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Original Article

Growth and developmental delay risk factors among under-five children in an inner-city slum area

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Abstract

Background Growth and developmental delays are common among children under the age of five years (under-five children), especially in slum areas. Early detection and intervention may give better prognoses.

Objective To detect growth and developmental delays and related risk factors among under-five children living in an inner-city slum area of the Indonesian capital.

Methods This cross-sectional study was conducted from October to November 2018 in Tanah Tinggi, Johar Baru District, an inner-city slum area in Central Jakarta. Subjects were healthy children aged 3-60 months. Socioeconomic profile was obtained through questionnaires, anthropometric data through measurements, and developmental status through the *Kuesioner Pra Skrining Perkembangan* (KPSP) instrument. Development was considered to be delayed for KPSP scores <9. Data were analyzed using Chi-square test.

Results Of 211 subjects, prevalence of underweight, stunting, and wasting were 35.1%, 28.0%, and 20.9%, respectively, meanwhile low maternal education, and low family income were 57.9% and 75%. The prevalence of developmental delay was 10%, while suspected developmental delay was 26.1%. The prevalence increased from age 21 months and peaked at 36 months. Associated risk factors were low maternal education, low family income, underweight weight-for-age, stunted height-for-age, and microcephalic head circumference-for-age.

Conclusion Low education and low income were significant risk factors for growth and developmental delay. [**Paediatr Indones. 2019;59:276-83; doi: http://dx.doi.org/10.14238/pi59.5.2019.276-83**].

Keywords: *development; growth; slum area*

Growth and development from conception to adolescence is characteristic of the childhood phase.[1] Growth can be monitored through increments of weight, height, and head circumference, while development is marked by increases in individual abilities, such as gross and fine motor skills, hearing, vision, communication, social-emotion, independence, intelligence, and moral.[2] Rapid growth and development occur in the first five years of life, therefore, close monitoring and early detection of delays during this critical period is crucial.[1,3]

Close monitoring of children's development can be done using questionnaires. A practical and widely-used questionnaire in Indonesia is the *Kuesioner Pra Skrining Perkembangan* (KPSP). This KPSP is the Indonesian version of the *Prescreening Developmental Questionnaire* (PDQ), modified by the Republic of Indonesia Ministry of Health in 1996 and revised in 2005.[1] With sensitivity of 60% and specificity of 92%,[3] KPSP is recommended for use in primary healthcare services as an early detection method for

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developmental problems in children.[1] Developmental delays are common, especially in children living in slum areas, with prevalences of 12-16% in America and 13-18% in Indonesia. However, most cases of developmental delay remain underdiagnosed and untreated, despite the established premise that children with developmental delays have better prognoses if the problem can be detected and treated earlier.[3] Developmental screening of children aged 6-12 months using the KPSP in Bandung, West Java, Indonesia, showed prevalences of suspected developmental delay and actual delay of 13.6% and 0.4%, respectively. Early intervention for children with suspected developmental delay significantly reduced the number of cases.[4] Despite the known benefits, only 2-3% of all children receive public early intervention services by the age of 3 years.[5] Therefore, identifying risk factors for developmental delay in children may provide better understanding and more effective approaches for early detection as well as early intervention in certain populations.

The aim of this study was to detect growth and developmental delays and their related risk factors among under-five children living in an inner-city slum area in the Indonesian capital.

Methods

A cross-sectional study was conducted in Tanah Tinggi, Johar Baru District, an inner-city slum area in Central Jakarta. This area was a densely populated slum area of low socioeconomic level. Children aged 3-60 months living in this area were included in this study, and selected by stratified random sampling. Data collection was conducted in 3 days: 19 October 2018, 26 October 2018, and 9 November 2018. Patients with Down syndrome, cerebral palsy, or hydrocephalus were excluded from the study. Using the sample size formula for cross-sectional studies,[6] the expected proportion of developmental delay in Indonesia was 13%. Hence, the minimum required sample size calculated for this study was 174 subjects.

This study was approved by the Ethics Committee of the Universitas Indonesia Medical School. All the participants' parents or caregivers provided written informed consent prior to this study.

Subjects' data were obtained through interviews, anthropometric measurements, and KPSP examinations conducted by doctors from the Department of Child Health, Universitas Indonesia Medical School. Interviews of mothers or caregivers were done using a questionnaire that consisted of parental and child identities, primary caregiver, total number of children in family, maternal education level, maternal working status, and family income. Total number of children in the family was classified as either 1-2 or more than 2. Maternal education level was classified as either low (below junior high school) or high (senior high school and above). Family income was classified based on the DKI Jakarta province regional monthly minimum wage in 2018 as either low (below Rp 3,600,000) or high (Rp 3,600,000 and above).

