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Meta Analysis
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# Meta Analysis: Effect of Exclusive Breastfeeding on Child's Development

**Feby Dwiantini[1)], Eti Poncorini Pamungkasari[2)], Rita Benya Adriani[3)]**

[1)]Master's Program in Public Health, Universitas Sebelas Maret
[2)]Faculty of Medicine, Universitas Sebelas Maret
[3)] Study Program in Nursing, School of Health Polytechnics, Ministry of Health, Surakarta

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## ABSTRACT

**Background:** Breast milk contains enough nutritional content for infants aged 0 to 6 months even without additional food. Exclusive breastfeeding has a positive impact on growth and development disorders experienced by babies. This study aimed to analyze and estimate the effect size of exclusive breastfeeding on 5 areas of child development, namely gross motor, fine motor, communication, problem solving and personal social.
**Subjects and Method:** It was a meta-analysis study conducted in accordance to PRISMA flow chart and PICO. Population= children aged 6 months to 5 years. Intervention= exclusive breastfeeding. Comparison= non-exclusive breastfeeding. Outcome= child development (gross motor, fine motor, communication, problem solving, and personal social). Articles were obtained from Google Schoolar, Science Direct, and PubMed. Inclusion criterias were cohort study, full text article, and child development measurement using the ages & stages questionnaire. Data analysis was conducted using Revman 5.3.
**Results:** 8 cohort studies from the America, Australia, Europe, Africa, and Asia were selected for meta-analysis. Total sample was 22,048. Exclusive breastfeeding increased child's development (aOR= 1.07; 95% CI= 1.04 to 1.10; p < 0.001). Exclusive breastfeeding had a positive effect on all five areas of gross motor development (aOR= 1.05; 95% CI= 1.00 to 1.10; p= 0.030), fine motor (aOR= 1.10; 95% CI= 1.02 to 1.18; p= 0.009), communication (aOR= 1.06; 95% CI = 1.01 to 1.11; p= 0.020), problem solving (aOR= 1.12; 95% CI= 1.02 to 1.21; p= 0.010) and personal social (aOR= 1.10; 95% CI= 1.03 to 1.17; p= 0.005).
**Conclusion:** Exclusive breastfeeding significantly increases child's development.

**Keywords:** exclusive breastfeeding, gross motor development, fine motor development, personal social, children under five

**Correspondence:**
Feby Dwiantini. Master's Program in Public Health, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java. Email: feby.dee05@gmail.com. Mobile: +628529290279.

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## BACKGROUND

One of the global targets related to nutrition to be achieved by 2025 is to increase the coverage of Exclusive Breasfeeding by at least 50%. Problems related to breastmilk and breastfeeding have never been included in

the topic of global health discussions, especially in the topic of maternal and child health. This cannot be separated from the effect size of breastmilk on children. Breastmilk contains nutrients that are needed for babies to grow healthily and help their development.

The immense benefits of breastfeeding is not directly proportional to the global coverage of breastfeeding. Based on UNICEF's Global database, globally the coverage of infants receiving exclusive breastfeeding from 0 to 5 months of age is 48%. South Asia has the highest coverage of exclusive breastfeeding at 61% and is far different from North America where only 26% of babies receive exclusive breastfeeding at 0 to 5 months of age (UNICEF, 2022). WHO also recommends that children must obtain breastmilk until 2 years old with complementary foods that are appropriate for the child's age. In Indonesia alone there are 51% of babies who are exclusively breastfed (UNICEF, 2020). According to data in 2021, as many as 48.6% of babies are breastfed in the first 1 hour of their lives or also called Early Breastfeeding Initiation (EIBF) it indicates a decrease compared to 2018 with 58.2%. While 52.5% babies are exclusively breastfeed up to the age of 6 months, it also experiences a significant decrease when compared to coverage in 2018 with 64.5% (UNICEF Indonesia, 2023).

Increasing breastfeeding globally could prevent 823,000 annual deaths in children under 5 and 20,000 annual deaths from breast cancer (Victora et al., 2016). The mortality rate of children under the age of 5 years has decreased every year, it is 5 million in 2021 (38 deaths in 1000 births), while the neonatal mortality rate in 2021 touched 2.3 million or around 6,400 newborn deaths every day, and this number is 47% of all under-five mortality (WHO, 2023).

Breastfeeding can be a protective factor for the baby in an attempt to avoid some health conditions. Various health problems that can occur to infants who are not breastfed. Infants who get formula milk will be more at risk of contracting diseases, experiencing otitis media, getting lower respiratory tract infections, gastrointestinal infections. Furthermore, children who get formula milk as infants are more at risk for obesity or type 2 diabetes (Stuebe, 2009). Breastfeeding can improve children's immune system so that children can have robust body defenses.

