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Descriptions of Child Developmental Disorders Living Around Gold Mining

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ABSTRACT

Living around the gold mining area, at risk of exposure to mercury (Hg). Pregnant women exposed to Hg alkyl can cause fetal brain damage so that the baby is born with d efects. This is due to the target toxicity of Hg, especially the organic metal compounds are the nervous system. Based on a child development screening questionnaire, ±100 children were questioned about their development, motor development, language and social interaction. This research was to see a picture of the development of children living around the Gold Mining village of Kalirejo, Kokap district, Kulon Progo District, Yogyakarta. The Longitudinal Observational Research Method with serial measurement measured the level of child development in five domains: cognitive, linguistic, motor, social, emotional and behavioral (adaptive behavior) with the Bayley Scale of Infant and Toddler Development Third Edition (BSID III) against 16 infants in the age range of 2-14 weeks (stage I) and 14-26 weeks. (tahap II). The baby's development observations resulted in an average composite development score of 85. Stage I obtained composite scores of cognitive domain; 102.81, language; 107.38, motor: 98.94, social emotional: 100,63 and behavioral: 90.00, while Stage II of each domain had the same scores as 105.94: cognitive, 105.38: language, 104.81: motor, social-emotional: 98,69 and behavioural: 92.44. The conclusion that the composite child development score was in the average range of 90 - 109 for all domains, means that the child development composite score was still within the normal range (85-115), indicating that there is no developmental impediment. It is recommended to reduce Hg exposure, provide optimal nutrition to the baby and enhance developmental interventions with stimulation to stimulate auditorium, visual, tactile and kinesthetic, thereby improving the quantity and quality of brain cell synapses, to optimize brain function.

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Introduction

Gold mining is one of the major sources of mercury (Hg) heavy metal pollution worldwide. Environmental pollution by Hg originating from gold mining is derived from the decommissioning of tailing gold processing in aggregation (Donkor et al., 2024). The tailing discharge without first processing makes Hg spread on land, water and in the air (Odumo et al., 2014). The evaporative properties of Hg are the presence in the air in the form of free metals (Palar, 2008), which will eventually settle in soil, sediments of lakes, rivers, coves, and oceans. Hg that is in soil and water will undergo methylation and become MethylHg (CH3Hg) by microorganisms in water and soil (Sharma Ghimire et al., 2019). MethylHg has a high solubility in the body of aerial animals so Hg accumulates through its bioaccumulation and biomagnification processes in body tissues of an air animal. (widowati et,al.2008; Balshaw et al., 2007). The same thing happens with plants, where plants have the ability to absorb heavy metals including vegetable plants. So living and staying around the gold mining area would be at risk from the high Hg content in the body. Hg contamination to humans can occur through food, drink and respiration as well as skin contact (Widowati et,al.2008)The tailing from the gold mining that is in the village of Kalirejo, Kokap district of Kulon Progo Yogyakarta, has been used by the community for fish conservation pools, as a side effort. This side effort has been going on for 20 years and has been putting the public health at risk. Sutomo, et al., 2004, mentioned that Hg neighborhoods are below the threshold, but 76.92% of workers and 56.18% of villagers are already contaminated with Hg in their blood, 24.7 percent have a habit of eating fish near gold mining and 82 percent consume vegetables nearest gold mines. The highest level of Hg in the blood among Yogyakarta workers was 13.7 ug/l, and the highest Hg level

among the Yogyakarta people around the gold mining area was 11.8 ug/ l. Soil in the Sangon basin contains >50 ppm Hg and 1 sample soil contains 7 ppmHg (Setiabudi 2005), as well as inhabitants wells around gold mining (Maruapey 2006). The ADKL team by BTKL Yoyakarta (2007) noted that and salak melinjo leaves contain Methylmercury at 8.07 ppm and 2.96 ppm respectively. Then in 2014 ADKL-BBTKLPP Yogyakarta (2014) team again performed the monitoring of waste from this gold mining, found that waste water contains 0.00816 mg/L, in sludge 14,585 mg/kg, river sediment before exposure to waste 15,621 mg/ kg and after exposure of waste 15,382 mg / kg, in water bodies before exposures to waste 0,00467 mg/ L and after contact with waste 0.00273 mg / L. In clean water Hg content ranges from: ttd-0,006 mg/ l, while in soil: 22,845-30,807 mg/ Kg. In fish 165,914 mg/ kilo and in plants: 11,934-171,551 mg/ kilograms. Hg levels in people's blood range from 42,197 to 185,980 g/l so the range is above quality standards. Hg levels in the urine of people and miners are still within the normal range of 0.0015 – 0.0106 and 0.0015 - 0.0129 g/g of creatinine.

Pregnant women who are exposed to Hg alkyl can cause damage to the fetal brain so that the baby is born with disability (WHO 2007). The nervous system is the primary target of Hg toxicity, especially organic metal compounds (Cope.WG.et.al, 2004; Risher. JF et.al 2007; Park & Zheng, 2012).

