	I Intervention	C Comparison	O Outcome
Kirkegaard et al. (2006)	Gestational age and birth weight in relation to school per-formance of 10-year-old children: A follow-up study of children born after 32 completed weeks	Denmark	Cohort	5,319	Children 2 years old	Gender, age of pregnant women, mother's education, father's educators, children living with parents, breastfeed-ing, mothers smoking and con-suming alcohol and caffeine during pregnancy, gestational age and birth weight	Not given ASI, normal birth, normal birth weight	School performance (Difficulty reading, spelling, and arithmetic)
Amin et al. (2007)	Hyperbilirubine mia and language delay in premature infants	Canada	Cohort	125	9 month old child	Gestational age, birth weight, gender, race, mother's educa-tion, exposure to illegal drugs, mode of delivery, Apgar score	Normal birth weight, not exposed to drugs, normal birth	Language Delay
Udo et al. (2016)	Maternal inti-mate partner violence: Relationships with language and neurological development of infant and toddlers	USA	Cohort	210	Children aged 9 to 11 years	Race, age of pregnant women, mother's education, father's education, parental employ-ment status, smoking before pregnancy, smoking during pregnancy, depression, stress, encouragement from peers and others, birth, birth weight	No smoking before and during preg-nancy, no depression or stress, normal birth, normal birth weight	Language Delay
Taylor et al. (2018)	Prenatal and perinatal risks for late language emergence in a population-level sample of twins at age 2	Australia	Cohort	946	Children aged 3 years	Pregnant mother's age, mother's education, marital status, income, socio-economic status, Apgar score, gestational age	The baby is born normal	Language Delay

Author (year)	Title	Country	Study Design	Sample	P Population	I Intervention	C Comparison	O Outcome
Dagvadorj et al. (2018)	Maternal socio-demographic and psychological predictors for risk of deve-lopmental delays among young children in Mongolia	Mongolia	Cohort	150	Children aged 3 to 24 months	Gender, age of pregnant women, birth, Apgar value, month of birth	The baby is born normal	Developmental delays (gross motor skills, fine motor skills, expres-sive and recep-tive language, social emotio-nal and adapt-ability)
Kim et al. (2019)	Cognitive out-comes of children with very low birth weight at 3 to 5 years of age	Korea	Cohort	88	2 year old child	Gender, birth, mother's education	The baby is born normal	Language Delay
Mirzakhani et al. (2020)	Stability of developmental status and risk of impairment at 24 and 36 months in late preterm infants	USA	Cohort	652	Children aged 13 to 24 months	Birth, gestational age, race, mother's education, income, breastfeeding consumption, birth weight, marital status	Babies born normal, normal birth weight, consumption of formula milk	Developmental Delays (gross motor skills, language, personal-social, skills and problem solving
Hochstedle r et al. (2020)	Gestational age at birth and risk of developmental delay: The upstate KIDS study	New York, State	Cohort	5868	Children aged 3 to 5 years	Birth weight, age of pregnant women, race, mother's education, alcohol consumption during pregnancy, smoking during pregnancy, maternal weight during pregnancy, consumption of breast milk, consumption of formula milk	Normal birth weight, babies born normal, do not consume alcohol, do not smoke	Developmental delays (fine motor skills, gross motor skills, commu-nication, per-sonal social, problem solving)

*variables included in the meta-analysis study

DISCUSSION

This study is a systematic study and meta-analysis that takes the theme of preterm babies with language delay in children. This study discusses data about language delay because language is an important developmental component and is one of the main milestones in child development.

This systematic study study and meta-analysis used research that controlled for confounding factors which could be seen from the study inclusion requirements, namely multivariate analysis and the statistical result reported was the adjusted odd ratio (aOR).

Estimates of the combined effect of preterm infants on language delay in children were processed using the RevMan 5.3 application with the generic inverse variance method. The results of the systematic study and meta-analysis are presented in the form of a forest plot and a funnel plot. Forest plots provide an overview of information from each of the studies examined in the meta-analysis, and estimates of the overall results (Murti, 2018).

The funnel plot shows visually the amount of variation (heterogeneity) (Akobeng, 2005 in Murti, 2018). The funnel plot shows the relationship between the effect size of the study and the sample size of the various studies studied, which can be measured in a number of different ways (Murti, 2018).

The effect of preterm babies on language delay

There are 8 observational research articles with a cohort study design as a source of meta-analysis of the effect of preterm infants on language delay in children.

The results of the meta-analysis of the cohort study showed that preterm infants could cause language delay in children 1.65 times as much as those who were born nominally (aOR= 1.65, 95% CI= 1.11 to 2.44, p= 0.010).

This is supported by Viana et al (2013), which concluded that there is a significant relationship between chronological age and age of cognitive and language development. Cattani et al (2010) added that premature children showed delays in all three aspects of communication and language. In particular, communicative-linguistic age tends to lag about 3 months behind chronological age when children are between 12 and 24 months old.

Babies born <37 weeks and the risk of health problems faced by premature babies increase the risk of developmental and academic disabilities. The risk of disorders will increase in babies born at a younger gestational age (Mann, 2011).

Babies born prematurely have problems with brain development and emotional development. Some of the risks of growth and development disorders for premature babies, namely: hearing and vision, language skills, psychomotor and behavior, cognitive abilities, and emotional development. The unique human ability to acquire language is a result of the functioning of the nervous system. Imperfections in the nervous system will affect a person's language skills. This disorder is very complex in terms of cognitive, communication, social interaction, attraction, and children's imagination activities, as well as children's emotions (Endarwati, 2015).

AUTHOR CONTRIBUTION

Alfiani is the main researcher who selects the topic, explores and collects research data. Didik Gunawan Tamtomo and Bhisma Murti played a role in analyzing data and reviewing research documents.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

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