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THE COGNITIVE SCREENING IN CHILDREN UNDER FIVE YEARS OLD IN DEVELOPING COUNTRIES: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Background: Stunting or being too short affects one-third of children under five years old in developing countries. Stunting has long-term effects on cognitive development, school performance and economic productivity in adulthood. Early detection of cognitive impairment caused by stunting offers rapid strategies for reducing stunting by examine the consequence on cognitive development. Reliable assessment tools are necessary to properly track cognitive development caused by stunting. This study identifies that the use of appropriate cognitive assessment tools assists in early detection of the impact of stunting in children under five years old in developing countries.

Methods: Systematic literature review using PRISMA-P guidelines were applied for this study. Studies were identified from 4 electronic sources (Scopus, Science Direct, EBSCO and Google Scholar) from 2015 to 2018 using relevant keywords. All studies were conducted on children under five years old in developing countries. The used studies for this review are limited to full-text in English and Bahasa Indonesia. Studies conducted from 19 April to 11 May 2018.

Results: From 492 studies that have been extracted, there are 10 studies reported the cognitive impairment assessment tools for under five years old children used in developing countries. The satisfying assessment tools in eligibility criteria are Bayley Scales of Infant Development (BSID III), the Indonesian child development pre-screening questionnaire (Kuesioner Pra-Skrining Perkembangan/KPSP) and Denver Developmental Screening Test (DDST II). They appear promising to be used in identifying and monitoring cognitive development of children in developing countries.

Conclusions: In the context of stunting in children under five years old, rapid assessment of cognitive ability is feasible for routine clinical use. The BSID III, KPSP and DDST II are the most common used in developing countries and they have moderately good accuracy to detect the cognitive impairment.

Keywords: Cognitive, Denver developmental screening test, child development pre-screening questionnaire, stunting, toddler

INTRODUCTION

In the human development report by the United Nations Development Program (UNDP), Indonesia's Human Development Index (HDI) was ranked on 113 out of 188 countries with an index of 0.689 in 2015. [1] This assessment shows the low quality of Indonesian human development with 3 basic dimensions in health (life expectancy at birth), education, and a decent standards of living (gross national income). [2] These three indicators are closely related to the nutritional status. The high rates of acute and chronic malnutrition is a big challenges in Indonesia. A long term chronic malnutrition in an early age manifest in stunting. [3] Children are defined as stunted if their length/height by age is below -2

standard deviation (SD) from the WHO Child Growth Standards median for the same age and sex. [4, 5] Furthermore the nutritional status of stunting causes a linear growth disorder.

The prevalence of stunting globally shows a downward trend over time. Between 1990 and 2014, the prevalence of stunting decreased from 39.6 % to 23.8 %. By 2016, the prevalence of stunting is about 22.9 % globally and more than half of all stunting children under the age of five live in Asia and more than one-third live in Africa. The prevalence of stunting varies substantially by world region with the highest prevalence in Africa and Asia [6, 7]. Indonesia ranks second in South East Asia with 37.2 % behind Laos with 44 % of stunting children under five years of age. During the period of 1993-2013 there was a trend of decreasing stunting prevalence (from 50.8 % to 37.2 %), but it is still classified as a large stunting problem (over than 30 %). [8, 9]

The adverse effects of stunting can last a lifetime, if it is not intervened. Stunting adversely affects the physical growth and cognitive development of school-aged children. [10] Toddlers with stunting have a risk of irreversible cognitive impairment. [11] Stunting is associated with an underdeveloped brain. Furthermore it has long-term consequences, including diminished mental ability and learning capacity, poor school performance in childhood, reduced earnings and increased risks of nutrition-related chronic diseases, such as diabetes, hypertension, and obesity in future. [12] The increased risk of overweight and obesity later in life take place when the nutrition intervention is wrong. [3, 13] In adjusted analyses, severely stunted children have significantly lower IQ scores than mild-moderately stunted children. [14]

Growth and development in the first few years of life are important health indicators for children. Severe retardation of growth has a strong association with mortality and morbidity in children under five years of age, [15] while developmental conditions characterized by significant impairment of cognitive functions, which are associated with limitations of learning, adaptive behaviour and skills [16, 17]. Child development is influenced by environmental as well as biological or genetic factors [9, 16].

