# Meta-Analysis: The Effect of Breast Milk on Child Language

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## ABSTRACT

**Background:** Language development is an individual's ability to master vocabulary, speech, grammar, and pronunciation ethics within a certain period of time according to age development. Breast milk is the best food for babies, because it contains all the nutrients needed in the right amount to promote a child's growth and development. The purpose of this study was to analyze the effect of breastfeeding on children's language development by using 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, Google Scholar, and Springer Link. The articles used in this study were those published from 1999-2020. The article search was carried out by considering the eligibility criteria defined using the PICO model. The population in the study were children aged 2 months to 6 years old with intervention in the form of receiving breast milk, the comparison was that the outcome was not given breast milk in the form of language development. Keywords for searching articles are as follows: "language development" AND "breast-feeding" OR "breastmilk" AND "child" AND "observational". 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 application.

**Results:** A total of 11 articles were reviewed in this study. Meta-analysis of 7 cohort studies showed that breast milk improved children's language development (aOR= 1.19; 95% CI= 0.82 to 1.73; p= 0.35). Meta-analysis of 4 cross-sectional studies showed that breast milk improved children's language development (aOR= 1.54; 95% CI= 0.72 to 3.30; p= 0.27).

**Conclusion:** Language development improved children's language development.

**Keywords:** breastfeeding, breastmilk, language development

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## BACKGROUND

Language development is an individual's ability to master vocabulary, speech, grammar, and pronunciation ethics within a certain period of time according to age development (Yusuf, 2004). A person can be said to have mastered the language if he/she has mastered the five components of the language itself, namely phonology, morphology, syntax, semantics, and pragmatics (ASHA, 2020).

One of the important aspects in the development of children's language is breast milk because it contains unsaturated fats that can be absorbed by the baby's digestion and is very good for metabolism in the growth and development of children (Iqbal et al., 2017).

Based on the Basic Health Research (2018) in Indonesia, it shows that exclusive breastfeeding has only reached 37.3%. The number of primary studies examining the effect of breastfeeding on children's language development has encouraged the researchers to carry out more comprehensive study from 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 studyis a systematic and meta-analysis review. The articles used in this study were obtained from several databases including PubMed, Google Scholar, and Springer Link. The keywords for finding articles are as follows: "language development" AND " breastfeeding" OR "breastmilk" AND "child" AND "observational".

### 2. Inclusion Criteria

The articles included in this study are full paper articles with an observational study design, in Indonesian and English. Appropriate articles should mention breast-fed interventions with the outcome of language development.

The article uses the appropriate population i.e. children aged 2 months to 6 years old. 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. Articles published before 1999 and artiket are not multivariate.

### 4. Operational definition of variables

The article search was conducted by considering the eligibility criteria defined using the PICO model. Population in children aged 2 months to 6 years old with intervention in the form of being given breast milk, comparison that was not received breast milk and outcomes in the form of language development.

Language development is an individual's ability to master vocabulary, speech, grammar, and pronunciation ethics within a certain period of time according to age development (Yusuf, 2004).

Breast milk is the best and natural food for babies. Breast milk is the best food for babies in early life, this is because breast milk can protect babies from infection. Breastfeeding saves about 1.5 million babies per year in developing countries (Ministry of Health, 2008).

According to Iqbal et al. (2017), children who were breastfed for more than 6 months found that their language skills were 95.3% and their cognitive abilities were 93.7%. This is different from children who are breastfed for less than 6 months where the results of children's language skills are only 88.6% and cognitive abilities are only 86.4%.

### 5. Data Analysis

Data processing was carried out by the Review Manager (RevMan 5.3) by calculating the effect size and heterogeneity to determine the study model that was combined and formed the final meta-analysis result.

## RESULTS

The process of searching for articles by searching through databases 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.

Based on the results of the forest plot (Figure 3) in the cohort study, breastfeeding increased language development in children by 1.19 times higher compared to non-breastfeeding which was statistically

significant (p = 0.35). The heterogeneity of the research data showed $I^2$= 77%. Meanwhile, in a cross-sectional study, breastfeeding increased language development in children by 1.54 times higher compared to not breastfed and it was statistically significant (p= 0.27). The heterogeneity of the study data showed $I^2$= 60%. So that the distribution of data was declared heterogeneous (random effect model).

