Journal of Public Health and Pharmacy
2775-4952 (Online - Elektronik)
Research Articles Open Access

Atomic Habits Parenting Validating a Behavioral Framework for Stunting Prevention

Sirajuddin Sirajuddin[1]*, Mustamin Mustamin[1], Dien Abdul Munir[2]
[1]Department of Nutrition, Health Polytechnic of Makassar, South Sulawesi, Indonesia
[2]Master Program of Nutritional Sciences, Graduate School, Universitas Sebelas Maret, Surakarta, Indonesia

***Corresponding Author:** E-mail: sirajuddin.gizi@poltekkes-mks.ac.id

ARTICLE INFO

Manuscript Received: 17 Nov, 2024
Revised: 02 Feb, 2025
Accepted: 05 Feb, 2025
Date of publication: 01 Jul, 2025
Volume: 5
Issue: 2
DOI: 10.56338/jphp.v5i2.6405

KEYWORDS

Atomic Habits;
Parenting;
Stunting Prevention

ABSTRACT

Introduction: Atomic Habits Parenting focuses on small, consistent actions by caregivers to detect and prevent stunting in children. A valid and reliable instrument is essential for early detection and effective prevention. This study aims to evaluate the validity and reliability of the Atomic Habits Parenting instrument and its association with stunting prevention in children under five. This method differs from others as the consistent daily practice of small habits leads to a 37-fold improvement over one year.
Methods: A cross-sectional study was conducted in Jeneponto, Barru, and Sinjai Districts of South Sulawesi, Indonesia, involving 900 children aged 0-59 months. Data were collected from February to August 2024. Validity and reliability were assessed using Cronbach's alpha, sensitivity, and specificity with ROC analysis, and the association with stunting was measured using the Chi-Square test.
Results: The instrument demonstrated high reliability with Cronbach's alpha values above 0.8 for all parenting practices. ROC analysis showed excellent sensitivity (75.6%) and specificity (82.3%) at a threshold score of 313.5. A significant association was found between Atomic Habits Parenting and stunting prevention ($p<0.001$).
Conclusion: The Atomic Habits Parenting instrument is valid and reliable, with strong sensitivity and specificity. It is significantly associated with the prevention of stunting in children under five, making it a valuable tool for public health programs. Adapting this approach globally in high-stunting regions (>20%) could support a sustainable stunting reduction roadmap.

Publisher: Pusat Pengembangan Teknologi Informasi dan Jurnal Universitas Muhammadiyah Palu

INTRODUCTION

Interventions to prevent malnutrition in children under five in Indonesia have been started for a long time, only the primary outcomes were dynamic (1),(2). The Indonesian government's commitment is very strong with the issuance of presidential regulation number 72 of 2022 concerning the Acceleration of Stunting Prevention and Control in Indonesia (3).

The nutrition interventions to improve children under five years age of nutritional status, has had been reported in studies (4,5), but the impact on both intervention sensitive and specific do not always to achieve the outcome when implementing in diverse context (6–8).

There was a gap based on Indonesian experience, namely in the basic philosophy of primary outcome-oriented intervention (stunting), which focuses on children as subjects. However, children should be seen as objects, not subjects, with the focus directed towards caregivers and the environmental factors that influence them (9–14). The orientation of the focus intervention on the mother or caregiver has great leverage because the mother is the main trigger who provides services forever. Its potential is natural as part of family resources. Very suitable for the Indonesian socio-demographic context. The orientation of the intervention on the mother or caregiver is well suited to the atomic habits parenting (16). The Atomic Habits framework differs from other interventions, as practicing optimal parenting habits 1% better each day for a year equates to 1.01^{365}=37.78, while suboptimal parenting habits result in 0.99^{365}= 0.03 Daily small optimal parenting habits yield a 37-fold improvement. Caring for children's growth and development requires good atomic habits parenting because by behavioral focus, holistic approach, and empowerment of caregivers (8).

Behavioral Focus: Unlike traditional stunting prevention frameworks that often emphasize nutritional interventions and healthcare services, the Atomic Habits Parenting approach centers on the daily behaviors and habits of caregivers. This shift in focus recognizes the critical role of consistent, positive actions in shaping a child's growth and development. Holistic Approach: This method integrates various aspects of caregiving, including hygiene, feeding, health-seeking behavior, and emotional support. By addressing multiple dimensions of child care, it provides a comprehensive strategy that goes beyond just addressing nutritional deficiencies. Empowerment of Caregivers: The approach empowers caregivers by providing them with practical, actionable steps they can take daily. This empowerment fosters a sense of agency and responsibility, which can lead to more sustained and effective stunting prevention efforts(17).

Objectives of the study was to evaluate the validity and reliability of the atomic habits parenting instrument to prevent stunting and measure its association with the proportion of stunting in children under five.

METHOD

The study included 900 subjects from three locations with varying stunting prevalence: Jeneponto (>30%), Barru (<20%), and Sinjai (21-29%). Recruitment and training of enumerators, along with the preparation of instruments, permits, and ethical clearance from the Health Polytechnic of Makassar, began in January 2024.