Child growth monitoring aims to observe growth and development over time and whether the child meets specific growth milestones according to the age. Important milestones that develop rapidly at five years age are social/emotional, language/communication, cognitive and movement or physical development. [18, 19] Healthcare providers, community and school settings in collaboration with parents and other caregivers may participate in the developmental monitoring. If a child has a developmental delay, it is important to identify it early to receive adequate intervention as early as possible by a paediatrician. [18]

Progress monitoring of child development can be performed using a valid and reliable screening tool according to the purpose of the screening, the age of children, culture and language. [20] This is a challenge as very few screening tools have been developed or tested in different linguistics or cultures. Furthermore, health practitioners may not have proper technical training to monitor child growth and development.

This study identifies the importance of developing cognitive assessment tools in stunted children under five years old in developing countries. So, this study provides recommendations in further research design to determine the effect of stunting on cognitive impairment. Also the recommendation of priority interventions and future policies to improve nutritional status in children as an effective strategy on improving human development.

METHODS

Search Strategy

This systematic literature review was based on PRISMA-P 2009. The source of data in this study conducted from electronic sources: Scopus, Science Direct, EBSCO and Google Scholar. The data collected from the articles published between 2015 and 2018 and the search terms included: (1) cognitive assessment tool and (2) children under five.

Inclusion and Exclusion Criteria

The authors screened the titles and abstracts of studies which are not full-text and irrelevant. Inclusion criteria of documents that were considered appropriate (eligibility) to do systematic review were as follows: (1) studies reported in English and Bahasa Indonesia; (2) reported assessment tools of cognitive impairment conducted in Indonesia and (3) target groups: children under five years old. The exclusion criteria are thesis and dissertation studies from websites of the universities. The selection process of a flow chart was presented in Figure 2.

Data Extraction

Electronic sources were searched during the weeks of 19 April - 11 May 2018. Titles and abstracts were screened to identify studies of likely relevance and full paper obtained. A structured form was used to determine study inclusion and to screen for duplication. The results are presented into structured tables from each publication: title, author(s), publication year, research method, cognitive impairment assessment (s) and findings. One reviewer (S.A) independently screened all the citations, and other reviewer (K.N.S) confirmed their eligibility.

RESULTS

A total 492 studies were identified for potential inclusion criteria from 4 sources. After screening based on year of publication 2015-2018, 283 studies were included and 23 were excluded for the not full-text articles. The remaining 260 studies were assessed for eligibility in the analysis. This review identified the cognitive impairment assessment in children under five years of age in developing countries and only 10 studies met the purpose of this review (Figure 2). Of the 10 relevant studies, only 1 study conducted in developing country outside Indonesia and the rest were conducted in Indonesia.

There were 10 studies which reported that children development monitoring is needed to detect if children are not meeting the specific milestones based on their age. Mostly, studies of child development assessment in Indonesia is to determine the factors that influence the development of children under five. The result of the study shows that there is a direct and indirect relationship between biopsychosocial and economic factors to the development of children under five years in Nganjuk. Mother's height, mother's education, middle upper arm circumference of the mother, income of the family and family support have indirect relation with the development of children under five. While low birth weight has a direct relation with the development of children. Some studies indicate that in general, cognitive impairment assessment still have not been used to determine as one of the impacts of stunting in children under five years in developing countries. However, only one study in East Java Indonesia reported that stunting affects the development of children. The study examined paths of analysis on the effect of biopsychosocial and economic factors during gestational period on the risk of stunting and development in children under five years of age. [21]. While seven studies in Indonesia used KPSP and three studies in Indonesia used DDST II as a monitoring tools of children development including the assessment of cognitive impairment. Only one study in Nepal used Bayley Scales of Infant Development III Cognitive and Motor Scales (BSID III). [22]