The most visible problem related to breastmilk is the growth of children. Breastmilk has an important role for babies born with low birth weight and have a risk of stunting and wasting. Maximizing breastfeeding babies who are at risk for stunting and wasting, is one of the efforts to improve the baby's condition (Campos et al., 2021). Babies who are not breastfed are 2 times more at risk of stunting than babies who are breastfed and stunted (Zaragoza-Cortes et al., 2018). Stunting or wasting can be markers of various pathological disorders associated with increased morbidity and mortality, loss of physical growth potential, decreased neurodevelopmental and cognitive function, and increased risk of chronic diseases in adulthood (de Onis and Branca, 2016).

For children development, exclusive breastfeeding may increase IQ by 2 to 3 percentage points compared to children who are not exclusively breastfed (Prentice, 2022). Children who are breastfed for more than 6 months have better cognitive outcomes, a lower risk of developing hyperactivity disorder and have a lower risk of being diagnosed with autism spectrum disorder (Bar et al., 2016). Exclusive breastfeeding can give a positive impact on gross motor and fine motor development in infants aged 6 to 12 months compared to infants who are not exclusively breastfed (Rukanah, 2021).

This study aims to analyze some of the

results of similar previous studies and then estimate the size effect of exclusive breastfeeding on 5 areas of child development, namely gross motor, fine motor, communication, problem solving, and personal social.

## SUBJECTS AND METHOD

### 1. Study Design

It was a systematic review and a meta-analyis studythat employes secondary data from Google Schoolar, PubMed, and Science Direct data bases based on PRISMA diagram. Key words used in the datadases searching were "exclusive breastfeeding" OR "breastfeeding duration" OR "infant feeding" AND "child development" OR "cognitive development" OR "ages stages questionnaires" OR "Gross Motor development" OR "Fine Motor Development" OR "Communication development" OR "Problem Solving development" OR "Personal Social development".

### 2. Steps of Meta-Analysis

Meta analysis was carried out in the following 5 steps:

1) Formulating study problems using the PICO (population, intervention, comparison and outcome) model.
2) Searching for primary study articles from electronic databases such as Google Schoolar, Science Direct, PubMed and others.
3) Determining inclusion and exclusion criteria from study articles and conduct critical appraisals.
4) Extracting primary study data and analyzing data using Review Manager 5.3.
5) Interpreting results and drawing conclusions.

### 3. Inclusion Criteria

The inclusion criteria were: (1) A study article in full-text paper with cohort study design; (2) The measure of association used was the adjusted Odds Ratio (aOR); (3) The subject of the study was Toddlers (Age 6 months to 5 years), according to the age range in the use of Ages and Stages Questionnaires; (4) Interventions studied was Exclusive breastfeeding; (5) The outcomes were either or all of the following: children's gross motor development, fine motor skills, communication, problem solving and personal social, and (6) Developmental tests using Ages and Stages Questionnaires.

### 4. Exclusion Criteria

The exclusion criteria were articles published in a non-English language and the statistical results were reported in a non-logistic regression.

### 5. Operational Definition of Variable

**Exclusive breastfeeding** was breastfeeding to infants without any additional food and drink other than breast milk except medicines.

**Child Development** was the increase of abilities or skills in more complex body structures and functions in a regular and predictable pattern as a result of experience and maturation processes. Relating to gross motor, fine motor, communication, problem solving and personal social.

### 6. Study Instrument

The quality assessment of primary studies was carried out with the Cohort Study Checklist that has been prepared by the Master Program in Public Health Science, Universitas Sebelas Maret.

### 7. Data Analysis

Data analysis was conducted by calculating the overall effect of combining selected study data. Data analysis was processed using analysis software in the form of Review Manager 5.3 (RevMan 5.3) published by Cochrane Collaboration. Data analysis was carried out based on variations across studies using fixed effect and/ or random effect analysis models. The result of the analysis was subsequently presented in the form of an overall mean difference (aOR) with a confident interval (CI) of 95% using model

effects that correspond to data heterogeneity ($I^2$).

## RESULTS

The articles that have been collected are obtained through several electronic journal databases, namely Science Direct, PubMed and Google Schoolar with a period of journal publication from 2011 to 2023. Article searches are conducted using the following keywords: "exclusive breastfeeding", OR "breastfeeding duration", OR "infant feeding", AND "child development", OR "cognitive development", OR "ages, stages, questionnaires", OR "Gross Motor development", OR "Fine Motor Development", OR "Communication development", OR "Problem Solving development", OR "Personal Social; development". The article search process is described in the PRISMA flow diagram in Figure 1.