Study Design, this cross-sectional study was conducted from February to August 2024 in the districts of Jeneponto, Barru, and Sinjai, South Sulawesi Province, Indonesia. Participants; The subjects in this study were children aged 0-59 months, identified through listings in 27 villages across 9 public health areas in 3 districts. The subjects were systematically selected using random sampling.

Variable; The Atomic Habit of Parenting refers to the repeated practice habits of mothers in parenting related to hygiene sanitation, infant feeding, health-seeking behaviour, and caring practices, measured on a visual analogue scale (0-30) scale point. Development process instrument begins with a study of the concept of atomic habits in the realm of parenting. Based on the similarity of the Positive Deviance study variables, namely feeding, care, sanitation and health seeking behavior. These four variables are reduced into several question items which are measured using a ratio scale. These four parenting variables, as a function of the caregiver's identity, are made by making a statement that the items are always repeated. If it is repeated, it is a characteristic of atomic habit. The second stage is to carry out trials to ensure that the content of the question items is appropriate to the socio-cultural conditions of the study population. This was done during enumerator training using a sub-sample of 10 people from childcare circles. Initially the instrument contained 100 questions, and was simplified to 50 questions according to recommendations during testing. Question items that were removed were those related to the father's role as a caregiver. In the Makassar Bugis

culture in South Sulawesi, the identity of the father is the breadwinner while the mother is the caregiver. The father as breadwinner is an unusual cultural value coupled with the caregiver identity, because it is considered to be demeaning to the mother. This instrument must be modified when used in cultural contexts different from the Bugis-Makassar culture. To achieve global generalizability, the respondent should be changed from the primary caregiving mother to other family members responsible for child caregiving. The father can be designated as the caregiver if the primary responsibility for child feeding is predominantly under his control. The variable exposures in this study are atomic habits, while the predictor variables are the child's age, gender, parents' education and occupation, type of income, and parents' income level. Potential confounders and effect modifiers in this study can be explained as follows: the confounder is the social safety net for those who are malnourished as a consequence of nutrition intervention policies in the research area.

Potential Confounders: Social Safety Net: In the context of this study, the social safety net is a confounder because it is related to malnutrition and also to nutrition intervention policies. Nutrition Intervention Policies: These policies can affect nutritional status and health outcomes, so they need to be controlled to reduce bias.

Effect Modifiers: Education Level: The impact of nutrition intervention may differ among groups with different education levels. For example, the effect of the intervention might be stronger in groups with higher education because they may be more able to access and utilize available resources. Age can modify the effect of nutrition interventions. For instance, children may respond differently to the interventions compared to adults.

Data source and measurement; The data on atomic habits are sourced from interviews with caregivers, focusing on feeding practices, hygiene practices, health-seeking behavior, and caregiving practices (See Table 01). Each sub-variable was measured using a visual analogue scale ranging from 0 to 30 points. The interviewers, who are nutritionists, were trained prior to the interviews. They also received daily training in anthropometric techniques and instrument calibration. Data collection was supervised by the team supervisor. The instrument used has been validated, with a Cronbach's alpha greater than 0.90.

Data on the subject's characteristics were collected through interviews with the respondent caregivers using a closed questionnaire, including the parent's education level, occupation, income levels, and types of income. Data on children's stunting were calculated using z-scores of height-for-age based on the WHO 2005 median. Stunting was defined as <-2 Standard Deviations. The assessment of children's height used a longboard for those under 24 months of age and a microtoice produced by the Indonesian Health Department.

Bias in this study is technical interviews, instruments, and procedures of anthropometric assessment. The efforts to address potentials of technical interviews bias were overcome by training of enumerator related interviews and the conceptual of visual analogue scale system. Try out and evaluated the enumerator competence before and after trained.

Study size; The sample size of toddlers was calculated based on a stunting prevalence of 27.2%, which was the reported prevalence for South Sulawesi in 2022, using the formula.

$$n = Z^2{}_{\alpha/2} x \text{ P x} \frac{(1 - \text{P})}{(0.05)^2}$$

Where: n = sample size required for each district Z = appropriate z-score value for the desired confidence level (1.96 for a 95% confidence level), p = prevalence of stunting (0,272); e = margin of margin of error 0.05, then n = (1.96)2* 0.272 * (1 - 0.272) / 0.052; n = 304.

Quantitative Variable; The method used to analyse the data first ensured the normality test for data with a continuous scale and categorical variables. The analysis of child feeding habits was based on sensitivity and specificity analysis using the Z-score standard for Height for Age (HAZ) < -2 Standard Deviations as the gold standard. This method strongly assumed that if a child's feeding score was below this minimum threshold, it was categorized as suboptimal.

Statistical Method; Cronbach's Alpha was a measure used to assess the reliability or internal consistency of a set of test items or scales. To conduct a Cronbach's Alpha analysis, researchers first prepared their dataset, ensuring that all items or variables intended for the reliability test were included. The analysis provided a Cronbach's Alpha value, which indicated the degree of internal consistency among the items. Generally, a value above 0.70 was considered acceptable, suggesting that the items had a good level of reliability. To control for confounding variables, randomization was used by randomly assigning participants to different groups to ensure that confounding variables

were evenly distributed across the groups, reducing their impact on the results, and standardization ensured that all participants were exposed to the same conditions. In this study, atomic habits groups were divided into two categories: suboptimal and optimal. The suboptimal category consisted of groups whose feeding habits scores did not reach the optimum value needed to impact stunting prevention based on sensitivity and specificity analysis, while the optimal category included groups that achieved the optimal scores in atomic feeding habits, which could prevent stunting.