Weight, height, and head circumference measurements were done to obtain anthropometric data of all subjects. Body weight was measured using a calibrated scale (*Seca*®), with accuracy to 1 gram, while subject was wearing minimal clothing. Body length was measured in a recumbent position using a length board (*Seca*®), with accuracy to 1 mm for children <2 years old, and body height was measured in a standing position using a height board (*Seca*®), with accuracy to 1 mm, for children ≥2 years old. The measurement for recumbent length was done while the child was lying on his back with head against the fixed headboard, compressing the hair, eyes looking straight up, legs straight, and soles of the feet flat against the footboard. The measurement of standing height was done while the child was standing on the baseboard with feet slightly apart, backs of the head, shoulder, buttocks, calves, and heels touching the vertical board, and a horizontal line from ear canal to the lower border of the eye socket running parallel to the baseboard.[7] The measurement of head circumference was done using a measuring tape (*Seca*®) around the broadest part of the forehead above the eyebrows, ears, and the most prominent part of the back of the head, with an accuracy of 1 mm.[8] The results were plotted on the *2005 World Health Organization* (WHO) growth curve to determine nutritional status using weight-for-length (WFL), weight-for-age (WFA), and length/height-for-age (LFA/HFA), then interpreted based on WHO growth indicators.[9] The WFA was categorized as normal weight (-2SD ≤ *z*-score <+1SD), underweight (-3SD ≤ *z*-score <-2SD), severely underweight (*z*-score <-3SD), or

having a risk of overweight (z-score ≥+1SD). The LFA/HFA was categorized as normal height (-2SD ≤ z-score <+3SD), stunted (-3SD ≤ z-score <-2SD), or severely stunted (z-score <-3SD). The WFL was categorized as good nutritional status (-2SD ≤ z-score <+2SD), wasted (-3SD ≤ z-score <-2SD), severely wasted (z-score <-3SD), or overweight (z-score ≥+2SD). Head circumference-for-age (HCA) was plotted on a Nellhaus curve,[10] then interpreted as normocephalic (-2SD ≤ HC <+2SD), microcephalic (HC <-2SD), or macrocephalic (HC >2SD). Children with any anthropometric problems (underweight, stunted, wasted, or microcephalic) were categorized as having a growth disturbance.

Developmental screening was conducted using the KPSP. This questionnaire was used as a preliminary screening tool for children aged 3 months to 6 years, and consists of 10 questions about ability based on the child's age group. The questions were answered by parents or caregivers with a 'yes' or 'no.' If the total number of yeses was 6 or below, developmental delay was suspected and the child was referred for further comprehensive evaluation. If the total number of yeses was 7-8, the result was inconclusive and re-examination was done within 1-2 weeks. If the total number of yeses was 9-10, the child was considered to have normal development, but routine KPSP examination in the next age grouping should be performed. In our study, KPSP results were categorized as normal (total score ≥9) or abnormal (score <9).

Data are presented in tables with frequency and percentage for each category. Differences in proportions of anthropometric results based on socioeconomic profiles and KPSP results were analyzed using Chi-square test with *SPSS version 20.0* software. Results with P values <0.05 were considered to be statistically significant.

Results

We examined 290 children during the study period (October 2018 until November 2018), of whom 5 children were excluded, 52 dropped out due to incomplete data, and 22 dropped out due to uncooperativeness during examination (refused, slept, or cried). Thus, 211 children aged 3-60 months were included in this study. The median age of subjects was 30 (range 3-59) months with a nearly proportional ratio of males and females. Subjects' characteristics are presented in **Table 1**.

The KPSP results were normal in 135 children (64%), inconclusive in 55 children (26.1%), and suspected developmental delay referral in 21 children (10%). Growth disturbance was reflected by the prevalence of underweight (WFA <-2SD), stunting (LFA/HFA <-2SD), and wasting (WFL <-2 SD), which were 35.1%, 28.0%, and 20.9%, respectively. The prevalence of microcephaly in this study was 17.1%. Of 21 subjects with suspected developmental delay, 42.9% were underweight and severely underweight, 38.1% were stunted and severely stunted, 23.8%