The study used 8 articles that came from several countries in the America, Europe, Australia, Africa and Asia. There were 2 study articles from the America, namely from the United States, and New York, 2 articles from the Australia, 2 study articles from the Europe, namely Ireland and Spain, 1 article from Ma'anshan, China in Asia, and 1 last article from South Africa (Figure 2).

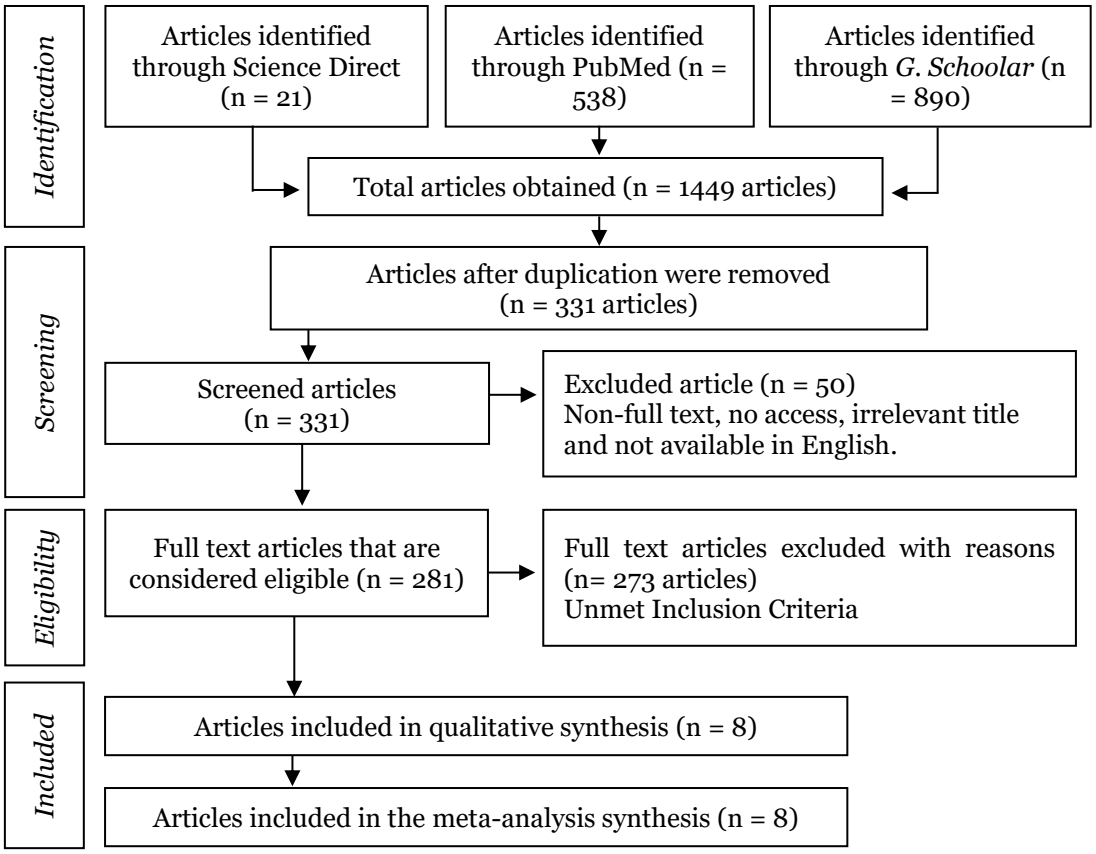


**Figure 1. Results of PRISMA flow diagrams of Effect of Exclusive Breastfeeding on the Child Development**


**Figure 2. Research distribution map of Effect of Exclusive Breastfeeding on the Child Development**

**Table 1. Critical Appraisal for Cohort Study of the effect of exclusive breastfeeding on child development**

| Publication (Author and Year) | | Checklist Questions | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1a | 1b | 1c | 1d | 2a | 2b | 3a | 3b | 4a | 4b | 5 | 6a | 6b | 7 | |
| Baumgartel et al. (2020) | I | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 27 |
| | II | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 28 |
| Liu et al. (2023) | I | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 27 |
| | II | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 27 |
| Madlala et al. (2020) | I | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 26 |
| | II | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 26 |
| Martinez-Nadal et al. (2018) | I | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 27 |
| | II | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 26 |
| McCrory and Murray. (2013) | I | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 26 |
| | II | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 26 |
| Mirzakhani et al. (2020) | I | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 26 |
| | II | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 27 |
| Oddy et al. 2011 | I | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 27 |
| | II | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 2 | 2 | 2 | 2 | 2 | 26 |
| Putnick et al. (2023) | I | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 28 |
| | II | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 28 |