The funnel plot (figure 4) is characterized by asymmetry of the right and left plots where 5 plots are on the left and 6 plots are on the right. The plot on the left of the graph have a standard error between 0 and 1 and the plot on the right has a standard error between 0.2 and 1.
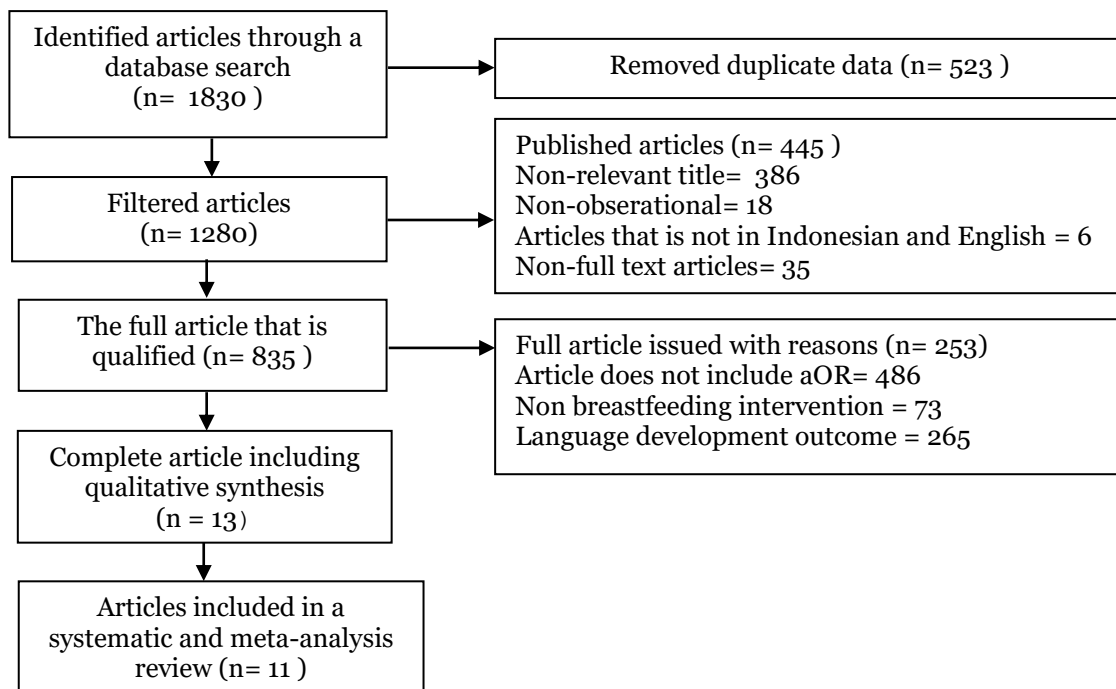
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┌─────────────────────────┐      ┌─────────────────────────────────────┐
│ Identified articles     │─────▶│ Removed duplicate data (n= 523 )    │
│ through a database      │      └─────────────────────────────────────┘
│ search (n= 1830 )       │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐      ┌─────────────────────────────────────────────────┐
│ Filtered articles       │─────▶│ Published articles (n= 445 )                    │
│ (n= 1280)               │      │ Non-relevant title= 386                         │
└─────────────────────────┘      │ Non-obserational= 18                            │
                                 │ Articles that is not in Indonesian and English = 6│
                                 │ Non-full text articles= 35                      │
                                 └─────────────────────────────────────────────────┘
            │
            ▼
┌─────────────────────────┐      ┌─────────────────────────────────────────────────┐
│ The full article that   │─────▶│ Full article issued with reasons (n= 253)       │
│ is qualified (n= 835 )  │      │ Article does not include aOR= 486               │
└─────────────────────────┘      │ Non breastfeeding intervention = 73             │
                                 │ Language development outcome = 265              │
            │                    └─────────────────────────────────────────────────┘
            ▼
┌─────────────────────────┐
│ Complete article        │
│ including qualitative   │
│ synthesis (n = 13)      │
└─────────────────────────┘
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            ▼
┌─────────────────────────┐
│ Articles included in a  │
│ systematic and meta-    │
│ analysis review (n= 11 )│
└─────────────────────────┘
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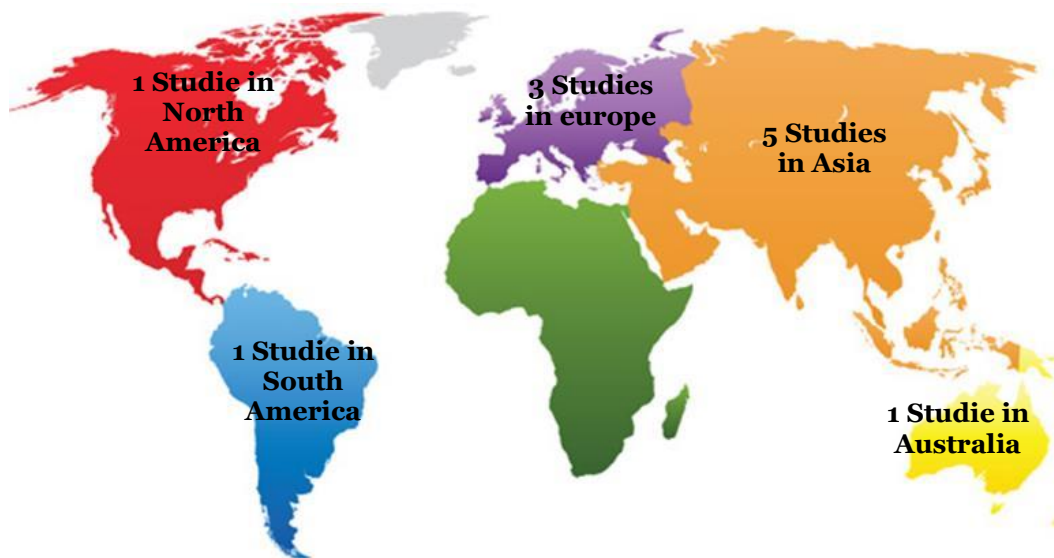
**Figure 1. PRISMA Flow Diagram**



