

Chronic Energy Deficiency, High Parity, and Child Stunting: An Urban–Rural Analysis Using Indonesia's 2024 Nutritional Status Survey

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Received: May 3, 2025; Accepted: September 29, 2026; Available online: October 16, 2026

ABSTRACT

Background: Stunting remains a major public health problem in Indonesia, affecting nearly one-fifth of children under five, with maternal chronic energy deficiency (CED) and high parity considered important contributing factors at the maternal–child interface. This study examined the association between maternal CED, parity, diarrheal morbidity, and residence with stunting among children under five, using nationally representative data from the 2024 Indonesian Nutritional Status Survey.

Subjects and Methods: This cross-sectional study used data on children aged 0–59 months selected through two-stage stratified sampling. After excluding children with incomplete data on all study variables, the final analytic sample comprised 261,819 children. The dependent variable was stunting status (stunted versus not stunted) among children aged 0–59 months, defined as height-for-age z-score (HAZ < -2 SD). Independent variables were child diarrheal history, maternal parity, CED, maternal BMI, and place of residence. Multivariate logistic regression was performed to obtain adjusted odds ratios (aOR) with 95% confidence intervals (CI).

Results: Grand multiparity (aOR = 2.11; 95% CI= 1.97 to 2.26; p < 0.001), rural residence (aOR = 1.30; 95% CI= 1.26 to 1.35; p < 0.001), maternal CED (aOR = 1.49; 95% CI= 1.40 to 1.60; p < 0.001), and maternal underweight (aOR = 1.26; 95% CI= 1.17 to 1.35; p < 0.001) were associated with higher odds of stunting. Diarrhea lasting more than two weeks increased risk of stunting (aOR = 1.28; 95% CI= 1.04 to 1.57; p = 0.019).

Conclusion: Maternal parity, chronic energy deficiency, BMI, diarrheal history, and rural residence were associated with childhood stunting. Practical strategies such as family planning counseling for high-parity mothers, supplementary feeding programs for underweight women, and community-based sanitation initiatives in rural areas may help reduce this burden.

Keywords: stunting, chronic energy deficiency, parity, diarrhea, rural

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Cite this as:

Niswah UK, Syevira KN, Anggraini S, Siddiq MNAA (2026). Chronic Energy Deficiency, High Parity, and Child Stunting: An Urban–Rural Analysis Using Indonesia's 2024 Nutritional Status Survey. *J Epidemiol Public Health*. 11(4): 486-497. <https://doi.org/10.26911/jepublichealth.2026.11.04.08>.



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BACKGROUND

Stunting, defined as a height-for-age z-score (HAZ) below -2 standard deviations relative to the WHO Child Growth Standards, remains a major global health problem. In 2022, an estimated 148.1 million children under five worldwide were affected, equivalent to 22.3% of the global under-five population, with approximately 52,542,800 living in Asia ([UNICEF-WHO-The World Bank, 2025](#)). This is a circumstance that has an strong connection with irreversible life-long consequences, including cognitive neurocognitive impairments, impaired academic achievement, and economic productivity ([Soliman et al., 2021](#); [Victora et al., 2021](#)).

In Indonesia, national strategies to reduce stunting have shown some progress. Ministry of Health data show that stunting prevalence declined to 19.8% in 2024, down from 21.5% in 2023 ([Ministry of Health of the Republic of Indonesia, 2025a](#)). Although such a trend shows a commendable improvement, the number remains close to the 20% mark of World Health Organization on the issue of public health importance ([Picauly et al., 2024](#)). This means that cross-sectoral dedication will be invaluable to achieve National Medium-Term Development Plan (RPJMN) projections of reducing prevalence of stunting to 14.2% by the year 2029 ([Ministry of Health of the Republic of Indonesia, 2025b](#)).

The pathogenesis of stunting is fundamentally multifactorial determined by a wide range of factors functioning at the individual, family, and community levels ([Beal et al., 2018](#); [Danaei et al., 2016](#)). The rural-urban residence dichotomy is one of the most prominent contextual variables. Statistical information released by Indonesian Nutrition Status Survey 2024 show a clear disparity if children living in rural areas have a stunting prevalence rate of 22.7%

compared with 17.8% in urban areas ([Ministry of Health of the Republic of Indonesia, 2025a](#); [Picauly et al., 2024](#)). This disparity is even more pronounced across provinces with Papua Pegunungan recording a prevalence as high as 40.0% and East Nusa Tenggara (NTT) at 37.0%, compared with only 8.7% in Bali. These figures highlight the need for context-specific policies to address the burden faced by rural and remote areas, where nutritional vulnerability is compounded by limited infrastructure and geographic isolation ([Headey et al., 2017](#); [Tasnim, 2018](#)).