Figure 1. Result of literature search

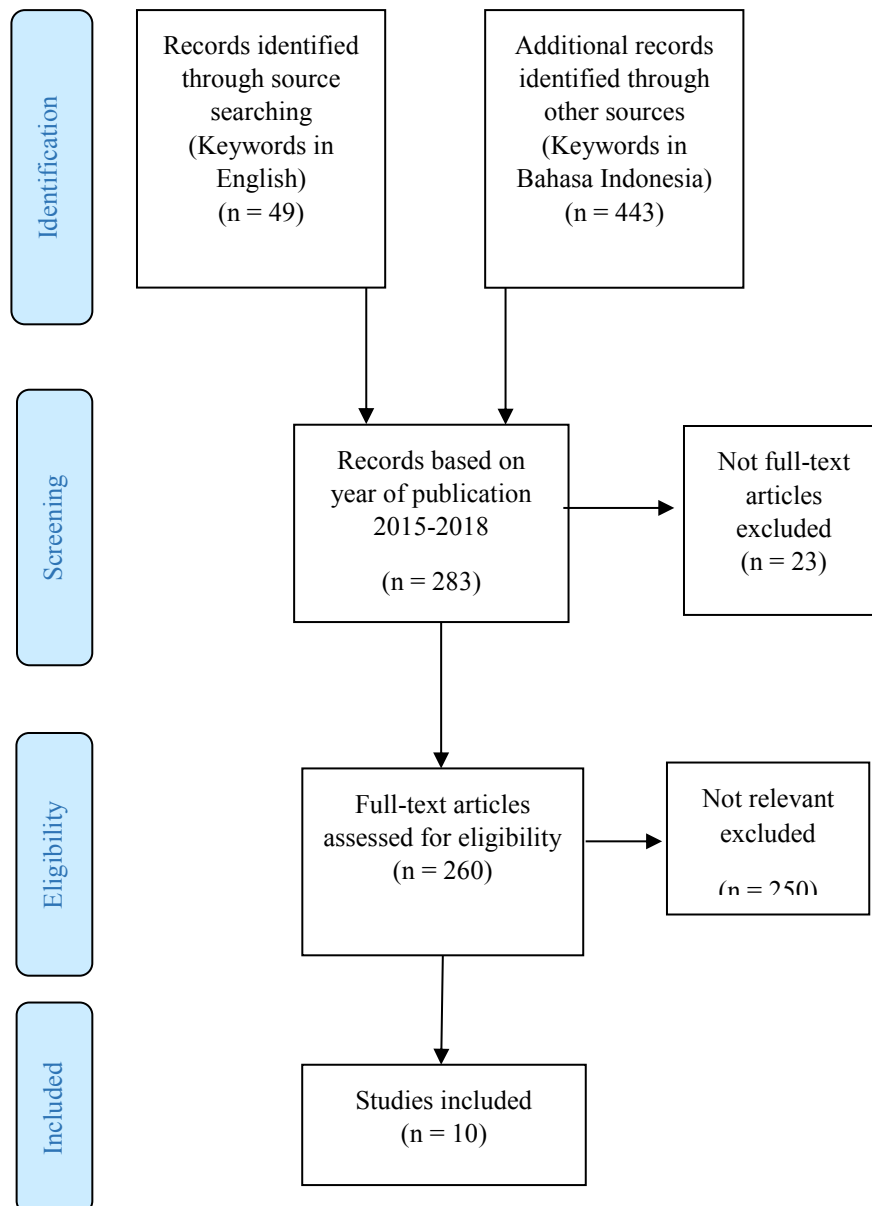




Table 1. Journals in Review

No	Title	Author	Year of publish	Location	Method	Sample	Cognitive impairment assessment
1	Acceptability and Reliability of the Bayley Scales of Infant Development III Cognitive and Motor Scales among Children in Makwanpur	Manandhar SR, Dulal S, Manandhar DS, Saville N, Prost A	2016	Makwanpur, Nepal	Observational experimental study	102 children aged 1-42 months (boys and girls)	Bayley Scales of Infant Development III Cognitive and Motor Scales (BSID III)
2	Survey of Toddler Development using The Indonesian Child Development KPSP (Kuesioner Pra-Skrining Perkembangan)	Mustaghfiroh L, Risnawati, I	2018	Jepara, Central Java, Indonesia	Descriptive research	Children aged 48-60 months	The Indonesian child development KPSP (Kuesioner Pra-Skrining Perkembangan)
3	Factors Related to Development of Toddler at Puskesmas Wanadadi Regency 2 District Banjarnegara	Happinasari O, Suryandari AE	2015	Banjarnegara, Central Java, Indonesia	Case control	Total 60 children under 5 years of age with low birth weight (30 children) and normal birth weight (30 children)	The Indonesian child development KPSP (Kuesioner Pra-Skrining Perkembangan)
4	Path Analysis on the Effect of Biopsychosocial and Economic Factors during	Viridula, EY, Murti, B, Suryani, N	2016	Nganjuk, East Java, Indonesia	Case control	Children under five, consisting of 50 stunted children and 100 normal children	The Indonesian child development Kuesioner Pra-Skrining Perkembangan (KPSP)



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No	Title	Author	Year of publish	Location	Method	Sample	Cognitive impairment assessment
	Gestational Period on the Risk of Stunting and Development in Children under Five, in Nganjuk, East Java						
5	Relationship Between Parenting Method With The Development Of Toddler In Sumbermulyo Village-Jogoroto-Jombang	Malik AI, Ratnawati, M, Prihantanti, NG	2017	Jombang, East Java, Indonesia	Cross sectional	Toddler aged 1-3 years old	KPSP (Kuesioner Pra-Skrining Perkembangan) instruments
