

Raising Awareness on Children's Immunity and Cognitive Abilities: Nationwide Survey to Indonesian Parents

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ABSTRACT: Early life nutrition influences the development of children's immunity and cognitive abilities. According to PISA 2018, only 29% of Indonesian students have a growth students that have growth mindset. The parent's inability to understand and improve the multifactorial aspect of cognitive development pose risk to children's cognitive growth. To raise awareness among parents to strengthen their children's cognitive and immunity through health education. Online survey with pretest and posttest, 4 questions each, distributed to Indonesian parents that attend online seminar about impact of children's immunity toward cognitive development. The data were further analyzed with t-test using SPSS. Survey of 334 participants shows that even before the intervention, Indonesian parents understand the relation between immune system and cognitive development in children thus showing no significant difference after intervention [p-value = 0.226]. However, they did not know how to observe or measure the cognitive score such as the 8 winning skills and growth mindset, also the nutrition needed to support cognitive abilities and immunity. The intervention prove a significant increase of parent's knowledge [Pre = 1.99 ± 0.83; Post = 3.08 ± 1.11; p-value = 0.000. Indonesian parents are aware that immunity affects cognitive growth of their children. However, there is still a lack of awareness or prior knowledge on cognitive measurement tools and components, and nutrition which is beneficial for immunity and cognitive growth.

Keywords- Awareness, Immunity, Cognitive Ability

INTRODUCTION

According to Program for International Student Assessment (PISA) 2018 conducted by Organization for Economic Co-operation and Development (OECD), Indonesia scores lower than the OECD average score globally, in all aspect including reading, mathematics, and science (PISA, 2019). Analysis of Indonesia's PISA reading score from 2000 until 2018 showed a hump-shaped curve means an initial increase and shows more negative over recent years that it showed no significant difference between 2018's and 2000's reading score (PISA, 2018).

Early life nutrition influences the development of intestinal microbiota in the first thousand days of life and correspondingly affect the development of immunity system (Wopereis et al., 2014). The development of intestinal microbiota also have positive relation with maturation of gut mucosa (Ximenez & Tores, 2017). nervous system (central, enteric, vagal innervation, Hypothalamus-Pituitary- Adrenal axis) (Suganya & Koo. 2020; Wang et al., 2018; O'Mahon et al., 2015). Subsequently, an impaired immune and nervous system affect children's cognitive development negatively such as reasoning, growth mindset, decision making, language, attention, memory, psychomotor, focus, logic, and language (Aziz et al., 2022).

The low cognitive scores may correlate with the low growth mindset in Indonesian children. Growth mindset is considered advantageous because the belief that intelligence can be developed leads to students being more willing to embrace challenges, persist when they encounter setbacks, view effort as a means to mastering new things, and learn from critical feedback. Fixed mindset or the belief that intelligence is static leads to students being more likely to avoid challenges, give up when there are obstacles, see effort as futile, become defensive when receiving critical feedback, and feel threatened by the success of others (Dweck, 2006). Growth mindset also affects the development of cognitive development, primarily influenced by parenting style (Wang et al., 2022). Another problem found is the increase of upper respiratory tract infection. Globally, the incident of Upper Respiratory Tract Infections (URTIs) increased by 37.07% (34.12% to 40.05%) from 1990 until 2019 (Jin et al., 2021). Meanwhile the prevalence of URTIs in Indonesia based on Indonesia's national health survey in 2018 is 9.3% (BPP Kemenkes, 2018). According to PISA 2018, only 29% of Indonesian students have a growth mindset (PISA, 2018). The parent's inability to understand and improve the multifactorial aspect of cognitive development pose risk to children's cognitive growth.

“Raising Awareness on Children's Immunity and Cognitive Abilities: Nationwide Survey to Indonesian Parents”

Adequate and balanced nutrition is important for optimal growth and development. Several nutrients have key roles in supporting the immunity and cognitive development of children, including polyunsaturated fatty acids (PUFA) and prebiotics (Cohen et al., 2021; Niers et al., 2008). Parents as main caregivers have an important role in ensuring nutritional sufficiency in children. Parents need to have awareness on their children's growth and development and how nutrition plays an important role (Wiguna et al., 2023). Therefore, it is necessary to carry out interventions to increase parental awareness of children's cognitive abilities and immunity. For this study, we organized a nationwide online seminar for parents with the goal of enhancing their understanding of children's cognitive capabilities and immune system. This study aims to raise awareness among parents to strengthen their children's cognitive and immunity through health education.