Maternal nutritional status and reproductive history are key component in the intergenerational cycle of malnutrition. Chronic energy deficiency (CED), measured using mid-upper arm circumference (MUAC) below 23.5 cm, and low maternal body mass index (BMI) have been shown to predict poor birth outcomes, including low birth weight (LBW), which affects an estimated 6.1% of neonates in Indonesia ([Health Development Policy Agency, 2023](#)). Maternal parity also influences the distribution of resources between successive episodes of gestation, families with a higher parity often face the issue of exhausted maternal physiological reserves and weakened per-capita provisioning of nutritious food ([Howell et al., 2016](#); [Molitoris et al., 2019](#)). Children of mothers with limited education, which is often associated with high parity and low nutritional awareness, also tend to have higher stunting rates. The highest proportion of stunted children (36.9%) was found among mothers with no or only primary education, who had a 40% higher likelihood of having a stunted child compared with mothers with tertiary education ([Titaley et al., 2019](#)).

In addition to maternal factors, there is a direct effect by infectious pathologies to the proximate etiology of linear growth

faltering. The role of diarrheal disease in this process is inextricably attributed to malabsorption of nutrients, interference of epithelial cells, and inflammation inside the body that conditions a state of environmental enteric malfunction ([Budge et al., 2019](#); [Owino et al., 2016](#)). The 2024 national surveillance indicates that 4.1% of Indonesian toddlers had diarrheal episodes in the preceding month, which is a common instance of morbidity that is often triggered by the inadequate sanitation infrastructure ([Ministry of Health of the Republic of Indonesia, 2025a](#)). Poor sanitation has been shown to increase stunting risk in Indonesia; children in households with poor hygiene had 1.55 times higher odds of concurrent stunting and anemia ([Meiyetrian & Utomo, 2025](#)), while the absence of basic hygiene facilities increased stunting odds by 1.37-fold, particularly in eastern provinces ([Saputra et al., 2025](#)). These findings support the link between environmental enteric dysfunction and impaired linear growth.

Although these determinants (maternal nutritional status, parity, diarrheal morbidity, and residence) have each been examined in previous Indonesian studies, most analyses have assessed them separately or within smaller, subnational samples, limiting their ability to disentangle independent effects from confounding at a nationally representative scale. Existing literature has also tended to report these associations descriptively rather than critically evaluating how maternal reproductive history interacts with morbidity and geographic context to shape stunting risk. Studies that jointly model maternal CED, parity, diarrheal history, BMI, and residence using nationally representative, complex survey data remain scarce in the Indonesian context, which constrains the ability of policymakers to prioritize interventions

across these overlapping risk pathways. To address this gap, the present study examined the independent associations between residence, maternal parity, CED, maternal BMI, and child diarrheal history with stunting among children under five in Indonesia, using nationally representative data from the 2024 Indonesian Nutritional Status Survey (SSGI).

SUBJECTS AND METHOD

1. Study Design

This study used an observational cross-sectional design, drawing on secondary data from the 2024 Indonesian Nutritional Status Survey (SSGI). The SSGI 2024 is a nationally implemented survey conducted by the Ministry of Health to assess the nutritional status of children at the district, provincial, and national levels across Indonesia ([Health Development Policy Agency, 2025](#)).

2. Population and Sample

The target population encompassed all households carrying children aged 0–59 months within the 38 provinces of Indonesia, with the source population specifically comprising those enumerated in the SSGI 2024 database. Participants were selected through a two-stage stratified sampling protocol. In the initial phase, 34,500 census blocks were selected from 514 districts utilizing the probability proportional to size (PPS) method with replacement. Subsequently, 10 households caring for toddlers were identified from each selected block following a comprehensive listing update conducted via the “FASIH” application. Although the total national sample included 345,000 households, this analysis was restricted to children aged 0–59 months with complete data on all study variables, resulting in a final analytic sample of 261,819 children.