6	The Relationship Between Parental Socio-Economic Status, Birth Weight, and Development in Children Aged 1-5 Years in Surakarta	Kusumasari RA, Tamtomo D, Dewi YLR	2016	Surakarta, Central Java, Indonesia	Case control	A total of 100 children under five was selected by fixed disease sampling, consisting of 25 cases and 75 controls	Ministry of Health's KPSP (Kuesioner Pra-Skrining Perkembangan)
7	Growth and Development Deviation in Children with Working Parents	Handayani DS, Sulastris A, Mariha T, Nurhaeni N	2017	Kramat Jati district, East Jakarta, Indonesia	Cross sectional	Children aged 0-72 months	Kuesioner Pra-Skrining Perkembangan (KPSP)



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No	Title	Author	Year of publish	Location	Method	Sample	Cognitive impairment assessment
8	Stimulation Of the Influence of Puzzle Game on Socialization and Independence Development in Preschool Children	Setyaningsih TSA, Wahyuni H	2018	Petanahan, Kebumen Central Java, Indonesia	Quasi experimental one group pre-test and post-test	Children aged 5 years old (60 months)	Kuesioner Pra-Skrining Perkembangan (KPSP)
9	Role of Caregivers Stimulation on Toddler's Language Development in Day Care	Krisnana I, Rachmawati PD, Sholihah M	2018	Surabaya, East Java, Indonesia	Cross sectional	Total 6 caregivers and 33 toddlers in 3 Day Care in Surabaya	Language development children through Denver II
10	Quality Time of Working Mother and Language Development of Toddler at Day Care in Surakarta	Anggarwati SK, Kusumawati Y, Werdani KE	2018	Surakarta, Central Java, Indonesia	Cross sectional	Total 75 mother and toddler in Day Care	Denver Developmental Screening Test (DDST II)

DISCUSSION

Our review of 10 studies showed that one study were used BSID III as a screening tools, 7 studies were used KPSP and the two other studies were used DDST II. It was found that each screening tools have their own strengths and weaknesses. The DDST II and BSID III are widely used for early developmental screening to evaluate the language, motor, cognition, and social. Based on the results of recent studies, the detection rate was higher for the DDST II than the BSID III. [23]