**Description of question criteria:**

All selected articles were assessed for study quality using the Cohort Study Checklist that has been prepared by the Master Program on Public Health Study, Universitas Sebelas Maret (Table 1). There are 14 questions that need to be answered, namely:

1. Formulation of study questions in the acronym PICO

a. Is the population in the primary study the same as the population in the PICO meta-analysis?

b. Is the operational definition of the inter-venes, i.e. exposed status in the primary

study the same as the definition intended in the meta-analysis?
c. Is the comparison, i.e. unexposed status used by the primary study the same as the definition intended in the meta-analysis?
d. Are the outcome variables studied in the primary study the same as the definitions intended in the meta-analysis?
2. Methods for choosing a study subject
a. Have the target population and accessible populations not experienced the outcomes studied at the beginning of the study?
b. Was the baseline of the study differentiated between exposed groups and unexposed groups?
3. Methods for measuring exposure (intervention) and outcome variables
a. Were both exposure and outcome variables measured with the same instruments in all primary studies?
b. If variables are measured on a categorical scale, are the cutoffs or categories used the same between primary studies?
4. Design-related bias
a. Is there no possibility of "Loss-to-Follow-up Bias" in the primary study?
b. Have primary study researchers made efforts to prevent or address such bias?
5. Methods for confounding. Have primary study researchers made efforts to control the effect of confusion?
6. Statistical analysis methods
a. Did the researchers analyze the data in this primary study with a multivariate analysis model?
b. Did the primary study report the effect size or relationship of the results of the multivariate analysis?
7. Conflict of interest. Was there no possibility of conflict of interest with the research sponsor, which causes bias in concluding research results?

All articles have been assessed by two raters and received a total assessment score of more than 24 points for each article, so the article can be used as a primary study in this meta-analysis study.

Table 2 is a description of 8 primary studies that have been selected and meet the assessment criteria. The articles come from 5 different continents, namely 2 articles from the Americas, 2 articles from Europe, 2 articles from Australia, 1 article from Africa and 1 last article from Asia. All articles used a cohort study design, with the study subjects being children with an age range of 9 months to 4 years and the intervention received was exclusive breastfeeding with the comparison not getting exclusive breastfeeding. The total sample amounted to 22,048 samples.

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

| Author (Year) | Country (sample) Study Design | Population | Intervention | Comparison | Outcome |
|---|---|---|---|---|---|
| Baumgartel et al. (2020) | Australia (1746) Cohort | Aged 12 months | Exclusive breastfeeding | Non-Exclusive Breastfeeding | Child development:<br>a. Gross motor<br>b. Fine motor<br>c. Communication<br>d. Problem solving<br>e. Personal social |

| Author (Year) | Country (sample) Study Design | Population | Intervention | Comparison | Outcome |
|---|---|---|---|---|---|
| Liu et al. (2023) | China (2032) Cohort | Aged 18 months | Exclusive breastfeeding | Non-Exclusive Breastfeeding | Child development:<br>a. Gross motor<br>b. Fine motor<br>c. Communication<br>d. Problem solving<br>e. Personal social |
| Madlala et al. (2020) | South Africa (355) Cohort | Aged 12 – 24 months | Exclusive breastfeeding | Non-Exclusive Breastfeeding | Child development:<br>a. Gross motor<br>b. Fine motor<br>c. Communication<br>d. Personal social |
| Martínez-Nadal et al. (2018) | Spain (321) Cohort | Aged 4 months | Exclusive breastfeeding | Non-Exclusive Breastfeeding | Child development:<br>a. Gross motor<br>b. Fine motor<br>c. Communication<br>d. Problem solving<br>e. Personal social |
| McCrory and Murray, 2013 | Ireland (11.134) Cohort | Aged 9 months | Exclusive breastfeeding | Non-Exclusive Breastfeeding | Child development:<br>a. Gross motor<br>b. Fine motor<br>c. Communication<br>d. Problem solving<br>e. Personal social |
| Mirzakhani et al. (2020) | United States (635) Cohort | Aged 24 – 36 months | Exclusive breastfeeding | Non-Exclusive Breastfeeding | Child development:<br>a. Gross motor<br>b. Fine motor<br>c. Communication<br>d. Problem solving<br>e. Personal social |
| Oddy et al. (2011) | Australia (2375) Cohort | Aged 12 months | Exclusive breastfeeding | Non-Exclusive Breastfeeding | Child development:<br>a. Gross motor<br>b. Fine motor<br>c. Communication<br>d. Problem solving<br>e. Personal social |
| Putnick et al. (2023) | New York (3450) Cohort | Aged 24 – 36 months | Exclusive breastfeeding | Non-Exclusive Breastfeeding | Child development:<br>a. Gross motor<br>b. Fine motor<br>c. Communication<br>d. Problem solving<br>e. Personal social |