Table 1. Subjects' characteristics based on KPSP results

Characteristics, n(%)	Normal KPSP (n=135)	Abnormal KPSP (n=76)
Gender		
Male	64 (47.4)	40 (52.6)
Female	71 (52.6)	36 (47.4)
Total number of children in family		
1–2	98 (72.6)	52 (68.4)
>2	37 (27.4)	24 (31.6)
Maternal education		
High	85 (63.0)	32 (42.1)
Low	50 (37.0)	44 (57.9)
Maternal working status		
Working	17 (12.6)	12 (15.8)
Non-working	118 (87.4)	64 (84.2)
Family income		
High	53 (39.3)	19 (25.0)
Low	82 (60.7)	57 (75.0)
Weight-for-age (WFA)		
Severely underweight	5 (3.7)	11 (14.5)
Underweight	32 (23.7)	26 (34.2)
Normal weight	91 (67.4)	35 (46.1)
Risk of overweight	7 (5.2)	4 (5.3)
Length/height-for-age (LFA/HFA)		
Severely stunted	9 (6.7)	3 (3.9)
Stunted	22 (16.3)	25 (32.9)
Normal height	104 (77.0)	48 (63.2)
Weight-for-length (WFL)		
Severely wasted	1 (0.7)	5 (6.6)
Wasted	23 (17.0)	15 (19.7)
Good nutritional status	106 (78.5)	52 (68.4)
Overweight	5 (3.7)	4 (5.3)
Head circumference for age (HCA)		
Microcephalic	15 (11.1)	21 (27.6)
Normocephalic	120 (88.9)	55 (72.4)

were wasted and severely wasted, and 42.9% were microcephalic. Associations between socioeconomic factors and growth disturbances are shown in **Table 2**. Significantly more children with mothers of low education were underweight (WFA) (P=0.009) and wasted (WFL) (P=0.004) than children with mothers of high education. In addition, significantly more children with low family income were underweight (WFA) (P=0.027) than those with high family income.

Associations between developmental delay and socioeconomic factors as well as anthropometric results are shown in **Table 3**. Significantly more children with abnormal KPSP scores had mothers with low education, low family income, underweight WFA status, stunted HFA status, and microcephalic HCA status than children with normal KPSP scores.

The age distribution of subjects with abnormal KPSP scores is presented in **Figure 1**. Most subjects with developmental delay were in the 36-month age group, while most subjects with inconclusive results were in 42-month age group. All subjects with KPSP

Table 2. Associations between socioeconomic factors and growth disturbances

Variables	WFA*	LFA/HFA**	WFL***	HCA****
Total number of children in family				
OR (95% CI)	0.96 (0.51-1.80)	1.39 (0.73-2.65)	1.36 (0.67-2.77)	0.66 (0.2-1.54)
P value	0.900	0.319	0.394	0.331
Maternal education				
OR (95% CI)	2.15 (1.21-3.81)	1.72 (0.94-3.15)	2.68 (1.35-5.33)	1.96 (0.95-4.05)
P value	0.009†	0.078	0.004†	0.068
Maternal working status				
OR (95% CI)	1.15 (0.51-2.59)	1.43 (0.62-3.29)	0.99 (0.38-2.60)	1.68 (0.66-4.29)
P value	0.728	0.400	0.981	0.290
Family income				
OR (95% CI)	2.02 (1.08-3.81)	1.76 (0.90-3.45)	1.73 (0.81-3.66)	1.43 (0.65–3.15)
P value	0.027†	0.097	0.151	0.378

* Categories used for analysis were underweight (underweight and severely underweight) and normal weight (normal and risk of overweight).
** Categories used for analysis were stunted (stunted and severely stunted) and normal height (normal).
*** Categories used for analysis were wasted (wasted and severely wasted) and good nutritional status (good and overweight).
**** Categories used for analysis were microcephalic and normocephalic.
†P< 0.05.

Table 3. Associations between developmental delay (abnormal KPSP scores) and socioeconomic factors as well as anthropometric results

Variables	OR (95%CI)	P value
Gender	1.23 (0.70-2.16)	0.466
Total number of children in family	1.22 (0.66-2.26)	0.521
Maternal education	2.34 (1.32-4.15)	0.003†
Maternal working status	1.30 (0.59-2.89)	0.517
Family income	1.94 (1.04-3.62)	0.036†
WFA*	2.51 (1.40-4.52)	0.002†
LFA/HFA**	1.96 (1.06-3.62)	0.031†
WFL***	1.65 (0.84-3.24)	0.143
HCA****	3.06 (1.46-6.37)	0.002†

* Categories used for analysis were underweight (underweight and severely underweight) and normal weight (normal and risk of overweight).
** Categories used for analysis were stunted (stunted and severely stunted) and normal height (normal).
*** Categories used for analysis were wasted (wasted and severely wasted) and good nutritional status (good and overweight).
**** Categories used for analysis were microcephalic and normocephalic.
† P< 0.05.