3. Study Variables

The dependent variable was stunted versus not stunted status among children under five. The independent variables were residence (urban versus rural), maternal parity (number of births), maternal chronic energy deficiency (CED), child diarrheal history, and maternal body mass index (BMI) category.

4. Operational Definition of Variables

Stunting was ascertained through height-for-age z-scores (HAZ), adhering to the anthropometric standards published by the World Health Organization, with a cut-off of $HAZ < -2$ SD ([UNICEF-WHO-The World Bank, 2025](#)).

Residence was classified as urban or rural according to the administrative classification used by Statistics Indonesia (*Badan Pusat Statistik/BPS*), based on population density, the proportion of agricultural households, and access to urban facilities.

Maternal parity was defined as the number of births a mother had experienced (not the number of pregnancies/gravidity), and was categorized as primipara (1 birth), multipara (2–4 births), and grand multipara (≥ 5 births).

Maternal chronic energy deficiency (CED) was defined as a mid-upper arm circumference (MUAC) below 23.5 cm, consistent with the standard cut-off used in Indonesian nutritional surveillance.

Child diarrheal history was defined by the occurrence and duration of diarrheal episodes experienced by the child in the month preceding data collection, categorized as no diarrhea, diarrhea lasting ≤ 2 weeks, and diarrhea lasting > 2 weeks.

Maternal body mass index was categorized into underweight (< 18.5 kg/m²), normal (18.5–24.9 kg/m²), and overweight/obesity (≥ 25.0 kg/m²).

5. Study Instruments

Data were obtained through an official request to the Health Policy Agency (*Badan Kebijakan Pembangunan Kesehatan*) of the Indonesian Ministry of Health. Anthropometric data collection in SSGI 2024 used standardized measurement instruments, and household interviews were conducted using the “FASIH” digital application.

6. Data Analysis

Bivariate logistic regression was first performed to obtain crude odds ratios (cOR), followed by multivariate logistic regression was used to assess the association between the study determinants and stunting. This analysis produced adjusted odds ratios (aOR) with 95% confidence intervals (CI) to estimate independent associations. The analysis accounted for the complex survey design, including stratification, clustering, and sampling weights, to ensure nationally representative estimates.

7. Research Ethics

Because this study used a de-identified secondary dataset, ethical requirements were met through rigorous adherence to non-disclosure agreements and the institutional data privacy mandates of the Indonesian Ministry of Health. These safeguards ensured that participant anonymity was preserved throughout the research project consistent with national ethical standards for health research.

RESULTS

1. Sample Characteristics

The characteristics of the study sample are presented in Table 1. In terms of residence, the sample was almost evenly distributed, with slightly more than half of the children living in urban areas (157,665; 52.53%) and the remainder in rural areas (142,477; 47.47%). Most children were born to multiparous mothers (194,651; 64.95%), followed by primiparous mothers (87,100; 29.06%),

while grand multiparous mothers accounted for the smallest proportion (17,924; 5.98%). The majority of mothers did not have chronic energy deficiency (273,938; 94.33%), and only 5.67% (16,476) were classified as having CED. Similarly, most children had no history of diarrhea (288,997; 96.66%), whereas 2.82% (8,420) had experienced

diarrhea lasting two weeks or less and 0.53% (1,577) for more than two weeks. With regard to maternal body mass index, close to half of the mothers were overweight or obese (132,991; 49.77%), 44.68% (119,369) had a normal BMI, and 5.55% (14,830) were underweight.

Table 1. Characteristics of categorical sample data

Characteristics	Category	Frequency (n)	Percentage(%)
Residence	Urban	157,665	52.53
	Rural	142,477	47.47
Maternal Parity	Primipara (1)	87,100	29.06
	Multipara (2–4)	194,651	64.95
	Grand Multipara (≥5)	17,924	5.98
Chronic Energy Deficiency	No	273,938	94.33
	Yes	16,476	5.67
Child Diarrheal History	No	288,997	96.66
	Yes, ≤2 weeks	8,420	2.82
	Yes, >2 weeks	1,577	0.53
Maternal Body Mass Index	Overweight/Obesity	132,991	49.77
	Normal	119,369	44.68
	Underweight	14,830	5.55