RESULTS

Characteristics

Mother's Education: Most mothers have completed high school (33.1%) or elementary school (25.0%). Family Head's Education: The majority have completed elementary school (36.8%) or high school (29.2%). Mother's Occupation: Predominantly in informal sectors (90.6%). Family Head's Occupation: Mostly labour (76.7%). Income Levels: Most families earn between IDR 1,800,001 and 3,000,000 (43.1%) (See Table 1)

Table 1. Characteristics Subject

Characteristics	Frequency (n, %)			P Value
	Stunting	Normal	Total	
Mother education				
Never go to school	4(1,5)	14(2,2)	18(2.0)	0.585
Elementary school	65(24.5)	160(25,2)	225(25.0)	
Junior school	52(19,6)	146(23,0)	198(22.0)	
High school	97(36.6)	201(31,7)	298(33.1)	
Collage/University	47(17.7)	114(18,0)	161(17.9)	
Father education				
Never go to school	2(2.6)	16(2.5)	23(2.6)	0.998
Elementary school	96(36.2)	235(37.0)	331(36.8)	
Junior school	54(20.4)	124(19.5)	178(19.8)	
High school	77(29.1)	186(29.3)	263(29.2)	
Collage/University	31(11.7)	74(11.7	105(11.7)	
Mother occupation				
Informal sectors	246(92.8)	569(89.6)	815(90.6%)	0.081
Labor	19(7.2)	66(10.4)	85(9.4)	
Father occupation				
Informal sectors	73(27.5)	137(21.6)	210(23.3)	0.034
Labor	192(72.5)	499(78.4)	690(76.7)	
Kind of income				
Daily	53(20.2)	101(15.9)	154(17.2)	0.299
Weekly	22(8.4)	52(8.2)	74(8.2)	
Monthly	188(71.5)	481(75.9)	669(74.6)	
Levels of Income				
< IDR1.800.000,-	113(42.8)	260(41.2)	372(41.7)	0.947
IDR1.800.001 to 3.000.000,-	114(43.2)	272(43.1)	386(43.1)	
IDR3.000.001 to 4.800.000,-	22(8.3)	62(9.8)	84(9.4)	
IDR4.800.001 t0 7.200.000,-	11(4.2)	25(4.0)	36(4.0)	
>IDR7.200.000,-	4(1.5)	12(1.9)	16(1.8)	

Validity and Reliability Instrument of The Atomic Habits for Stunting Prevention

The ROC Curve Analysis was used to determine the threshold score for atomic feeding habits that can protect against stunting. The area under the curve (AUC) is 0.920, indicating high accuracy. Threshold Score: The threshold score for atomic feeding habits to prevent stunting was set at 313.5 points. Sensitivity and Specificity: At the threshold score of 313.5, the sensitivity is 75.6% and the specificity is 82.3%. Classification: Atomic feeding habits are classified as good if the score is >315.5 points and not good if the score is <315.5 points.

Table 02. The Atomic Habits Parenting Children of Instrument for Early Detection and Preventing of Stunting in Children

No	Atomic Habit Parenting Items	Valid items	Cronbach alfa	N of items
1	Hygiene and Sanitation (HS)	HS38, HS39, HS42, HS43, HS44, HS45, HS46	0,913*	9
2	Infant and Young Chil Feeding (IYCF)	IYCF 47A, IYCF A47 IYCF47B, IYCF47C, IYCF 48, IYCF49, IYCF50, IYCF51, IYCF51, IYCF53, IYCF54, IYCF55, IYCF56, IYCF57, IYCF58, IYCF59, IYCF60, IYCF61, IYCF63, IYCF64, IYCF65, IYCF66, IYCF67, IYCF68, IYCF69,	0,881*	22
3	Health seeking behavior (HSB)	HSB70, HSB71, HSB72, HSB73,	0,827*	4
4	Caring Practices (CPR)	CPR74, CPR75, CPR76, CPR77, CPR78, CPR79, CPR80, CPR81, CPR82	0,824*	9

Note: *instrument reliable

This instrument demonstrates excellent sensitivity and specificity (Figure 1) for early detection of stunting, allowing for the identification of children at risk well before the condition becomes evident. Sensitivity refers to the instrument's ability to correctly identify children who are at risk of stunting, while specificity ensures that it effectively distinguishes those who are not at risk. The early detection capabilities of this instrument provide a valuable tool for public health practitioners, enabling timely interventions that can prevent the development of stunting and its associated long-term health consequences. Its high accuracy ensures that the results are reliable, contributing to effective stunting prevention programs globally.