METHODS

A cross-sectional study is used, through online surveys with pretest and posttest questionnaire models. The population of this study are the participants of nation-wide online health education through Zoom to raise awareness on the impact of children's immunity towards their cognitive development. There are no specific inclusion or exclusion criteria for participants selection, however the attendees are Indonesian parents.

To attend the event, participants need to register through an Indonesian parenting platform website, namely Parentalk. Parentalk's social media, such as Instagram, is used to share information on the event. Registered participants were invited to join a WhatsApp group for easier distribution of information by the committee. In this group, the Zoom online meeting information and pretest link were distributed. The online health education was conducted on July 26th, 2023 and was composed of presentation sessions by a panel of speakers; a child psychologist and a consultant pediatrician in allergy-immunology, followed by a question and answer session. At the end of event, posttest link was shared on the online meeting chat and social media group chat. The questionnaires were distributed through Google form, and participant's written consent were not asked due to the voluntary nature of questionnaire participation. All of the processes are conducted in Indonesia's national language which is Bahasa Indonesia.

The responses to the surveys were compiled and underwent a process of data cleaning. The collected data is thereafter subjected to further analysis. The study's outcome includes a change in the

“Raising Awareness on Children's Immunity and Cognitive Abilities: Nationwide Survey to Indonesian Parents”

participants' awareness of and knowledge regarding the immune and cognitive development of children. The pretest and posttest scores will be evaluated to provide insights into the participants' comprehension of the topic, both in terms of their overall performance and their understanding of individual questions. The data analysis will be conducted using the SPSS software using t-test. Elaborating on the demographic characteristics and the dynamics of survey scores.

RESULTS AND DISCUSSION

RESULT

A total of 334 participants that answer the pre-intervention and post-intervention survey were included. Survey that has been answered by participants that does not fill both surveys were excluded. The survey comprised of four questions for both surveys shown in Table 1.

Table 1. Survey questions

Question	Answer	Correct/wrong
Q1 In your opinion, what is the relationship between the immune system and cognitive development in children?	Because a strong immune system supports healthy cognitive. If children get sick, their cognitive abilities are not optimal	Correct
	It's not related	Wrong
Q2 Have you ever heard of the 8 Winning Skills as indicators of children's cognitive development?	Yes	Correct
	No	Wrong
Q3 Have you ever heard of Growth Mindset?	Yes	Correct
	No	Wrong
Q4 What kind of nutrition that is important to support children's immune and cognitive systems?	Prebiotic FOSGOS, long chain fatty acids (omega-3, omega-6, DHA)	Correct

“Raising Awareness on Children's Immunity and Cognitive Abilities: Nationwide Survey to Indonesian Parents”

Tannins, phytic acid	Wrong
Do not know	Wrong
All of the above	Wrong

All 334 responses were analyzed, without missing answers. The correct answers of each question were analyzed and shown in Table 2. There is significant positive difference on question number 2, 3, and 4 with p-value <0.05 and non-significant difference for question number 1 (p-value 0.226). Question 4 had the most false answer in the pre-intervention survey with only 51/334 (15.3%) correct answers.

Table 2. Analysis of Each Question

Question	Correct answers (%)	Question	Correct answers (%)	P – value*
Pre Q1	327 (97.9%)	Post Q1	322 (96.4%)	0.226
Pre Q2	137 (41%)	Post Q2	248 (74.3%)	0.000
Pre Q3	150 (44.9%)	Post Q3	231 (69.2%)	0.000
Pre Q4	51 (15.3%)	Post Q4	229 (68.6%)	0.000

*P – value of each pretest dan posttest question analyzed with paired t-test; p-value <0.05 is significant

Based on the total score between pre-intervention and post-intervention survey in Table 3, there is a change of total score. Mean of total score were analyzed, there is significant increase from pre-intervention survey 1.99 ± 0.83 to 3.08 ± 1.11 in the post-intervention survey (p-value=0.000).

Table 3. Total Score of Pre-intervention and Post-intervention Survey

Question	Correct answer					Mean ± SD	P-value*
	0	1	2	3	4		
Pre-, n (%)	1 (0.3%)	100 (29.9%)	148 (44.3%)	71 (21.3%)	14 (4.2%)	1.99 ± 0.83	0.000
Post-, n (%)	1 (0.3%)	44 (13.2%)	55 (16.5%)	60 (18%)	174 (52.1%)	3.08 ± 1.11	

*P – value of total pretest dan posttest analyzed with paired t-test; p-value <0.05 is significant.