The BSID III has been restructured for predicting future cognitive functioning to improve its ability to identify the developmental delay. The BSID III has low levels of sensitivity, but high specificity. With the use of the BSID III norms at 24 months of age, the cut-points are <85 and <70 to identify mild/moderate and moderate delay, respectively. Based on the cohort study of very preterm Australian children, it showed that at 24 months, some at high risk children were are not being classified as delayed on the BSID III, so they might missed to receive early intervention that is required. [24] Meanwhile, the KPSP has good specificity but low sensitivity. For younger age group of children (3-24 months old), KPSP has good sensitivity, but not for the older age group of children (>24 months old). [25]

Estimated 200 million children under the age of five in low and middle-income countries are not reaching their full developmental potential because of poverty, nutritional deficiencies and lack of learning opportunities. [26, 27] The first 2 years of child's life is called critical period, when rapid physical and mental development occurs. [28] During the first 3 years of life, child development is dynamic and involves the maturation of interrelated functions such as cognitive, physical and socio-emotional capabilities. It is a period that requires proper nutrition in order for the child to achieve those capabilities so that the child can reach their full potential not only in quality of life, but also in terms of educational achievement and earning potential. [29]

Progressive screening checks are important and should be performed using appropriate developmental screening tools. By knowing in advance, it can be searched for the cause of the delay and immediately appropriate intervention can be executed. Since 2007, the Ministry of Health in Indonesia has collaborated with the Indonesian Paediatricians Association to develop stimulation, detection, early-growth and development interventions for children aged zero to six years at basic health service level.

Early detection of child development delay that have been used at basic health service level is KPSP. The KPSP can be used to determine whether or not the child's developmental barriers are present. Screening KPSP can be done by health workers, kindergarten teachers and trained preschool personnel. Routine screening schedule of KPSP is every 3 months in children <24 months and every 6 months in children ages 24 - 72 months. [30] Meanwhile there are four developmental areas in the Denver II: personal-social, fine motor-adaptive, language and gross motor by the intended age range zero months to six years old. [20]

The Bayley III screening test is designed to assess the cognitive, language and motor functions of infants and young children to quickly determine whether a child is progressing according to normal expectations. [22] The BSID III's cognitive and motor sub-scales is an instrument to measure the development of children aged 1 to 42 months in rural area in Nepal. The length of the assessment varies between 20 minutes and two and a half hours, depending on the child's age and ability. [27]

A big challenge in early identification of developmental disability is having tools that respond to local differences. This includes cultural perceptions in meaning of disability and the possibility to use the methods across countries. Standardized tools from western countries provide assessment tests that have been well-validated in their settings. The transfer of western-based tests to non-western contexts is associated with significant limitations of score interpretation and feasibility of use in resource-constrained settings. [31, 32]

The strength of this study are it was conducted through a comprehensive search and identified additional studies. Furthermore, the bias of this study was reduced by using selection of studies, extraction, cross-checking of data and results to strengthen conclusions.

The limitations of this study is the numbers of countries which are included as developing countries that have been reviewed (only Nepal and Indonesia). Very few studies were found in other developing countries to compare for the use of screening tools in cognitive impairment in children under five years, especially in the context of stunting. However the data from these countries are helpful in showing the potential to recognize cognitive impairment in children caused by stunting. The importance of cognitive assessment in stunted children under five years old developed based on the on conceptual framework of the determinants of child undernutrition and previous studies.

CONCLUSION

Early cognitive assessment in stunted children under five years old required a paradigm shift to become a routine clinical part to distinguish the aspects of cognitive development compared to the developmental milestones. The BSID III, KPSP and DDST II are the common cognitive assessment used in developing countries and they have moderately good accuracy to detect cognitive impairment.

Further research and development is needed to optimize the use of these assessment tools to detect cognitive impairment caused by stunting in children. Early detection of cognitive impairment allows for diagnosis and appropriate intervention, education, psychosocial support, and engagement in integrated decision-making regarding the goal of achieving a 40 % reduction in the number of stunted children under five years old by 2025. This study also will provide a recommendation of priority intervention and future policies aiming to improve human development.

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CONFLICT OF INTEREST

The authors report no declarations of interest. The authors are responsible for the content and writing of this article.

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