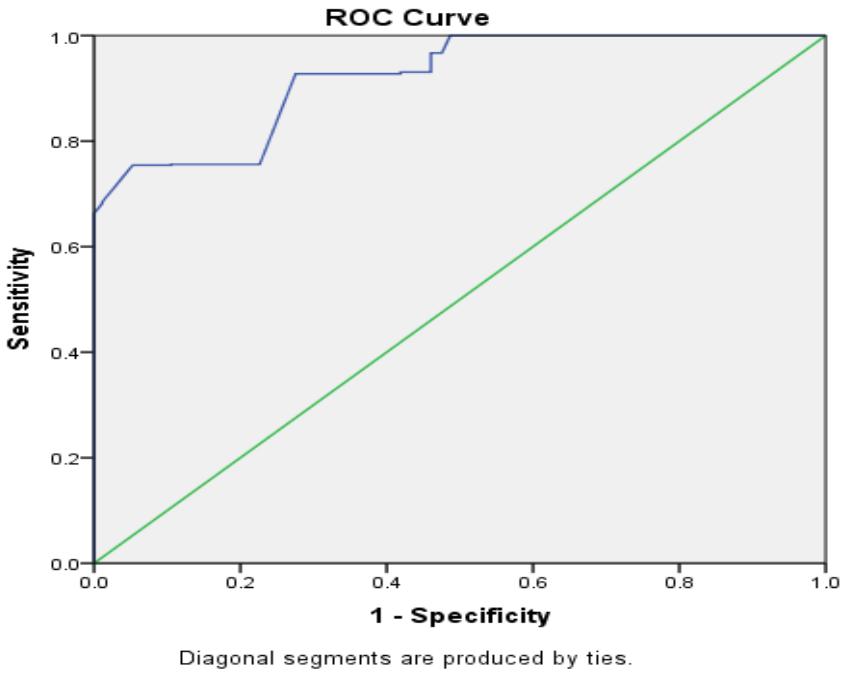
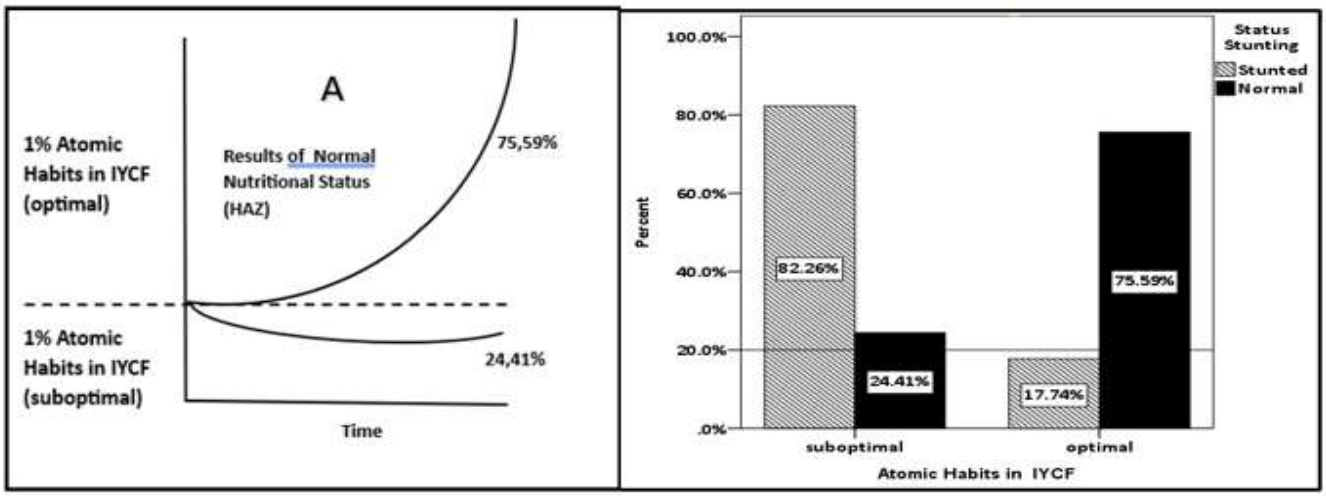


Figure 1. ROC Curve the Instrument of Atomic Habit Parenting (Sensitivity and Specificity)

Table 3. The Association between Atomic Habit IYCF (Infant and Young Child Feeding) practices and stunting

Atomic Habit of IYCF	Stunting n (%)	Normal n (%)	Total n (%)	95% CI	P Value
Sub optimal (<315,5)	219 (82,3)	155(24,4)	373(41,4)	6,5(4,9:8,7)	<0,001
Optimal (>=315,5)	47(17,7)	480(75,6)	527(58,6)		
Total	265(100)	635(100)	900(100)		

To provide a clear and detailed description, visualization is presented in Figure 2. This figure illustrates the mechanism of atomic habits in IYCF and their impact on children's height status.



Section A : The Principle of Atomic Habits: A 1% daily improvement over a year mathematically equates to $1.01^{365} = \approx 37.78$ (James Clear). **Section B:** Evidence from the study on *Atomic Habits Optimization in IYCF* shows that optimal atomic habits result in 75.59% normal height status, whereas suboptimal atomic habits achieve only 24.4% normal height status.