2. Bivariate Analysis

Bivariate logistic regression showed that grand multipara status (≥5) was the strongest risk factor, with a twofold increase in the odds of stunting compared with the reference group (COR = 2.04; 95% CI, 1.92 to 2.18; $p < 0.001$). Chronic energy deficiency (COR = 1.60; 95% CI, 1.51 to 1.71; $p < 0.001$) and underweight BMI (COR = 1.33; 95% CI, 1.25 to 1.43; $p < 0.001$) were also significant risk factors. In contrast, children of overweight or obese mothers had lower odds of stunting than those of mothers with

normal BMI (COR = 0.85; 95% CI, 0.82 to 0.88; $p < 0.001$). Rural residence increased the crude odds of stunting by 36% (COR = 1.36; 95% CI, 1.32 to 1.40; $p < 0.001$). Diarrhea lasting two weeks or less increased the odds of stunting (COR = 1.23; 95% CI, 1.13 to 1.35; $p < 0.001$), as did diarrhea lasting more than two weeks (COR = 1.21; 95% CI, 1.01 to 1.46; $p = 0.042$). These unadjusted associations were further examined using multivariate analysis to account for potential confounding.

Table 2. Results of bivariate logistic regression analysis

Independent Variables	cOR	95% CI		P
		Lower Limit	Upper Limit	
Residence				
Urban	Ref.			
Rural	1.36	1.32	1.40	<0.001
Maternal Parity				
Primipara (1)	Ref.			
Multipara (2–4)	1.36	1.32	1.42	<0.001

Independent Variables	cOR	95% CI		p
		Lower Limit	Upper Limit	
Grand Multipara (≥ 5)	2.04	1.92	2.18	<0.001
Chronic Energy Deficiency				
No	Ref.			
Yes	1.60	1.51	1.71	<0.001
Child Diarrheal History				
No	Ref.			
Yes, ≤ 2 weeks	1.23	1.13	1.35	<0.001
Yes, > 2 weeks	1.21	1.01	1.46	0.042
Maternal Body Mass Index				
Overweight/Obesity	0.85	0.82	0.88	<0.001
Normal	Ref.			
Underweight	1.33	1.25	1.43	<0.001

3. Multivariate Analysis

After adjustment for confounding variables in the multivariate model, all determinants remained statistically significant ($p < 0.05$). Grand multipara status remained the strongest predictor, with a 2.11-fold increase in the odds of stunting compared with primiparous mothers (aOR = 2.11; 95% CI, 1.97 to 2.26; $p < 0.001$). Multiparity was also associated with increased risk (aOR = 1.45; 95% CI, 1.40 to 1.51; $p < 0.001$). Chronic energy deficiency (aOR = 1.49; 95% CI, 1.40 to 1.60; $p < 0.001$) and maternal overweight

or obesity remained associated with lower odds of stunting (aOR = 0.86; 95% CI, 0.84 to 0.90; $p < 0.001$). Diarrhea lasting more than two weeks showed a slightly stronger association after adjustment (aOR = 1.28; 95% CI, 1.04 to 1.57; $p = 0.019$), highlighting the impact of prolonged illness. Rural residence remained independently associated with stunting (aOR = 1.30; 95% CI, 1.26 to 1.35; $p < 0.001$). Overweight/Obesity BMI remained protective, associated with a 14% reduction in risk (aOR = 0.86; 95% CI, 0.84 to 0.90; $p < 0.001$).

Table 3. Results of multivariate logistic regression analysis

Independent Variables	aOR	95% CI		p
		Lower Limit	Upper Limit	
Residence				
Urban	Ref.			
Rural	1.30	1.26	1.35	<0.001
Maternal Parity				
Primipara (1)	Ref.			
Multipara (2–4)	1.45	1.40	1.51	<0.001
Grand Multipara (≥ 5)	2.11	1.97	2.26	<0.001
Chronic Energy Deficiency				
No	Ref.			
Yes	1.49	1.40	1.60	<0.001
Child Diarrheal History				
No	Ref.			
Yes, ≤ 2 weeks	1.24	1.14	1.36	<0.001
Yes, > 2 weeks	1.28	1.04	1.57	0.019
Maternal Body Mass Index				
Overweight/Obesity	0.86	0.84	0.90	<0.001
Normal	Ref.			
Underweight	1.26	1.17	1.35	<0.001

DISCUSSION

This study examined determinants of childhood stunting using nationally representative data from the 2024 Indonesian Nutritional Status Survey. The results show that residence, maternal parity, chronic energy deficiency, diarrheal morbidity, and maternal BMI were independently and statistically significantly associated with stunting among children under five. Grand multiparity was the strongest determinant in the multivariate model, with important implications for reproductive health policy and family planning services.