Discussion

The purpose of the survey is to measure the impact of the intervention aimed to raise awareness among parents about their children's cognitive and immunity and how to strengthen them. Studies suggest that parental awareness has a substantial influence on both the way parents raise their children and the developmental results of the children (Jeong et al., 2021). Hence, it is imperative to increase awareness of parents for the optimal growth and development of their children.

Besides emphasizing antenatal care and birth preparedness practices through training, issues to optimal child growth and development in relation to healthy digestion, nutrition, and parenting are also substantial for midwife to manage child nutrition related conditions (Barsono et al., 2018). Parents play a major role in the growth and development of children, especially when they are under the age of five. In maternal childcare, the quality of a child's growth and development is determined by the quality of nutrition, love, stimulation, and protection against disease (Soedjatmiko et al., 2017). A child's nutrition plays a very important role in the development and function of their immune system. A healthy immune system is crucial for optimal cognitive development in children, hence it is important for parents to be aware of that so that they can support their children's optimal growth and development. The immune system has been identified as one of the possible key bridges connecting the gut-brain axis (Kartjito et al., 2023). The first question is aimed to understand parents' awareness on the effect of immunity to the cognitive system. The result of the first question shows no significant difference before and after the survey, mainly because a lot of parents already answer the question correctly in the pre-intervention survey (97.9%). The result shows that participants already have high awareness that immunity can affect the cognitive development of children.

Parental involvement is intricately linked to the progress of children's cognitive development (Jeong et al., 2021). By one year they continue to have higher cognitive functioning, are better problem solvers as toddlers, and have higher IQ's by age three. When compared with mothers, fathers' talk with toddlers is characterized by more “wh” questions, such as what, where, etc that requires children to assume more communicative responsibility in the interaction (Bardosono et al., 2017). Understanding a child's cognitive abilities, also known as their cognition, is critical to their growth and development throughout their entire lives. Composing perception, memory, and reasoning, cognition comprises the mental processes involved in the acquisition and processing of information. This complex structure is

“Raising Awareness on Children's Immunity and Cognitive Abilities: Nationwide Survey to Indonesian Parents”

formed by a combination of biological, environmental, experience, sociocultural, and motivational factors (Drago et al., 2020).

Asking parents about their concerns about language, motor skills, cognitive abilities, and emotional-behavioral development is a useful way to find developmental problems in babies and early children because these worries are often in line with real difficulties (American Academy of Pediatrics, 2001). Thus, it is essential for parents to have knowledge of the signs of cognitive development in order to swiftly seek appropriate professional help (Shonkoff et al., 2012).

One of the parent-friendly methods to measure a child's cognition is utilizing the 8 Winning Skills screening assessment. Published by Wiguna et al, the 8 Winning Skills is a tool developed by Indonesian experts in children growth and development to screen the cognitive development of children 1-5 years. It composed of logical reasoning, decision-making, problem-solving, concentration, attention, psychomotor skills, language, and memory (Wiguna et al., 2023).

Mastering these skills necessitates a continuous learning process method, where children may experience failure and have to repeat the process to achieve success in learning. In that context, a child's growth mindset is important as the growth mindset is the foundation of all learning processes. Growth mindset, developed by Carol Dweck, is a mindset that believes that an individual's capacity and talent can be continually developed (O'Keefe et al., 2018). On the second and third question, parents are asked whether they are aware of the 8 Winning Skills screening tool and the Growth Mindset concept. The posttest scores both showed significant improvement compared to the pretest score ($p=0.000$)

After being aware of the impact of the immune system to cognition and of cognitive-related tools, parents need to be aware of how to bolster their immune system and cognition, especially through their diet. There are several key nutrients that are found to be beneficial. Polyunsaturated fatty acids (PUFA) such as linoleic acid (LA), alpha-linolenic acid (ALA), and DHA (docosahexanoic acid) are known to play important roles in neurodevelopment and cognitive function in infant and young children (Cohen et al., 2021). Prebiotics have been found to confer benefit in strengthening and improving children's gut and immunity development (Pai et al., 2018; Miqdady et al., 2020; Braegger et al., 2011). Prebiotic oligosaccharides, in particular long-chain fructo-oligosaccharide (lcFOS) and short-chain galacto-oligosaccharides (scGOS) 1:9 mixture is the most commonly studied prebiotic in healthy infants.^{22,23} In toddlers, one of the nutritional interventions available for children is through growing-