Figure 2. illustrates the mechanism of atomic habits in IYCF and their impact on children's height status

In this study, the threshold score for having a protective capacity against stunting was identified as the optimal category with a score >313 points. Several potential barriers for caregivers include the failure to consistently implement simple, good practices every day. Additionally, the suboptimal support from the immediate family or extended family for child caregiving practices can hinder effective child care.

DISCUSSION

Interpretation of ROC Curve

The ROC curve analysis (AUC = 0.920) identified a threshold score of 313.5 points for atomic feeding habits to prevent stunting, with a sensitivity of 75.6% and specificity of 82.3%. Atomic feeding habits were classified as optimal if the score was greater than 315.5 points and suboptimal if it was less than 315.5 points. The study measured atomic habits in four areas: Hygiene and Sanitation (handwashing, bathing, cleaning, waste disposal), Infant and Young Child Feeding (22 items on breastfeeding and diverse foods, Cronbach's Alpha = 0.881), Child Treatment (fever, diarrhea, cough, vomiting, Cronbach's Alpha = 0.827), and Child Care (safe environment, emotional, cognitive, and moral development, Cronbach's Alpha = 0.824).

The information from the ROC curve analysis can be highly valuable in public health programs aimed at reducing stunting. There are five addresses related to the findings of this research, namely the targets of stunting interventions., resources allocation, monitoring-evaluation, policy development, research and development.

Targeted Interventions: By using the threshold score of 313.5 points for atomic feeding habits, public health programs can identify children at high risk of stunting more accurately. This allows for targeted interventions to those who need it most (18).

Resource Allocation: With a clear threshold, resources such as nutritional supplements, healthcare services, and educational programs can be allocated more efficiently to areas or populations with higher stunting risks. Children

are more likely to experience stunting and overweight if they are in the youngest age group (2.0-2.9 years), were weaned after the age of 6 months, have short-statured mothers, or live in rural areas (19).

Monitoring and Evaluation: The sensitivity (75.6%) and specificity (82.3%) values provide a reliable measure for monitoring and evaluating the effectiveness of public health interventions,(20) (21). Programs can track improvements over time and adjust strategies as needed. Community Education. Educating caregivers and communities about the importance of atomic feeding habits and how they can meet the threshold score can empower them to take proactive steps in preventing stunting (22).

Policy Development: Policymakers can use this data to develop and implement policies that support better feeding practices and overall child health. This could include regulations on food quality, subsidies for nutritious foods, and public health campaigns (23). Training Healthcare Workers: Training programs for healthcare workers can incorporate this information to improve their ability to assess and address stunting risks in children. This can enhance the overall effectiveness of public health services (24). The study emphasizes the importance of training nutrition officers to strengthen positive caregiving habits through atomic habits techniques. It highlights the development of an innovative research ecosystem focused on realistic and impactful child feeding practices. The approach aims to create positive health outcomes for children by reinforcing effective caregiving behaviors.

Research and Innovation: The high AUC value (0.920) indicates a strong predictive capability, which can be used in further research to refine and develop new methods for stunting prevention and intervention. By integrating this data into public health strategies, programs can become more effective in combating stunting and promoting healthier growth and development in children. Based on the data here are some key points for parents to improve their child's feeding practices: Use of Visual Analog Scale (VAS): This method provides a detailed and dynamic range for assessing feeding practices, which can help in understanding and improving them. Diverse Diet: Ensure the child receives a variety of foods, including cereals, vegetables, fruits, meat, and dairy, to cover all nutritional needs. Regular Monitoring: Use tools like the Receiver Operating Characteristic (ROC) curve to monitor and adjust feeding practices to prevent stunting. Hygiene and Sanitation: Maintain good hygiene practices such as handwashing and proper waste disposal to support overall health.

The nutrition intervention is an intervention that integrates multidisciplinary applied sciences, including psychology (25), behavior, sociology and economics into applied nutrition science (26). This integration aims to make nutritional problem interventions more effective in solving community nutritional problems. In developing countries, one of the chronic nutritional problems is stunting in children (27). Stunting increases the risk of morbidity and death in children under five (28), cognitive abilities decrease at school age (29), and work productivity decreases in adulthood. Accumulated losses at the country level reduce productivity, resulting in slowing economic growth (30), (31).

Indonesia as a country with a population of 275 million people in 2024, the percentage of stunting is 21% nationally and varies between provinces from the lowest % and the highest %. This prevalence is above the public health problem threshold of <20% set by WHO. The demographic bonus is one of Indonesia's advantages which requires human resource management to be implemented properly, including appropriate stunting prevention efforts, (27,32)(33). Stunting is one of the constraints in increasing the nation's competitiveness(34),(35). The United Nations disclaimer that was only a 2% reduction of stunting between 2015 to 2019 (36). In Indonesia during period 2013 (37,2%) to 2022 (21,6%) reduction only a 15,6% during nine years (37–39).

Comparison with Previous Studies

The Atomic habits in the context of child-care have not been previously explored in existing studies. A comparable approach is found in positive deviance studies (40,41), which examine unique behaviors among impoverished families that contribute to improving children's nutritional status. The positive deviance framework focuses on unique behaviors linked to economic constraints. In contrast, the context of atomic habits in this study is broader, encompassing not only economic barriers but also ecosystem-level challenges at the family and community levels.