The obtained data were subsequently synthesized using Review Manager 5.3. The results of the Meta-analysis related to the effect of exclusive breastfeeding on child development can be seen in Figure 3. The forest plot (Figure 3) indicates that children with a history of exclusive breastfeeding were 1.07 times more likely to achieve overall normal development than children who were not exclusively breastfed and the association was statistically significant (aOR= 1.07; 95% CI= 1.04 to 1.10; p <0.001). Overall, the heterogeneity of research data showed $I^2$= 41% so that the distribution of data was stated homogeneous and the calculation of the average effect estimates was conducted

with a fixed effect model approach.

The funnel plot in Figure 4 indicates the absence of publication bias characterized by a symmetrical distribution of effect estimates on the right and left of the average vertical line of the effect estimates.

**Table 3. Adjusted Odds Ratio (aOR) value of the effect of exclusive breastfeeding on gross motor development in children**

| Publication (Author and Year) | aOR | 95% CI | |
|---|---|---|---|
| | | Lower Limit | Upper Limit |
| Baumgartel et al. (2020) | 0.27 | 0.03 | 2.34 |
| Liu et al. (2023) | 0.94 | 0.40 | 2.25 |
| Madlala et al. (2020) | 1.25 | 0.42 | 3.72 |
| Martínez-Nadal et al. (2018) | 0.27 | 0.05 | 1.46 |
| McCrory and Murray, 2013 | 1.14 | 0.80 | 1.62 |
| Mirzakhani et al. (2020) | 1.10 | 0.56 | 2.16 |
| Oddy et al. (2011) | 1.24 | 0.79 | 1.95 |
| Putnick et al. (2023) | 1.05 | 1.00 | 1.10 |

**Table 4. Adjusted Odds Ratio (aOR) value of the effect of exclusive breastfeeding on fine motor development in children**

| Publication (Author and year) | aOR | 95% CI | |
|---|---|---|---|
| | | Lower Limit | Upper Limit |
| Baumgartel et al. (2020) | 2.34 | 0.78 | 7.02 |
| Liu et al. (2023) | 1.11 | 0.15 | 2.41 |
| Madlala et al. (2020) | 0.97 | 0.36 | 2.61 |
| Martínez-Nadal et al. (2018) | 1.53 | 0.45 | 5.20 |
| McCrory and Murray, 2013 | 0.82 | 0.53 | 1.27 |
| Mirzakhani et al. (2020) | 0.74 | 0.39 | 1.40 |
| Oddy et al. (2011) | 1.38 | 0.96 | 1.98 |
| Putnick et al. (2023) | 1.10 | 1.02 | 1.19 |

**Table 5. Adjusted Odds Ratio (aOR) value of the effect of exclusive breastfeeding on communication development in children**

| Publication (Author and year) | aOR | 95% CI | |
|---|---|---|---|
| | | Lower Limit | Upper Limit |
| Baumgartel et al. (2020) | 2.48 | 1.20 | 5.13 |
| Liu et al. (2023) | 0.40 | 0.09 | 1.83 |
| Madlala et al. (2020) | 0.82 | 0.20 | 3.36 |
| Martínez-Nadal et al. (2018) | 2.00 | 0.50 | 8.00 |
| McCrory and Murray, 2013 | 0.71 | 0.45 | 1.12 |
| Mirzakhani et al. (2020) | 1.35 | 0.62 | 2.94 |
| Oddy et al. (2011) | 1.66 | 1.11 | 2.48 |
| Putnick et al. (2023) | 1.05 | 1.00 | 1.10 |

**Table 6. Adjusted Odds Ratio (aOR) value of the effect of exclusive breastfeeding on problem solving development in children**

| Publication (Author and year) | aOR | 95% CI | |
|---|---|---|---|
| | | Lower Limit | Upper Limit |
| Baumgartel et al. (2020) | 1.11 | 0.43 | 2.87 |
| Liu et al. (2023) | 0.74 | 0.30 | 1.81 |
| Madlala et al. (2020) | 1.42 | 0.36 | 5.60 |
| Martínez-Nadal et al. (2018) | 0.92 | 0.65 | 1.30 |
| McCrory and Murray, 2013 | 0.34 | 0.17 | 0.68 |

| Publication (Author and year) | aOR | 95% CI | |
|---|---|---|---|
| | | Lower Limit | Upper Limit |
| Mirzakhani et al. (2020) | 1.82 | 1.28 | 2.59 |
| Oddy et al. (2011) | 1.12 | 1.02 | 1.23 |