“Raising Awareness on Children's Immunity and Cognitive Abilities: Nationwide Survey to Indonesian Parents”

up milk (GUM) consumption. Children that consumed growing-up milk (GUM) supplemented with short-chain galacto-oligosaccharides (scGOS)/ long-chain fructo-oligosaccharides (lcFOS) (9:1) and n-3 long-chain polyunsaturated fatty acids (LCPUFAs) show lower risk of infection than GUM only or cow's milk (Chatchatee et al., 2014).

Question number four observes the parent's knowledge about the key nutrients impacting children's immunity and cognitive development. Prior to the intervention, only 15.3% can answer correctly but after the intervention, up to 68.6% of parents have the correct answer to question 4 ($p=0.000$).

CONCLUSION

Indonesian parents are aware that immunity affects cognitive growth of their children. However, there is still a lack of awareness or prior knowledge on cognitive measurement tools and components, and nutrition which is beneficial for immunity and cognitive growth. Overall, the intervention is very effective to increase awareness in parents on the 8 Winning Skills and Growth Mindset concepts. It is also very effective to raise awareness on some of the key nutrients that are beneficial to support a child's immune and cognition.

REFERENCES

- American Academy of Pediatrics. (2001). Committee on children with disabilities. Developmental surveillance and screening of infants and young children. *Pediatrics*, 108, 192-196.
- Azziz-Baumgartner, E., Gonzalez, R., Davis, W., Calvo, A., Olson, N., Grant, L., ... & Peacock, G. (2022). Lower cognitive scores among toddlers in birth cohorts with acute respiratory illnesses, fevers, and laboratory-confirmed influenza. *Influenza and other respiratory viruses*, 16(1), 101-112
- Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI (BPP Kemenkes). (2018). Riset kesehatan dasar RISKESDAS. Published online 2018. <https://kesmas.kemkes.go.id/konten/105/0/020417-hasil-riskesdas-2018>
- Bardosono, S., Hildayani, R., Chandra, D. N., Wibowo, Y., & Basrowi, R. (2017). Bonding Development between Parents and Children through Playing Together to Improve Family Happiness. *World Nutrition Journal*, 1(1), 41-51.

“Raising Awareness on Children's Immunity and Cognitive Abilities: Nationwide Survey to Indonesian Parents”

- Bardosono, S., Hildayani, R., Chandra, D. N., Basrowi, R. W., & Wibowo, Y. (2018). The knowledge retention after continuing health education among midwives in Indonesia. *Medical Journal of Indonesia*, 27(2), 128-33.
- Braegger, C., Chmielewska, A., Decsi, T., Kolacek, S., Mihatsch, W., Moreno, L., ... & ESPGHAN Committee on Nutrition. (2011). Supplementation of infant formula with probiotics and/or prebiotics: a systematic review and comment by the ESPGHAN committee on nutrition. *Journal of pediatric gastroenterology and nutrition*, 52(2), 238-250.
- Chatchatee, P., Lee, W. S., Carrilho, E., Kosuwon, P., Simakachorn, N., Yavuz, Y., ... & Szajewska, H. (2014). Effects of growing-up milk supplemented with prebiotics and LCPUFAs on infections in young children. *Journal of Pediatric Gastroenterology and Nutrition*, 58(4), 428-437.
- Cohen Kadosh, K., Muhandi, L., Parikh, P., Basso, M., Jan Mohamed, H. J., Prawitasari, T., ... & Geurts, J. M. (2021). Nutritional support of neurodevelopment and cognitive function in infants and young children—an update and novel insights. *Nutrients*, 13(1), 199.
- Drago, F., Scharf, R. J., Maphula, A., Nyathi, E., Mahopo, T. C., Svensen, E., ... & Rogawski McQuade, E. T. (2020). Psychosocial and environmental determinants of child cognitive development in rural south africa and tanzania: Findings from the mal-ed cohort. *BMC Public Health*, 20, 1-8.
- Jeong, J., Franchett, E. E., Ramos de Oliveira, C. V., Rehmani, K., & Yousafzai, A. K. (2021). Parenting interventions to promote early child development in the first three years of life: A global systematic review and meta-analysis. *PLoS medicine*, 18(5), e1003602.
- Jin, X., Ren, J., Li, R., Gao, Y., Zhang, H., Li, J., ... & Wang, G. (2021). Global burden of upper respiratory infections in 204 countries and territories, from 1990 to 2019. *EClinicalMedicine*, 37.
- Kartjito, M. S., Yosia, M., Wasito, E., Soloan, G., Agussalim, A. F., & Basrowi, R. W. (2023). Defining the relationship of gut microbiota, immunity, and cognition in early life—a narrative review. *Nutrients*, 15(12), 2642.
- Miqdady, M., Al Mistarihi, J., Azaz, A., & Rawat, D. (2020). Prebiotics in the infant microbiome: The past, present, and future. *Pediatric Gastroenterology, Hepatology & Nutrition*, 23(1), 1.
- Niers, L., Stasse-Wolthuis, M., Rombouts, F. M., & Rijkers, G. T. (2008). Nutritional support for the infant's immune system. *Nutrition reviews*, 65(8), 347-360.
- O'Keefe, P. A., Dweck, C. S., & Walton, G. M. (2018). Having a growth mindset makes it easier to develop new interests. *Harvard Business Review*.