Global nutrition efforts emphasize targets, equity, multisectoral collaboration, and monitoring. The WHO aims to reduce stunting by 40% by 2025. The Atomic Habits Parenting approach supports this goal by offering a preventive, community-based strategy to combat stunting, aligning with global initiatives.

Equity and multisectoral collaboration are key to stunting prevention. The Atomic Habits Parenting approach promotes culturally accepted, sustainable interventions by building on caregivers' daily routines, ensuring reach to those most in need. Its integration into health, education, and social services fosters a collaborative effort to address stunting effectively.

Implications for Public Health

Implementation in public health programs can be achieved through community health centers, caregiver training programs, home visits by health workers, and integration with existing initiatives. At community health centers, the Atomic Habits Parenting instrument can be incorporated into routine check-ups, enabling nutritionists and healthcare workers to assess caregivers' habits and provide tailored advice to improve childcare practices. Training programs for caregivers can focus on workshops that teach practical steps to enhance hygiene, feeding, health-seeking behaviors, and caregiving practices. Home visits by health workers allow for personalized monitoring and support, using the instrument to identify areas for improvement and provide hands-on guidance. Integration with existing programs, such as immunization drives, nutrition supplementation initiatives, and early childhood development programs, ensures a holistic approach to maternal and child health.

The main difference between the Atomic Habits approach and the Positive Deviance (PD) approach lies in caregiver filtering. Unlike PD, which differentiates between poor and wealthy families, Atomic Habits does not categorize caregivers based on socioeconomic status.

In PD, key behaviors include optimal child feeding, caring practices, health seeking behaviour and hygiene practices observed among poor families with well-nourished children. Similarly, Atomic Habits focuses on these same optimal behaviors but applies them across both poor and wealthy families with well-nourished children.

This distinction is based on the PD concept that the feeding practices of Positive Deviance families may not always be adaptable by Negative Deviance families (wealthy families with malnourished children). The Atomic Habits approach overcomes this limitation by not restricting original intent based on socioeconomic status, making it a more universally applicable framework.

Limitations and Cautions

The primary source of bias in this study was technical interview bias. To address this, several measures were implemented. Enumerators underwent training on interview techniques and the conceptual framework of the Visual Analogue Scale (VAS) system to ensure consistency in data collection. Additionally, their competence was evaluated through a trial phase, with assessments conducted before and after the training to measure improvements in their skills. Despite these efforts, a mixed-methods approach incorporating qualitative interviews with fathers or extended family members could provide a more comprehensive understanding of caregiving dynamics, offering deeper insights into the factors influencing child care practices.

Recommendations for Future Research

The recommendation for future research is a randomized controlled trial focusing on the intervention of atomic habits in child caregiving across various geographical contexts (rural, urban, mountainous, and coastal areas) and socio-demographic contexts (low-income, middle-income, and affluent families).

CONCLUSION

The validation results of the behavioral framework for stunting prevention based on the Atomic Habit Parenting Instrument indicate that it is eligible for the optimal category and can be applied in the Bugis-Makassar cultural context. It is also suitable for global contexts by designating the mother, father, or extended family members as the caregivers responsible for child feeding.

AUTHOR'S CONTRIBUTION STATEMENT

Author S contributed to the conceptualization, methodology, and data analysis. Author D was responsible for data collection and drafting the manuscript. Author M supervised the study and contributed to the final manuscript revisions. All authors reviewed and approved the final manuscript

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The author declares that the writing of this article was assisted by AI.

SOURCE OF FUNDING STATEMENTS

This research was supported by Health Polytechnic of Makassar, South Sulawesi, under grant number DP.04.03/F.XX.12.3/544/2024.

ACKNOWLEDGMENTS

Thank you to the Director of Health Polytechnic of Makassar, South Sulawesi Indonesia and the Finance Department for supporting the funding of this research. Gratitude was also extended to all enumerators for their efforts in data collection and entry. Special thanks to the nutrition officers at community health centers (Puskesmas) in Jeneponto, Barru, and Sinjai Regencies for providing accommodations to the team during the research.