Maternal parity was among the strongest predictors in this study, demonstrating that mothers in the grand multipara category had 2.11 times higher odds of having stunted children. This finding aligns with the results of [Taufiqoh et al. \(2017\)](#), who found that children of multiparous mothers had more than three times higher odds of stunting compared with children of primiparous mothers. This association is likely driven by cumulative maternal nutritional depletion. With each successive pregnancy, maternal stores of essential micronutrients (e.g., iron, zinc, and folate) become progressively exhausted, thereby impairing placental nutrient transfer and negatively affecting postnatal growth ([Da Silva et al., 2025](#); [Gernand et al., 2016](#)).

Interestingly, the increased vulnerability to stunting in children aged 12-36 months is associated with higher parity. In contrast, [Sari and Sartika \(2021\)](#) found that the risk of stunting at birth was higher among firstborn neonates. This difference suggests that the negative effects of high parity on linear growth become more apparent over time, as cumulative maternal depletion and household resource dilution exert stronger influences beyond the neonatal period.

This study found that rural residence independently increased the risk of stunting by 1.30-fold, consistent with the multilevel study by [Mulyaningsih et al. \(2021\)](#) which identified rural residence as an important community-level factor associated with higher stunting prevalence among Indonesian children ([Widyaningsih et al., 2022](#)). Health and nutrition services are often limited and less accessible in rural settings. Besides, low-quality sanitary systems and limited access to clean water are more widespread in rural settlements ([Kwami et al., 2019](#); [Sentika et al., 2024](#)). The conditions of the environment predispose the threat of enteric infections, especially diarrheal diseases, which have adverse effects on child development and lead to stunting due to a combination of mechanisms of nutrient malabsorption and chronic inflammation of the intestines ([Torlesse et al., 2016](#)). These conditions are disproportionately common in underserved regions, since geospatial analysis of 514 districts in Indonesia found that districts in the Papua region, including Maluku and Nusa Tenggara, were found to have higher stunting prevalence than Java and Bali, and that the poorest districts had 74% higher prevalence of severe stunting than the richest ones, justifying that geographical location in eastern Indonesia and socioeconomic disparities constitute significant determinants of childhood stunting ([Ayuningtyas et al., 2022](#)).

In this study, stunting was statistically significantly related to diarrheal morbidity. Children with diarrheal episodes of two weeks and less had 1.24 times increased odds of stunting, and children with prolonged diarrheal episodes greater than two weeks had 1.28-fold increased risk compared to children who had no history of diarrheal episodes. This finding implies that acute and chronic cases of diarrhea lead to impaired

linear growth. Mechanistically, diarrheal disease compromises the integrity of intestinal epithelia, reducing the ability to absorb nutrients and increasing the depletion of important micronutrients needed to elongate the skeleton ([Budge et al., 2019](#)). Diarrhea is also commonly associated with reduced appetite, which further limits nutrient intake and, over time, impairs linear growth ([Choiroh et al., 2020](#)). These findings align with [Samsuddin et al. \(2021\)](#) who reported that a history of diarrhea increased the risk of stunting in toddlers by 1.60-fold. This is also consistent with the broader analysis by [Victora et al. \(2021\)](#), which identified diarrhea as an independent predictor of growth faltering in various low-income settings. The biological plausibility of such association is also supported by the idea of environmental enteric dysfunction, which is a subclinical manifestation of chronic inflammation of the intestine that is frequently observed in the environment with inadequate water, sanitation, and hygiene (WASH) infrastructure ([Harper et al., 2018](#); [Owino et al., 2016](#)).