**Table 7. Adjusted Odds Ratio (aOR) value of the effect of exclusive breastfeeding on personal social development in children**

| Publication (Author and year) | aOR | 95% CI | |
|---|---|---|---|
| | | Lower Limit | Upper Limit |
| Baumgartel et al. (2020) | 2.56 | 0.60 | 10.92 |
| Liu et al. (2023) | 1.01 | 0.45 | 2.30 |
| Madlala et al. (2020) | 0.60 | 0.13 | 2.77 |
| Martínez-Nadal et al. (2018) | 0.29 | 0.03 | 2.80 |
| McCrory and Murray, 2013 | 1.41 | 1.03 | 1.93 |
| Mirzakhani et al. (2020) | 0.15 | 0.28 | 0.93 |
| Oddy et al. (2011) | 1.53 | 0.84 | 2.79 |
| Putnick et al. (2023) | 1.09 | 1.02 | 1.16 |

While the analysis results for 5 areas of development are as follows:

1. Gross motor

Children with a history of exclusive breastfeeding were 1.05 times more likely to achieve normal gross motor development than children who were not exclusively breastfed and the association was statistically significant (aOR = 1.05; 95% CI= 1.00 to 1.10; p = 0.030). The heterogeneity in gross motor development data was $I^2$= 0%, so the distribution of data was stated homogeneous.

2. Fine motor

Children with a history of exclusive breastfeeding were 1.10 times more likely to achieve normal fine motor development than children who were not exclusively breastfed and the association was statistically significant (aOR = 1.10; 95% CI = 1.02 to 1.18; p= 0.009). The heterogeneity in fine motor development data was $I^2$= 0%, so the distribution of data was declared homogeneous.

3. Communication

Children with a history of exclusive breastfeeding were 1.06 times more likely to achieve normal communication development than children who were not exclusively breastfed and the association was statistically significant (aOR = 1.06; 95% CI = 1.01 to 1.11; p = 0.020). Heterogeneity in communication development data was $I^2$ = 56%, so that the distribution of data was declared non- homogeneous or diverse.

4. Problem solving

Children with a history of exclusive breastfeeding were 1.12 times more likely to achieve normal problem-solving development than children who were not exclusively breastfed and the association was statistically significant (aOR= 1.12; 95% CI= 1.02 to 1.21; p= 0.010). Heterogeneity in the data on the development of problem solving was $I^2$= 71%, so that the distribution of data was non-homogeneous or diverse.

5. Personal Social

Children with a history of exclusive breastfeeding were 1.10 times more likely to achieve normal personal social development than children who were not exclusively breastfed and the association was statistically significant (aOR= 1.10; 95% CI = 1.03 to 1.17; p= 0.005). heterogeneity in gross motor development data was $I^2$= 47%, so the distribution of data was declared homogeneous.