“Raising Awareness on Children's Immunity and Cognitive Abilities: Nationwide Survey to Indonesian Parents”

- O'Mahony, S. M., Stilling, R. M., Dinan, T. G., & Cryan, J. F. (2015). The microbiome and childhood diseases: Focus on brain-gut axis. *Birth Defects Research Part C: Embryo Today: Reviews*, 105(4), 296-313.
- Pai, U. A., Chandrasekhar, P., Carvalho, R. S., & Kumar, S. (2018). The role of nutrition in immunity in infants and toddlers: An expert panel opinion. *Clinical Epidemiology and Global Health*, 6(4), 155- 159.
- PISA. (2019). OECD. *PISA 2018 Results (Volume I)*. doi:<https://doi.org/https://doi.org/10.1787/5f07c754-en>
- PISA. (2018). Schleicher A. PISA 2018 Insights and Interpretations. Published online 2018. <https://www.oecd.org/pisa/publications/pisa-2018-results.htm>
- Shonkoff, J. P., Richter, L., Van Der Gaag, J., & Bhutta, Z. A. (2012). An integrated scientific framework for child survival and early childhood development. *Pediatrics*, 129(2), e460-e472.
- Soedjatmiko, S., Gunardi, H., Sekartini, R., Medise, B. E., Johnson, I., Wibowo, Y., & Basrowi, R. W. (2018). Efektivitas Seminar pada Perubahan Sikap Ibu dalam Pemberian Dukungan Nutrisi dan Stimulasi selama Pemantauan Tumbuh Kembang. *Sari Pediatri*, 19(4), 201-8.
- Suganya, K., & Koo, B. S. (2020). Gut–brain axis: role of gut microbiota on neurological disorders and how probiotics/prebiotics beneficially modulate microbial and immune pathways to improve brain functions. *International journal of molecular sciences*, 21(20), 7551.
- Wang, S., Harvey, L., Martin, R., van der Beek, E. M., Knol, J., Cryan, J. F., & Renes, I. B. (2018). Targeting the gut microbiota to influence brain development and function in early life. *Neuroscience & Biobehavioral Reviews*, 95, 191-201.
- Wang, L., Xian, Y., Dill, S. E., Fang, Z., Emmers, D., Zhang, S., & Rozelle, S. (2022). Parenting style and the cognitive development of preschool-aged children: Evidence from rural China. *Journal of experimental child psychology*, 223, 105490.
- Wiguna, T., Sekartini, R., Pasiak, T. F., Basrowi, R. W., & Kartjito, M. S. (2023). Exploring key cognitive indicators for practical use by parents in community setting. *World Nutrition Journal*, 6(S2), 41-49.
- Wopereis, H., Oozeer, R., Knipping, K., Belzer, C., & Knol, J. (2014). The first thousand days–intestinal microbiology of early life: establishing a symbiosis. *Pediatric Allergy and Immunology*, 25(5), 428-438.

“Raising Awareness on Children's Immunity and Cognitive Abilities: Nationwide Survey to Indonesian Parents”

Ximenez, C., & Torres, J. (2017). Development of microbiota in infants and its role in maturation of gut mucosa and immune system. *Archives of medical research*, 48(8), 666-680.