**Figure 2. Map of the study area**

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

| Checklist Questions | Publication (Author andYear) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Wendy et al. (2011) | Quigley et al. (2012) | Kim and Choi (2020) | McCrory and Murray (2013) | Chiu et al. (2011) | Vestergaard et al. (1999) | Prathanee et al. (2007) |
| Does this study address focused and clear issues? | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Is the group included in an acceptable way? | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Is exposure measured accurately to minimize bias? | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Are the results measured accurately to minimize bias? | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Have the authors identified all the important confounding factors? | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Is the follow-up to the subject of this study complete? | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| What are the results of this study? | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| How precise is the result? | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Do you believe in the results? | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Can the results be applied to the local population? | 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 |
| What are the implications of this study for practice? | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Total | 12 | 12 | 12 | 12 | 11 | 12 | 12 |

Information: Yes = 1, No = 0

**Table 2. Critical appraisal checklist for cross-sectional study**

| Checklist Questions | Publication (Author andYear) | | | |
|---|---|---|---|---|
| | Barbosa et al (2009) | Sharma et al (2019) | Iqbal et al (2017) | Dee et al (2006) |
| Does this objective clearly address the focus/research problem? | 1 | 1 | 1 | 1 |

| | | | | |
|---|---|---|---|---|
| Is the cross-sectional research method suitable for answering research questions? | 1 | 1 | 1 | 1 |
| Is the method of selecting research subjects clearly written? | 0 | 1 | 0 | 0 |
| Does the sampling method create bias (selection)? | 1 | 0 | 1 | 0 |
| Does the research sample taken represent the designated population? | 1 | 1 | 1 | 1 |
| Is the sample size based on pre-study considerations? | 0 | 0 | 1 | 0 |
| Is a satisfactory response achieved? | 1 | 1 | 1 | 1 |
| Are the research instruments valid and reliable? | 1 | 1 | 1 | 1 |
| Is statistical significance assessed? | 1 | 1 | 1 | 1 |
| Are confidence intervals given for the main outcome? | 1 | 1 | 1 | 1 |
| Are there any confounding factors that have not been taken into account? | 0 | 1 | 1 | 1 |
| Are the results applicable to your research? | 1 | 1 | 1 | 1 |
| **Total** | 9 | 10 | 11 | 9 |