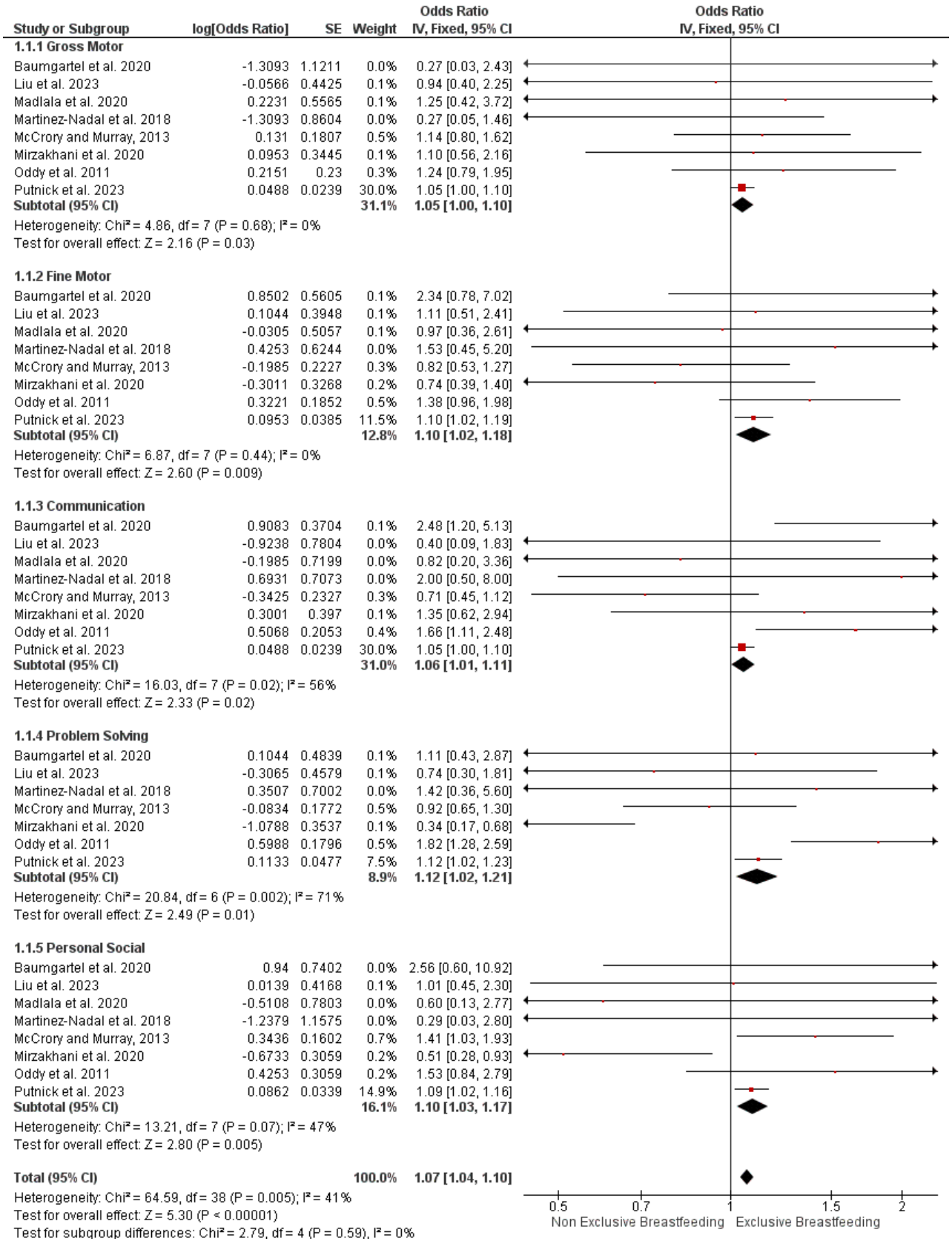


**Figure 3. Forest plot of the effect of exclusive breastfeeding on child development**

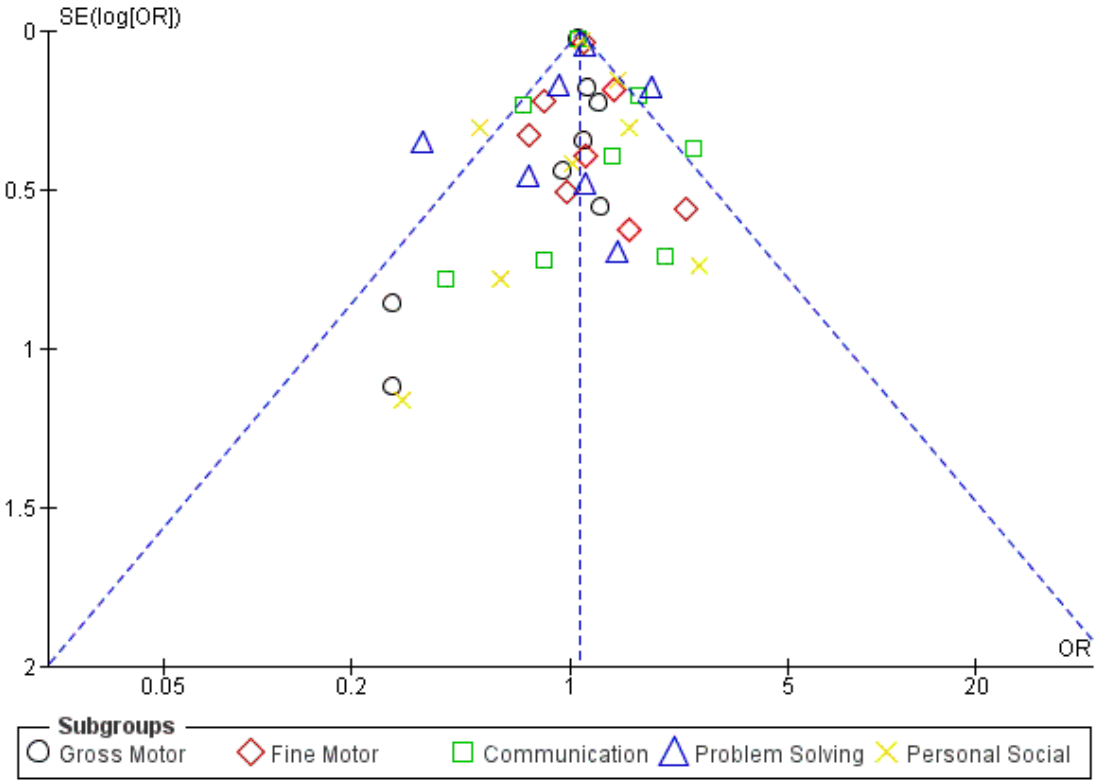


**Figure 4. Funnel plot of the effect of exclusive breastfeeding on child development**

## DISCUSSION

Systematic review and meta-analysis in this study aims to increase the generalization of findings and obtain convincing conclusions from various similar primary study results related to the effect of exclusive breastfeeding on child development. There were 8 articles that were suitable and could be used as a source of meta-analysis in this study. This study indicated that exclusive breastfeeding could statistically significantly affect a child's development. Forest plot result (Figure 3) showed that exclusively breastfed children were 1.07 times more likely to achieve overall normal development than non-exclusively breastfed children and the association was statistically significant (aOR = 1.07; 95% CI = 1.04 to 1.10; p <0.001). Overall heterogeneity of study data indicated $I^2$ = 41% so that the distribution of data was declared homogeneous.

The eight primary study articles included in this study used the Ages and Stages Questionnaire as an instrument to assess child development. The Ages and Stages Questionnaire outlines five areas of neural development: gross motor, fine motor, communication, problem solving and personal social. Exclusive breastfeeding has a positive influence on five areas of child development.

Gross motor assesses the performance of large muscles including arms and legs, fine motor which assesses coordination and movement of hands and fingers, communication assessment is carried out regarding children's language skills including what children are able to say and their ability to understand instructions given, problem solving assesses children's ability to solve problems through play and personal social assesses children's skills in self-help and interaction performed by children with parents

and caregivers.

Exclusive breastfeeding of infants has a positive effect on five areas of development in children. This result is in line with the hypothesis. Children's cognitive can develop well in children who are breastfed for more than 3 months (Kim and Choi, 2020), Breast milk contributes to the improvement of children's cognitive development (Banerjee et al., 2022). The duration of breastfeeding also has an effect, children who are breastfed more than 6 months have a smaller risk of experiencing developmental delays compared to children who have never received breast milk (Chiu et al., 2011). In addition, children who are breastfed will reduce their risk of experiencing developmental delays at the age of one year (Sanefuji et al., 2021). Reducing the duration of breastfeeding in infants can also increase the risk of developmental delays in children (Rocha et al., 2022). For premature infants, breastfeeding can