(Marques et al., (2016) stated that there was a significant relationship between neurodevelopmental delay and exposure to Hg (MeHg and EHMg) in children aged between 5 and 24 months. Al-saleh et al., (2016) found that the exposure of low levels of Hg caused a delay in the development of the nerve of babies aged 3 to 24 months old. A study conducted in Boston of 341 pregnant women registered between 1999 and 2002, which compared Hg levels with their children's fine motor skills over a period of three years, showed that children had lower average scores if their mother's blood levels were high (Oken & Bellinger, 2008). A study that compared the levels of Hg in the central cord blood with Bayley's results at the age of 12, 24 and 36 months was also conducted, showing a decrease in motor development at age 12 months (Jędrychowski et al., 2007).

The results of the Detection of Growth Kembang Balita Year 2015 conducted by Puskesmas department of Kokap village of Kalirejo that based on the screening questionnaire development more than about 100 children are questioned their development especially motor development, language and social interaction (LaporanPuskesmas Kokap, 2015).

Method

This Longitudi Obsevasional study was carried out in the area around the gold mining of Kalirejo village and Kokap district of Kulon Progo, Yogyakarta. A minimum of 16 babies born to a mother who has lived for three years at the maximum during her lifetime in the village of Kalirejo. Ethical clearance for conducting this research was obtained from the Medical Health Research Ethics Committee, Medical Faculty of Gadjah Mada University (Ref: KE / FK / 1036 / EC / 2017). Declaration of willingness to become a Respondent by signing this informed consent. The signature is made after obtaining an explanation of the research, understanding the purpose, method or implementation of research and the risks that arise during the research. Bayley Scales of Infant and Toddler Development (Bayley III/BSID III) (Moore et al., 2012). The test was conducted at the age range of 2 weeks (16 days) to 14 minutes, and 14 weeks to 26 weeks.The test is aimed at measuring the level of pre-development of children in five domains/aspects: cognitive, motor language, socio-emotional and adaptive behavior. The observations were carried out by two trained and experienced professional psychologists. Psychologist of research from the Faculty of Psychology of Gadjah Mada University and has a training certificate. The Bayley-III score has been simplified from the previous version. Score for each item is either 1 (credit) or 0 (tanpa kredit). Available scores include crude scores, scale score, composite score, percentage rating, and confidence intervals. Measuring with a series of progressive play tasks takes between 45–60 minutes. Raw scores of successfully completed items are converted into scale scores and composite scores. Scores obtained by newspapers are used to determine their performance compared to the norms taken from children who are normally developing. Normal is a reference average of 85–115. BSID-III has a reliability and reliability coefficient for the subscale and its composite score ranges from 0.86 to 0.93 (Metwally et al., 2016). According to Sevianti, 2014 BSID Instruments edition-III Indonesian language version is a valid and reliable measurement tool to use. With validity scores from BSID-III edition being 0.964 (cognitive), 0.934 (language), 0.822 (moving) with Cronbach Alpha of 0.918 and test-retest reliability of 0.846.

Results

The table below shows that baby development is assessed in several domains, namely cognitive, linguistic, motor, socio-emotional and adaptive behavior. Rates of scores obtained on stage I observations (the age of each infant is 102.81 for the cognitive aspect, 105.38 for the linguistic aspect, 98.94 for the motor 100,63 for the socio-emotional aspect and 89.69 for the adaptive aspect. As for the Median of the five aspects, they are 105.00 ± 9.827, 109.00 10.893; 98.50 ± 9.037; 100.00 ± 14.477; and 90.50 9.386. The maximum minimum dam scores of each aspect are as follows: cognitive aspects score lowest 85 and highest 115, lowest language score 89, extended 121; lowest motor score 9,037, highest 85; lower socio-emotional score 75 and higher 125, and lowest adaptive score 70, highest 104.

Table 1. The show baby development is assessed in several domains

Variable	Mean	Median	SD	Min - Max	95% CI
Cognitive Score level I	102,81	105,00	9,83	85 - 115	97,58 - 108,05
Language Score Level I	107,38	109,00	10,89	89 - 121	101,57 - 113,18
Motoric Level I	98,94	98,50	9,04	9,04 - 85	94,12 - 103,75
Emotional Social Score level I	100,63	100,00	14,48	75 – 125	92,91 - 108,34
Adaptive score level I	90,00	90,50	9,39	70 - 104	84,69 - 94,69
Cognitive score level II	105,94	105,00	6,88	90 - 115	102,27 - 109,61
Language score level II	105,38	103,00	11,94	89 - 127	99,01 - 111,74
Motoric score level II	104,81	103,00	15,22	67 - 133	96,70 - 112,92
Emational Sosial Score level II	98,69	97,50	15,26	70 - 139	90,56 - 106,82
Adaotive score level II	92,44	93,50	9,54	76 - 105	87,36 - 97,52

Stage II child development scores, where the lowest cognitive score is 90 and the highest is 115; lowest language score is 89 and the top is 127, lowest motor score is 67 and the tallest is 133, lowest emotional social score is 70, highest 139 and the lower adaptive score is 76, and highest score is 105. The ratio of scores for each consecutive aspect is 105.94 for cognitive, 105.38 for language, 105,38 for motor scores, 98.69 for social-emotional scores and 92.44 for adaptive scores. The median of the five aspects is 105,00; 6,884; 103,00; 11,938; 10,3; 15,219; 97,50; 15,261; and 93,50; 9,536

Discussion

Persistent exposure to Hg would be a high risk for a variety of chronic diseases in communities, especially in vulnerable communities such as pregnant mothers, infants and children. The neurological symptoms of exposure to Hg can include mental retardation, seizures, visual and hearing impairments, develmopmment delays, language disorders, and memory loss (UNEP & WHO, 2008). Common symptoms of methyl Hg exposure during perinatal period are increased sensory (visual) deficit, motor impairment, and overall cognitive decline (Patel & Reynolds, 2013).