Information: Yes = 1, No = 0

Table 4.Primary study descriptions included in the meta-analysis

| Author (year) | Title | Country | Study Design | Sample | P Population | I Intervention | C Comparison | O Outcome |
|---|---|---|---|---|---|---|---|---|
| Prathanee et al. (2009) | Early language delay and predictor factors in children aged 2 years | Bangkok, Thailand | Cohort | 3905 | Children aged 2 years old | Breastfeeding, gestational age, gender, birth order, birth weight, maternal age, first word in 1 year, walking ability in 1 year, listening within 5 months, education, maternal age, maternal status, maternal occupation, socioeconomic, language number , family membership, site | Not given breast milk, normal birth, normal weight, 3rd, 4th and above birth, city area | Language development |
| McCrory and Murray | The effeect of breastfeeding on neurodevelopment | Newyork, United States | Cohort | 11134 | Children aged 9 months old | Given breast milk, gender, birth weight, gestational age, single | Not given breast milk | Language development (communica- |

| Author (year) | Title | Country | Study Design | Sample | P Population | I Intervention | C Comparison | O Outcome |
|---|---|---|---|---|---|---|---|---|
| (2013) | in infaancy | | | | | status, maternal age, ethnicity, social class, maternal education and smoking status | | tion) |
| Min and Choi (2020) | Association between breastfeeding and cognitive function in children from early childhood to school age: a prospective birth cohort study | Cheonan, Korea | Cohort | 1752 | Children aged 3 years old | Given breast milk, gender, gestational age, birth weight, income, parental education, age in each assessment | Not given breast milk | Intellectual development (language, gross and fine motives, personal, social, problem solving) |
| Quigley et al (2011) | Breastfeeding is associated with improved child cognitive develop-ment: A popolation based cohort study | Newyork, United States | Cohort | 11879 | Children aged 5 years old | Duration of breastfeeding | Not given breast milk | Cognitive development, language development (vocabulary) |
| Vestergaard et al (1999) | Duration of breast-feeding and develop-ment milestone during the latter half of infancy | Denmark, Eropa | Cohort | 250000 | Children aged 8months old | Exclusive breastfeeding | Not given breast milk | Development of milestones (language, gross motor skills, fine motor skills) |
| Chiu et al (2011) | Duration of breast feeding and risk of development delay in Taiwanese child-ren: a nationwide birth cohort study | Taipei, Taiwan, Asia | Cohort | 14621 | Children aged 15 to 18 months old | Duration of breastfeeding, gross motor skills, fine motor skills, language, social | Never given breast milk | Language development |
| Oddy et al (2011) | Breastfeeding and early child development: a prospective cohort | Perth, Australia | Cohort | 2868 | Children aged 3 and 1,2 years old | Breastfeeding less than 4 months and more than 4 months, gross motor skills, fine motor skills, | Have never been given breast milk or given breast | Child development (language, gross motor |

| Author (year) | Title | Country | Study Design | Sample | P Population | I Intervention | C Comparison | O Outcome |
|---|---|---|---|---|---|---|---|---|
| | study | | | | | adaptation, language (communication), social | milk for less than 4 months and more than 4 months | skills, fine motor skills, adaptability, social |
| Sharma et al (2019) | Asessment of risk factors for developmental delays among children in a rural communityof north India: a cross-sectional study | India, Asia | Cross-secctional | 450 | Children aged 2 monthsto6years old | Given breast milk | Not given breast milk | Speech, social and cognitive language development |
| Lee et al (2007) | Associations between breastfeeding practices and young children's language and motor skill development | Maryland. United States | Cross-secctional | 22399 | Children aged 10to 71months old | Given breast milk | Not given breast milk | Language Development and Motor Development |
| Barbosa et al (2009) | The relationship of bottle feeding and other sucking behaviors with speech disorders in Patagonian preschoolers | Wasshington , United States | Cross-secctional | 128 | Children aged 3to5years old | Given breast milk | Not given breast milk | Speech language development |
| Iqbal et al (2017) | The effect of breastfeeding on the cognitive development of children under 3 years of age: result of balochistan early childhood developmental project | Pakistan, Asia | Cross-secctional | 604 | Children under 3 years old | Given breast milk | Not given breast milk | Language development and cognitive development |