improve their cognitive development verbally and non-verbally at the age of 2 years when compared to children who have never been breastfed (Rodrigues et al., 2022). Breastfeeding babies is one solution that can be done by countries that have malnutrition problems in children. India is one of the countries with a high problem of malnutrition in children and breastfeeding has a positive influence on all areas of development in children aged 3 years (Ali et al., 2014). Not only in children, the benefits of breast milk can be seen even when the child has grown up, breast milk given more than 6 months can reduce the possibility of experiencing some symptoms of depression in children as adults (De Mola et al., 2016).

Some families try to replace breast milk with formula for various reasons or conditions that do not allow them to breastfeed their babies. A study indicates that infants who were given formula milk or soy milk do not show a significant difference between the two, they showed normal development, however infants who are breastfed have better cognitive development when compared to babies who receive formula milk (Andres et al., 2012). Replacing breast milk with formula milk can also increase the risk of babies suffering from obesity (1.1 to 1.3 times) or type 2 diabetes (1.6 times), compared to children are breastfed, breastfeeding can improve the child's immune system so that children can have strong body defenses (Stuebe, 2009).

Breast milk is not an absolute factor in child development. In addition to breast milk, maternal education is one of the important factors in child development, in addition to gender and living environment (Sinno et al., 2018). Parental intelligence also seems to have a positive effect on a child's cognitive development (Gomez-Sanchiz et al., 2004). Prematurity, complications during childbirth, poor maternal education, low family income, and the occurrence of micronutrient deficiencies are major risk factors that can result in delayed cognitive development in children (Din et al., 2019). The parenting style applied by parents is also one of the important factors in the development of children's behavior (Liu et al., 2023).

Breast milk has enough nutrients to be able to support the life of babies aged 0 to 6 months even without other additional foods. Exclusive breastfeeding can optimize growth and child development, even to adulthood. Breast milk given exclusively has a positive effect on gross motor, fine motor development, communication, problem solving and personal social in children.

## AUTHORS CONTRIBUTION

Feby Dwiantini as the main researcher selected topics, searched for and collected study data. Eti Poncorini Pamungkasari and Rita Benya Adriani analyzed the data and reviewed study documents.

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**CONFLICT OF INTEREST**

There was no conflict of interest.

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