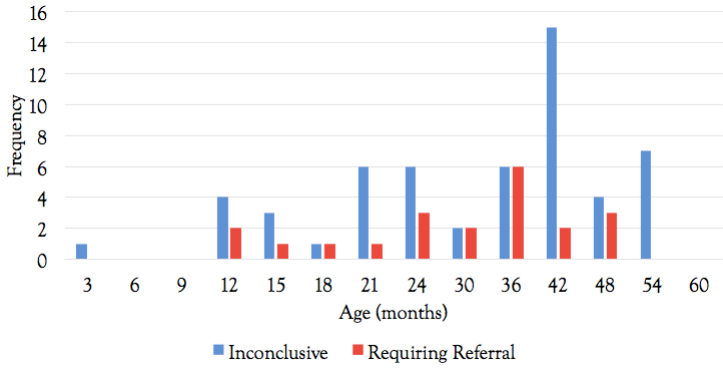

Figure 1. Age distribution of subjects with abnormal KPSP result

results requiring referral had global developmental delay (GDD), which was delay in 2 or more domains of development. Sixteen children were delayed in gross motor skills, 19 children in fine motor skills, 14 children in language skills, and 15 children in personal-social skills. One mother (primary caregiver) of a child with GDD suffered hearing loss and a speech disorder.

Discussion

Growth disturbances among under-five children living in inner-city slum areas are reflected in the prevalences of underweight (WFA <-2SD) and wasted (WFL <-2SD), which were higher in our study than in the national data from the Indonesian Basic Health Research Report 2018 (underweight: 35.1% *vs.* 10.2%, respectively; wasted: 20.9% *vs.* 17.7%, respectively).[11] However, the prevalence of stunted (LFA/HFA <-2SD) in our study population was lower compared to the national data (28.0% vs. 30.8%, respectively), yet higher than the local DKI Jakarta province prevalence, which was 17.7%.[11] Growth problems in under-five children living in urban slum areas can be caused by inappropriate feeding practices, diseases occurring due to poor sanitation, inappropriate parenting, and lack of access and coordination of public health services.[12]

In our study, low maternal educational level was associated with weight-for-length (wasted). This finding was in agreement with a study by Makoka,[13] which showed that children's nutritional status increased with maternal education. In addition, another Indonesian study conducted in children aged 2 to 4.9 years reported that maternal education to middle school and below was significantly associated with nutritional status of a child. The study finds that maternal education to middle school and below were associated with weight-for-age Z score <-2 (underweight) and height-for-age Z score <-2 (stunted).[14] We noted that maternal education to senior high school was significantly associated with children's improved nutritional status. Mothers with higher education are better placed to receive information about childhood nutrition and are more responsive in facing acute conditions, such as fever and diarrhea,[13] such that weight loss may be prevented. Therefore, one of the strategies for solving nutritional problems in children is strengthening the education sector, especially for girls, by completing their senior high school education, as recommended by the national, 12-year, compulsory education program.[15]

A study reported that in children aged 1-3 years old in Sidoarjo, East of Java, weight-for-age was a significantly related variable to family income, but not to maternal working status.[16] Sufficient family income provides the means to better meeting the nutritional requirements of children.

There was no significant difference in socioeconomic factors between stunting and normal height in our study. This finding might have been due to the limited sample size. In addition, several factors associated with height-for-age were not studied, such as history of intrauterine growth restriction, premature birth, poor sanitation, infectious disease, as well as energy and protein intake.[17,18] These factors may play

important roles in linear growth in children under-five living in urban slum areas.

There was also no significant difference in socioeconomic factors between normocephalic and microcephalic children under-five. Our finding was in agreement with a study conducted in Kenyan children. Abubakar *et al.*[19] found that wealth index and maternal education had no significant associations with head circumference. A relatively larger contribution of genetic factors might explain this finding. Head circumference is less susceptible to socioeconomic factors compared to other anthropometric measurements. However, our results differed from that of Bouthoorn *et al.*[20] who found that children born to highly-educated mothers had significantly larger head circumference compared to children born to mothers with low and mid-low educational levels. This finding may have been due to differing methods of interpretation of microcephaly as well as differing classifications of maternal education levels.