*variables included in the meta-analysis study

## 1. Breastfeeding on Language Development
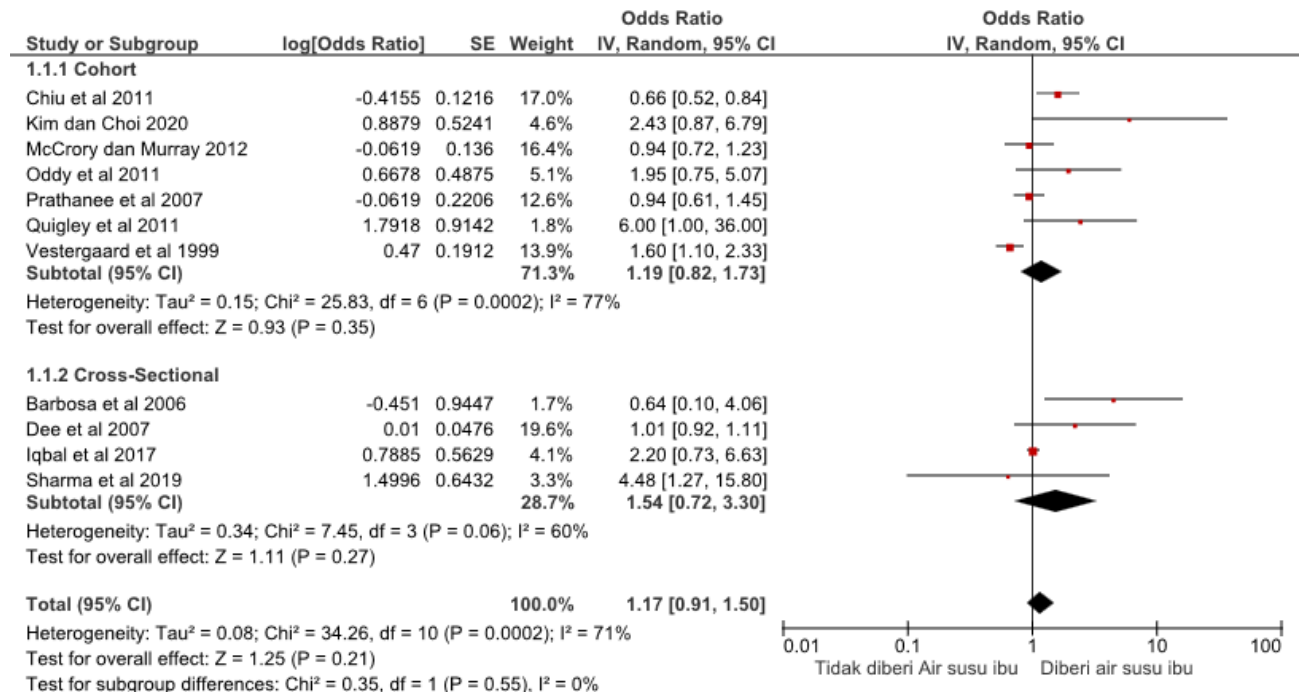### a. Forest Plot



**Figure 4. Funnel Plot of the effect of breastfeeding on language development**
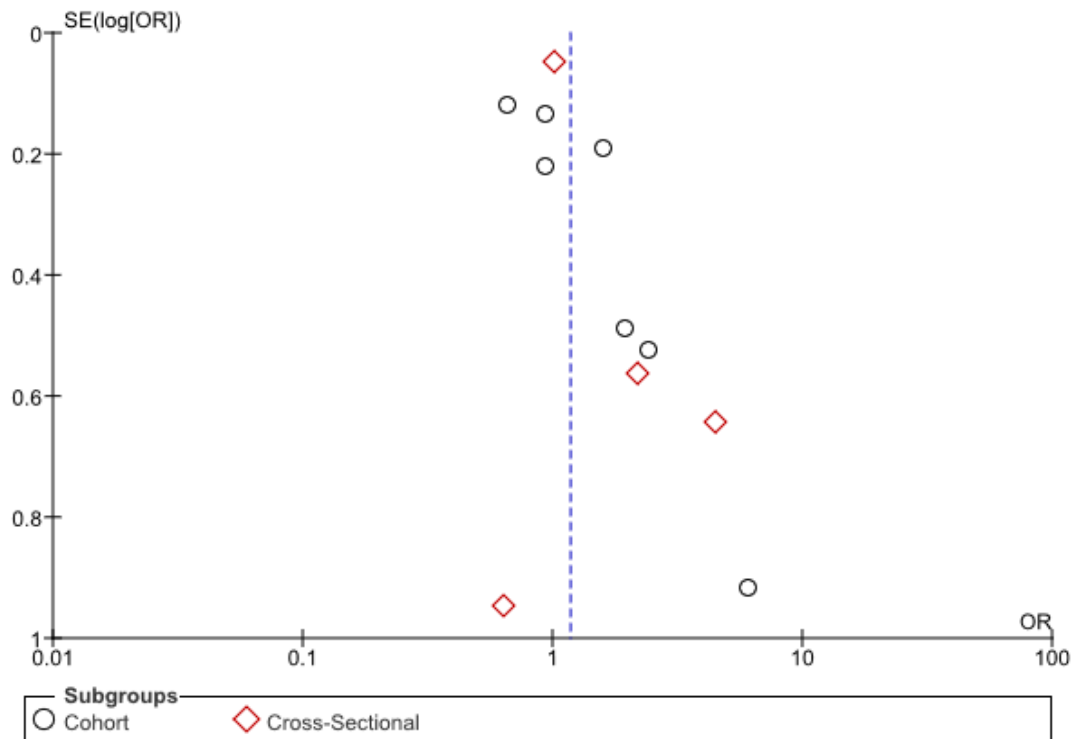
### b. Funnel Plot



**Figure 4. Funnel Plot of the effect of breastfeeding on language development**

## DISCUSSION

The systematic and meta-analysis study raised the theme of breastfeeding with children's language development. The study discussed data on language development because language is an important developmental component and is one of the main milestones in child development.

This systematic review and meta-analysis study used research that controls the confounding factor which can 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 breastfeeding on language development 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 were presented in the form of a forest plot and a funnel plot. The forest plot provided 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 showed the amount of variation visually (heterogeneity) (Akobeng, 2005 in Murti, 2018). The funnel plot showed the relationship between the effect size of the study and the sample size of the various studies under study, which can be measured in a number of different ways (Murti, 2018).

## 1. The effect of breastfeeding on language development

There are 11 observational study articles consisting of 7 cohort studies and 4 cross-sectional studies as a source of meta-analysis of the effect of breastfeeding on language development in children.

Analyzes were performed with subgroups of each observational study design. The meta-analysis results of the cohort study showed that breastfeeding increased children's language development by 1.19 times higher compared to language development of children who were not breastfed (aOR 1.19, 95% CI 0.82-1.73, p = 0.35. ). Meanwhile, the meta-analysis of cross-sectional studies showed that breastfeeding can improve children's language development by 1.54 times higher compared to language development of children who were not breastfed(aOR 1.54, CI 95% 0.72 - 3. 30, p= 0.27).