The development observation results of babies born around the gold mining Kalirejo has a composite development score in the average range of 90-109 for all domains. It means that the composite child development scores in all aspects of this study are within the normal range. A composite score of 70 is an appropriate limit for defining developmental delay, children with a score below 85 may be to be at "risk" of developing delay (Ballot et al., 2017).

Composite development scores within this normal range indicate that exposure to Hg has no effect on child development. This can happen because the age of a child is so young that it has not shown any disturbance to its mining. Consumption of pregnant supplements, vitamin and antioxidant intake by the mother during pregnancy can have a protective effect on the baby from oxidative disorders. Besides, the nutrition of babies such as getting colostrum and getting exclusive milk is the primary promoter of growth and development in all aspects with optimum (Wiji, 2013). A cohort study by ((Lony Novita et al., 2008) in Bandung showed that exclusive breastfeeding yielded better cognitive function results compared to not receiving exclusive milk. Milk is an ideal source of nutrition, so exclusive breastfeeding is very beneficial in the development of a child's brain that is related to the growth and development of the child.

Development scores are still within the normal range, which can occur as a result of parental intervention in foster care, such as parents performing basic needs of the child in the form of stimulation (ASAH), affection (ASIH) and need for shelter and food (ASUH)(Alfiana dan Lusiana, 2016). Patterns of care, affection, and affection tend to influence the growth of the child (Nur & Adriani, 2009). So the role of parent is very much needed, especially mother. You should have a great deal of care and attention for the basic needs of growing a baby. A child from zero to two years old, his hundreds of billions of neurons are not connected to his brain tissues. Therefore, through the stimulation of the environment, the connections of the brain tissue will be formed and the germ will be strong. When she was a baby, through the interaction of affinity with her parents, her family and her affectionate environment and introducing her to this world, it was at that moment that a network of neuronal connections called synapses was forming. When these synapses are used over and over again in everyday life, they are reinforced and attached to the child's brain, but if used rarely, they will weaken and eventually disappear from the children's brains(Khadijah, 2016).

Composite development scores in the average range of 90-109 indicate that there are no symptoms of neurological damage, meaning the baby's brain has no dysfunction. However, it should be noted that exposure to Hg symptoms is chronic. That's why this child is born to be able to develop optimally, as soon as it is avoided from constant exposure to Hg. Because 0-2 years is the peak of the development of higher visual, hearing, speech, and cognitive functions (Achadi, 2014).

Optimal development is the development that occurs when the potential of the child can be developed and built so that the highest ability can be achieved according to the level, range of potential and age of the individual. The most risky stage of development is in the period of the first 1000 days of life (Achadi, 2014). This period of 1000 BC has been scientifically proven to be a period that determines the quality of a person's life, therefore this period is often referred to as the "golden period" (Kemenko Kesra RI, 2013). As for the critical points to be observed during the period of 1000 HPK are the period in conception (280

days), the period 0 – 6 months (180 days) and the period 6 – 24 months (540 days) The conception period until the eighth month of pregnancy is the formation of the nervous system, the nine months until the birth of the baby is the growth and further development of the organs of the body so that the baby will be ready to live in the new world, beyond the mother's womb and the age of 0-2 years is the peak of the development of vision, hearing, speech, and higher cognitive functions. (Achadi, 2014). The brain after birth develops functionally and decreases after the age of two to three. Individual physical development covers four aspects: nervous system, muscle, endocrine glands, and body or physical structure.

Children born and living around the gold mining village of Kalirejo kecamatn Kokap district of Kulon Progo Yogyakarta are not indicated developmental disorders. It could be because of their very young age. But bear in mind that Hg's toxicity is chronic, so it's likely that the next 10 or 20 years will show symptoms. So for the quality of child development in the future, children should be avoided from constant exposure to Hg, good nutritional fulfillment and optimum developmental stimulation are essential and should be done from an early age.

Conclusion

Children born and living around the gold mining village of Kalirejo kecamatn Kokap district of Kulon Progo Yogyakarta are not indicated developmental disorders. It could be because of their very young age. But bear in mind that Hg's toxicity is chronic, so it's likely that the next 10 or 20 years will show symptoms.

So for the quality of child development in the future, children should be avoided from constant exposure to Hg, good nutritional fulfillment and optimum developmental stimulation are essential and should be done from an early age.

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Author Contribution and Competing Interest

The author of this research as a researcher and has made various efforts to complete this research and also as the lead author in the writing of this script.

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