BIBLIOGRAPHY

1. Beal T, Tumilowicz A, Sutrisna A, Izwardy D, Neufeld LM. A review of child stunting determinants in Indonesia. Matern Child Nutr. 2018 Oct 17;14(4):e12617. Available from: https://onlinelibrary.wiley.com/doi/10.1111/mcn.12617
2. Krishna A, Mejía-Guevara I, McGovern M, Aguayo VM, Subramanian S V. Trends in inequalities in child stunting in South Asia. Matern Child Nutr. 2018 Nov 19;14(S4). Available from: https://onlinelibrary.wiley.com/doi/10.1111/mcn.12517
3. Palutturi S, Syam A, Asnawi A, Hamzah. Stunting in a political context: A systematic review. Enferm Clin. 2020 Jun;30:95–8. Available from : https://doi.org/10.1016/j.enfcli.2019.10.049
4. Keats EC, Das JK, Salam RA, Lassi ZS, Imdad A, Black RE, et al. Effective interventions to address maternal and child malnutrition: an update of the evidence. Lancet Child Adolesc Health. 2021 May;5(5):367–84. Available from : https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642(20)30274-1/abstract
5. Black RE, Alderman H, Bhutta ZA, Gillespie S, Haddad L, Horton S, et al. Maternal and child nutrition: building momentum for impact. The Lancet. 2013 Aug;382(9890):372–5. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(13)60988-5/abstract
6. Fabrizio CS, van Liere M, Pelto G. Identifying determinants of effective complementary feeding behaviour change interventions in developing countries. Matern Child Nutr. 2014 Oct 5;10(4):575–92. Available from: https://onlinelibrary.wiley.com/doi/10.1111/mcn.12119
7. Bhutta ZA, Ahmed T, Black RE, Cousens S, Dewey K, Giugliani E, et al. What works? Interventions for maternal and child undernutrition and survival. The Lancet. 2008 Feb;371(9610):417–40. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(07)61693-6/abstract
8. Martin SL, Zongrone AA, Craig HC, Litvin K, Fort P, Cooper S, et al. Measuring the intangible resources caregivers need to provide nurturing care during the complementary feeding period: a scoping review in low- and lower-middle-income countries. Public Health Nutr. 2024 Jan 15;27(1):e78. Available from: https://doi.org/10.1017/S1368980024000065
9. Purwestri RC, Barati Z, Wirawan NN, Fahmi I, Lauvai J, Scherbaum V. What explains stunting among children living in a rice surplus area in Central Java, Indonesia? In: Diversity and change in food wellbeing. The Netherlands: Wageningen Academic Publishers; 2018. p. 137–51. Available from : https://doi.org/10.3920/978-90-8686-864-3_7
10. Titaley CR, Ariawan I, Hapsari D, Muasyaroh A, Dibley MJ. Determinants of the Stunting of Children Under Two Years Old in Indonesia: A Multilevel Analysis of the 2013 Indonesia Basic Health Survey. Nutrients. 2019 May 18;11(5):1106. Available from : https://doi.org/10.3390/nu11051106

11. Rachmi CN, Agho KE, Li M, Baur LA. Stunting, underweight and overweight in children aged 2.0-4.9 years in Indonesia: Prevalence trends and associated risk factors. PLoS One. 2016;11(5). Available from : https://doi.org/10.1371/journal.pone.0154756.
12. Rah JH, Sukotjo S, Badgaiyan N, Cronin AA, Torlesse H. Improved sanitation is associated with reduced child stunting amongst Indonesian children under 3 years of age. Matern Child Nutr. 2020 Oct 1;16(S2). Available from : https://doi.org/10.1111/mcn.12741.
13. Soekatri MYE, Sandjaja S, Syauqy A. Stunting Was Associated with Reported Morbidity, Parental Education and Socioeconomic Status in 0.5–12-Year-Old Indonesian Children. Int J Environ Res Public Health. 2020 Aug 27;17(17):6204. Available from : https://doi.org/10.3390/ijerph17176204.
14. Anastasia H, Hadju V, Hartono R, Samarang, Manjilala, Sirajuddin, et al. Determinants of stunting in children under five years old in South Sulawesi and West Sulawesi Province: 2013 and 2018 Indonesian Basic Health Survey. PLoS One. 2023 May 11;18(5):e0281962. Available from : https://doi.org/10.1371/journal.pone.0281962
15. Keats EC, Das JK, Salam RA, Lassi ZS, Imdad A, Black RE, et al. Effective interventions to address maternal and child malnutrition: an update of the evidence. Lancet Child Adolesc Health. 2021 May;5(5):367–84. Available from : https://doi.org/10.1016/s2352-4642(20)30274-1.
17. James Clear. Atomic Habits. Gramedia Jakarta; 2018. 1-340 p : Available from : Atomic Habits by James Clear.pdf.pdf - Google Drive.
18. Oddo VM, Roshita A, Rah JH. Potential interventions targeting adolescent nutrition in Indonesia: a literature review. Public Health Nutr. 2019 Jan 23;22(1):15–27. Available from : https://doi.org/10.1017/S1368980018002215
19. Rachmi CN, Agho KE, Li M, Baur LA. Stunting coexisting with overweight in 2·0–4·9-year-old Indonesian children: prevalence, trends and associated risk factors from repeated cross-sectional surveys. Public Health Nutr. 2016 Oct 28;19(15):2698–707. Available from : https://doi.org/10.1017/S1368980016000926.
20. Gleason PM, Harris J, Sheean PM, Boushey CJ, Bruemmer B. Publishing Nutrition Research: Validity, Reliability, and Diagnostic Test Assessment in Nutrition-Related Research. J Am Diet Assoc. 2010 Mar;110(3):409–19. Availale from : https://www.jandonline.org/action/showPdf?pii=S0002-8223%2809%2901956-7.
21. Doocy S, Emerson J, Colantouni E, Strong J, Amundson-Mansen K, Menakuntuala J. Evaluating interventions to improve child nutrition in Eastern Democratic Republic of Congo. Public Health Nutr. 2019 Jan 6;22(1):3–14. Available from : https://doi.org/10.1017/S1368980018002859.
22. Hydery T, Shields S, Hen E, Rizzo P, Sullivan K, Savageau JA. The Impact of Local Education and Resource Distribution on Maternal Health Behaviors. Matern Child Health J. 2022 Aug 21;26(8):1676–88. Available from : https://link.springer.com/article/10.1007/s10995-022-03416-3.
23. Zeraatkar D, Johnston BC, Guyatt G. Evidence Collection and Evaluation for the Development of Dietary Guidelines and Public Policy on Nutrition. Annu Rev Nutr. 2019 Aug 21;39(1):227–47. Available from : https://doi.org/10.1146/annurev-nutr-082018-124610.
24. Marples O, Baldwin C, Weekes CE. The effect of nutrition training for health care staff on learner and patient outcomes in adults: a systematic review and meta-analysis. Am J Clin Nutr. 2017 Jul;106(1):284–310. Available from : https://doi.org/10.3945/ajcn.116.144808.
25. Anato A, Baye K, Tafese Z, Stoecker BJ. Maternal depression is associated with child undernutrition: A cross-sectional study in Ethiopia. Matern Child Nutr. 2020 Jul 12;16(3). Available from : https://doi.org/10.1111/mcn.12934.
26. Alderman H, Fernald L. The Nexus Between Nutrition and Early Childhood Development. Annu Rev Nutr. 2017 Aug 21;37(1):447–76. Available from : https://doi.org/10.1146/annurev-nutr-071816-064627.
27. Prendergast AJ, Humphrey JH. The stunting syndrome in developing countries. Paediatr Int Child Health. 2014 Nov 13;34(4):250–65. Available from : https://doi.org/10.1179/2046905514Y.0000000158.
28. Arini D, Nursalam N, Mahmudah M, Faradilah I. The Incidence of Stunting, the Frequency/Duration of Diarrhea and Acute Respiratory Infection in Toddlers. J Public Health Res. 2020 Jul 3;9(2):jphr.2020.1816. Available from : https://doi.org/10.4081/jphr.2020.1816.