The prevalence of developmental delay in Tanah Tinggi, Johar Baru District, Central Jakarta was 10%. Previous studies using the same instrument (KPSP) in children under-five showed similar numbers of 10% in Malang, East Java, and 8% in Bantul, Yogyakarta.[3,21]

Five variables had statistically significant associations with developmental delay: low maternal education, low family income, underweight weight-for-age, stunted height-for-age, and microcephalic head circumference-for-age. Similarly, a previous study in Bantul, Yogyakarta found that low maternal education, low socioeconomic status, and maternal working outside the home were risk factors for developmental delay in children under-five.[21] Demirci *et al.*[22] concluded that developmental delay was related to advanced maternal age, low maternal education, low socioeconomic status, and consanguinity.

Maternal working status, total number of children in the family, and nutritional status according to weight-for-height were not significantly related to developmental delay in our subjects. These findings might have been caused by another important unevaluated factor, stimulation in all area of child development. Non-working mothers with low education may not provide enough stimulation to their children due to lack of knowledge about the importance of stimulation for childhood development.[23]

There were 76 children with abnormal KPSP results in our study, 55 children with (inconclusive and 21 children with suspected developmental delay. Children with inconclusive should undergo re-examination within 1 week, while children with suspected developmental delay should be referred for further examination. Delays were distributed in four aspects of development, yet the highest number of children were delayed in fine motor skills. In contrast, Fadlyana *et al.*[24] in Bandung, West Java, showed that most delays occurred in vocalization and language comprehension. Twenty-one children with confirmed developmental delay had global developmental delay. However, the mother of one such child had a hearing loss and speech disorder. As the primary caregiver, her child's delay may have been caused by lack of stimulation. Based on age groups, the incidence of developmental delay increased from 21 months of age and peaked at 36 months. This result suggests that early detection and intervention for development should be started before 21 months of age, or within first the 1000 days of life to achieve optimum results.[25]

Malnutrition and inadequate stimulation are the main risk factors for disturbances in cognitive, motor, social behavior, school behavior, and psychomotor development. Nutrition and stimulation play important roles in brain development in the first five years of life.[26,27] In our study, 21 children with confirmed developmental delay had nutritional problems reflected by anthropometric results, 42.9% underweight and severely underweight, 38.1% stunted, 23.8% wasted and severely wasted, and 42.9% microcephalic. A cross-sectional study involving children under-five in Nigeria found that weight-for-age had significant associations with the hearing and language domain (P=0.036) and the interactive social domain (P=0.001). Underweight children were three times as likely to have delays in hearing and language skills and five times as likely to have delays in interactive social skills.[26] A systematic review and meta-analysis by Sudfeld *et al.*[28] concluded that linear growth as reflected by height-for-age was associated with cognitive and motor development in children in developing countries. Nutritional status was a predictor in hearing, language, and social interaction abilities. Malnutrition results in delayed

auditory system maturation, which affects both the central and peripheral auditory systems. Children with malnutrition have difficulty understanding information, causing them to be apathetic and indolent in exploring their surroundings, and resulting in delayed social interaction skills. Such conditions may impact children's academic achievement as well as work-related skills in the future.[26]

In our study, 42.9% of children with developmental delay had microcephaly, 50% children with developmental delay had chronic malnutrition as reflected by wasting and stunting. In microcephalic children, 0.1% may be asymptomatic, while 15-20% manifest developmental delay.[29] Microcephaly can be caused by genetic disorders as part of a syndrome, teratogens, infection, metabolic disorders, as well as prenatal, perinatal, or post-natal problems.[30] Microcephaly was associated with lower developmental quotient (DQ) and higher morbidities (epilepsy, hearing disorders, and visual impairments).[28]

Our study had several limitations. The KPSP was evaluated in an open space near the anthropometric measurement location with a little bit noisy and distractful environment, which may cause inconvenience to the children. This situation resulted in a high number of dropouts due to uncooperativeness during the examination. We suggest that further community study on child development be done in a comfortable and quiet room in order to provide a conducive environment for examination. In addition, we did not evaluate other important factors contributing to development such as parental stimulation, home environment, and comorbidities. Further study should include evaluation of such factors.

In conclusion, prevalence of underweight and wasting in children under-five in an inner-city slum area are higher than their corresponding national data, while the prevalence of stunting is higher than provincial data. Based on KPSP results, the prevalence of developmental delay in children under-five in Tanah Tinggi, Central Jakarta is 10%, and suspected developmental delay is 26.1%. Risk factors for growth disturbances are low maternal education and low family income, while risk factors for developmental delay are low maternal education, low family income, underweight weight-for-age, stunted height-for-age, and microcephalic head circumference-for age. All children with developmental delay or malnutrition were referred to the Tanah Tinggi Primary Health Center for further evaluation. Growth and development in children should be monitored closely and routinely so the intervention can be done as soon as possible, especially in the first 1000 days of life.

Conflict of Interest

None declared.

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