In this study, 5.67 percent of the mothers who had chronic energy deficiency. Multivariate analysis revealed that maternal CED increased the odds of stunting by 1.49 times relative to mothers of sufficient nutritional status. This finding highlights the importance of maternal nutritional status in determining child growth outcomes. The presence of nutritional adequacy in mothers before and during gestation is essential for optimal fetal growth and the placental one, insufficient energy stores might negatively affect intrauterine growth and increase the likelihood of low birth weight and subsequent linear growth retardation ([Danaei et al., 2016](#); [Victora et al., 2021](#)). Children born to mothers with poor nutritional status may also begin life with limited growth potential, making them more vulnerable to stunting

during the first 1,000 days ([Simbolon et al., 2019](#)). These results support previous studies that has reported a strong association between maternal history of CED and the occurrence of stunting in toddlers ([Yuliastanti et al., 2023](#)).

Children of underweight mothers (BMI < 18.5 kg/m²) had 1.26 times higher odds of stunting than those of mothers with normal BMI, suggesting that maternal undernutrition is an important target for stunting prevention. These findings highlight that maternal nutritional status is an essential factor determinant of childhood stunting. Poor prenatal and intrapartum maternal nutrition is causally linked to fetal growth restriction and low birth weight, both of which are strong predictors of childhood linear growth faltering. Furthermore, growing evidence suggests that maternal nutritional deficits perpetuate an intergenerational cycle of undernutrition and stunting. Poor maternal nutrition status or lack of gain during gestation increases the risk of giving birth to low weight babies and putting the children at risk of stunting. A North Indian, pregnancy cohort study established that a gestational weight gain below the Institute of Medicine recommendations resulted in a higher likelihood of low birth weight and an increased likelihood of stunting at birth with each 100-gram per week increment in gestational weight gain and that suboptimal gestational weight gain was a good predictor of anthropometric deficiencies at birth, and subsequent, linear, growth retardation. Mother underweight is a substantive predictor of childhood stunting where the preconception nutrition markers such as weight and BMI have a significant impact on the linear growth of the offspring during the first thousand days and often the stunting process begins in the womb. It was established that birth length deprivation is the most effective predictors of stunting in

24 months, which agrees with the idea that postnatal growth gains are substantially dependent on the growth of the intrauterus. This data highlights the importance of long-term prenatal nutritional fortification when the intervention began at least 3 months before conception when maternal supplementation lowered the risk of neonatal stunting by 44% relative to standard care ([Chowdhury et al., 2022](#)).

This study has several methodological limitations. Cross-sectional design does not make it possible to infer causal relationships, only possible to establish statistical relationships. The dependence on secondary data limits the range of variables that can be examined, and confounding by unmeasured factors, including household dietary variety, adherence to micronutrient supplements or maternal mental health condition cannot be completely avoided. Diarrheal history was based on maternal recall over the preceding month, which may be subject to recall bias and could result in non-differential misclassification of exposure status, potentially attenuating the observed associations. Similarly, chronic energy deficiency and BMI were measured at a single time point, which does not capture changes in maternal nutritional status across pregnancies and may introduce further misclassification bias. Moreover, longitudinal follow-up data is not available, which rules out the possibility of conducting assessment on a temporal trend in the relationship between maternal exposures and child growth outcomes. Despite these shortcomings, there is a considerable external validity and statistical power to the current findings due to the fact that the use of a large-scale, nationally representative dataset with 38 provinces and solid two-stage stratified sampling methodology and complicated survey analytical procedures. Overall, this study supports independent associations between grand multiparity,

chronic energy deficiency, maternal underweight, diarrheal morbidity, and rural residence with the risk of childhood stunting in Indonesia, with grand multiparity showing the strongest association. The practical implications of these findings to village midwives and integrated health post cadre are that family planning counseling for high-parity mothers should promote long-acting contraceptive methods, supported by regular integrated health post visits, and supplementary feeding programs for underweight women of reproductive age should begin during the preconception period. Rural areas would benefit by setting up mobile anthropometric monitoring, and expending community-based total sanitation initiatives including household latrines, household water treatment, and handwashing would target the connection of diarrhea-stunting, in rural areas, at its source.

FINANCIAL SUPPORT AND SPONSORSHIP

None.

ACKNOWLEDGEMENT

The authors extend their gratitude to the Health Policy Agency of the Indonesian Ministry of Health for granting access to the 2024 SSGI dataset.

CONFLICT OF INTEREST

The authors declare that this investigation was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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