29. Mireku MO, Cot M, Massougbodji A, Bodeau-Livinec F. Relationship between Stunting, Wasting, Underweight and Geophagy and Cognitive Function of Children. J Trop Pediatr. 2020 Oct 1;66(5):517–27. Available from : https://doi.org/10.1093/tropej/fmaa009.
30. Stewart CP, Iannotti L, Dewey KG, Michaelsen KF, Onyango AW. Contextualising complementary feeding in a broader framework for stunting prevention. Matern Child Nutr. 2013 Sep 18;9(S2):27–45. Available from: https://doi.org/10.1111/mcn.12088.
31. Bommer C, Vollmer S, Subramanian S V. How socioeconomic status moderates the stunting-age relationship in low-income and middle-income countries. BMJ Glob Health. 2019 Feb 8;4(1):e001175. Available from: https://doi.org/10.1136/bmjgh-2018-001175.
32. Sari DDP, Sukanto S, Marwa T, Bashir A. The Causality between Economic Growth, Poverty, and Stunting: Empirical evidence from Indonesia. Jurnal Perspektif Pembiayaan dan Pembangunan Daerah. 2020 Apr 30;8(1):13–30. Available from: https://doi.org/10.22437/ppd.v8i1.8834.
33. Raiten DJ, Bremer AA. Exploring the Nutritional Ecology of Stunting: New Approaches to an Old Problem. Nutrients. 2020 Jan 31;12(2):371. Available from: https://doi.org/10.3390/nu12020371.
34. de Onis M, Branca F. Childhood stunting: a global perspective. Matern Child Nutr. 2016 May 17;12(S1):12–26. Available from: https://doi.org/10.1111/mcn.12231.
35. Shekar M, Kakietek J, D'Alimonte MR, Rogers HE, Eberwein JD, Akuoku JK, et al. Reaching the global target to reduce stunting: an investment framework. Health Policy Plan. 2017 Jun;32(5):657–68. Available from: https://doi.org/10.1093/heapol/czw184.
36. United Nations. The Sustainable Development Goals Report. 2021. Available from: https://unstats.un.org/sdgs/report/2024/.
37. Health Ministry Republic of Indonesia. Indonesian Basic Health Survey 2013. 2013.
38. Health Ministry Republic of Indonesia. Indonesian Basic Health Survey 2018. 2018;
39. Health Ministry Republic of Indonesia. Survey of Nutritional Status 2022. 2022. 1-154 p. Available from : https://drive.google.com/file/d/1tZuQNyUaKe0i_kyj1nbYx7aNo7KWjNZ8/view.
40. Bisits Bullen PA. The positive deviance/hearth approach to reducing child malnutrition: systematic review. Tropical Medicine & International Health. 2011 Nov 12;16(11):1354–66. Available from: https://doi.org/10.1111/j.1365-3156.2011.02839.x.
41. Rose AJ, McCullough MB. A Practical Guide to Using the Positive Deviance Method in Health Services Research. Health Serv Res. 2017 Jun 28;52(3):1207–22. Available from: https://doi.org/10.1111/1475-6773.12524.