This is supported by Rosidi et al. (2019), which stated that children who receive breastmilk exclusively get sufficient energy intake so that language development increases.

This study is in line with study done by Blomkvist et al. (2019) which stated that breast milk is related to children's neurodevelopment because it contains nutrients needed by the brain, such as carbohydrates, proteins, vitamins, minerals, lipids and minerals.

Another study by Cai et al. (2019) stated that breastfeeding showed significant benefits for memory development and language development in children. Children who are given breast milk have better comprehension language skills and oral language skills compared to children who do not get breast milk.

Jinliuxing (2020) stated that breastfeeding is very important for the development of the baby, especially for communication. Another benefit of breast milk in this study is for the development of problem-solving skills and children's social interactions. Babies who are given breast milk have much better development in their communication. Babies who get formula milk have a higher risk of developing developmental delays than babies who are breastfed.

This study is strengthened by the research of Zulaikha and Rizqi (2017). From this study, it was found that a history of breast-feeding predicts the level of language development of children. Child nutrition is very important, especially in the early stages of development, which is the age of 0-24 months old, and it is a golden period for child development and growth.

## AUTHOR CONTRIBUTION

Liza is the main researcher who selected topics, searched and collected study data. Bhisma Murti and Hanung Prasetya had a role in analyzing data and reviewing study documents.

## CONFLICT OF INTEREST

There was no conflict of interest.

## FUNDING AND SPONSORSHIP

This study used personal fund of the main researcher.

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