https://doi.org/10.36570/jduhs.2024.2.2055

JDUHS

ORIGINAL ARTICLE

Prevalence and Determinants of Stunting among Female Adolescents in Priority Areas of Bali: A Cross-Sectional Study in the Year 2022

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ABSTRACT

Objective: This study aims to determine the prevalence and factors associated with the occurrence of stunting in female adolescents in the Bangli Regency, Bali Province, Indonesia.

Methods: This cross-sectional study was conducted from May to July 2022 in senior and vocational high schools in Bangli Regency, Bali Province, Indonesia. Adolescent girls aged 15-18 years not experiencing any illness at the time of enrolment were included. Stunting was defined using the WHO's 2007 standards (Height-for-Age z-score <-2SD). Dietary habits were evaluated using the Dietary Diversity Score (DDS), with a score of less than 5 indicating low dietary diversity. Chronic Energy Deficiency (CED) was determined by mid upper arm circumference, with a threshold of <23 cm indicating CED. Sociodemographic factors, dietary habits, and knowledge and attitudes regarding stunting were also assessed.

Results: Of total 560 females, the mean age was 16.32 ±0.854 years. Stunting was observed in 66 (11.8%) adolescents. The risk of stunting was approximately 2.55 times significantly higher among adolescents with negative attitude towards stunting prevention (cOR 2.55, 95% CI 1.48 to 4.38, p-value <0.001), 2 times significantly higher among adolescents with low DDS (cOR 1.87, 95% CI 1.10 to 3.22, p-value 0.021) and experienced CED (cOR 1.76, 95% CI 1.01 to 3.04, p-value 0.042).

Conclusion: This study identified a stunting prevalence of 11.8% among female adolescents in the Bangli Regency, Bali Province, Indonesia. The findings indicate that a negative attitude towards stunting prevention, poor diet, and continuous energy imbalance are significant risk factors associated with stunting.

Keywords: Adolescents, Height for Age, Nutrition, Stunting.

INTRODUCTION

During adolescence, a period marked by significant growth, individuals undergo substantial physical, psychological, cognitive, and hormonal changes. They achieve 15% of their final height, a 45% increase in bone mass, and a 50% rise in weight, alongside shifts in body shape and composition.[1,2] Nutritional deficiencies at this stage, especially in female adolescents, can lead to severe consequences, such as increased risks of low birth weight in newborns and higher mortality rates related to pregnancy and childbirth.[3] A 2021 United Nations Children's Fund (UNICEF's) report highlighted a concerning lack of dietary diversity among adolescents, with only a quarter consuming adequate amounts of vegetables, animal proteins, and iron, pointing to a vital need for nutritional interventions.[4]

Technological advances, high screen time, sedentary lifestyles, and poor diets adversely affect adolescent nutrition.[5] The 2018 Basic Health Research found that over 25% of teenagers exhibit stunting due to chronic malnutrition.[6] Bangli Regency in Bali, with the highest stunting rate at 43.2%, is a priority area for stunting reduction efforts.[7] Poverty, closely linked to stunting,[8] is prevalent in Bangli, where the poverty rate rose from 9.56% in 2020 to 12.17% in 2022,[9] highlighting the urgent need for targeted interventions.

Stunting often stems from a lack of animal protein and iron in diets, particularly in impoverished areas where nutritional needs are unmet.[10] Despite Bangli Regency contributing 13% to the province's aquaculture, its residents consume very little fish.[11] A diversified diet significantly reduces the risk of stunting. In addition to dietary diversification, the inclusion of animal-based

foods acts as a protective factor against both stunting and underweight conditions. Ensuring the availability of locally sourced nutritious foods can further help in preventing stunting among adolescents.[12,13] This indicates a gap in utilizing local food resources effectively. Given the critical impact of nutrition on adolescent females and children in stunting-prone areas, targeting these groups for nutritional interventions is vital. This paper aims to address the gap in understanding the prevalence and factors influencing stunting in female adolescents by focusing on these determinants and prevalence rates.

METHODS

This cross-sectional study was conducted in senior high schools and vocational high schools in Bangli Regency, Bali Province, Indonesia, from May to July 2022. Ethical clearance was obtained from the Ethics Committee of the Faculty of Medicine, Udayana University (Ethical Clearance Number: 1448/UN14.2.2.VII.14/LT/2022). Prior to data collection, respondents were informed about the research objectives, benefits, risks, and procedures. Written informed consent was obtained from respondents and their guardians, confirming their agreement to participate in the research.

The study included adolescent girls aged 15-18 years who were enrolled in senior high schools and vocational high schools in Bangli Regency, were not experiencing any illness at the time of enrollment in the study and completed the survey questions. Incomplete responses were excluded from the analysis. Bangli Regency consists of four districts: Bangli, Tembuku, Kintamani, and Susut. Two schools from each district were randomly selected. Within the selected schools, participants were recruited using a consecutive sampling technique.

The primary outcome was the prevalence of stunting among the respondents, defined as a Height-for-Age z-score (HAZ) of less than-2 Standard Deviations (SD) according to the WHO's 2007 anthropometric standards.[14] Respondents with a z-score above-2 SD were categorized as normal. Stunting measurements were assessed using variables such as age, height, and Mid-Upper Arm Circumference (MUAC), with chronic energy deficiency (CED) status determined by MUAC (<23 cm indicating CED, ≥23 cm indicating not CED).

Sociodemographic factors examined included parental education and occupation, monthly family income (with the minimum wage in Bangli Regency being IDR 2,516,971), and family size (categorized as large if ≥4 members and small if <4 members). Additionally, the characteristics of respondents included access to information about stunting, their knowledge, and attitudes regarding stunting prevention, covering aspects such as definition, causes, signs and symptoms, impacts, and prevention strategies. Knowledge and attitude data were collected using structured questionnaires. The questionnaires were self-administered; however, trained enumerators were available if participants required assistance.

Dietary habits were evaluated using the Dietary Diversity Score (DDS), defined as the number of food groups consumed over 24 hours. According to the Food and Agriculture Organization (FAO) guidelines, the foods were aggregated into 10 groups. A DDS of less than 5 was categorized as Low Dietary Diversity (LDD).[15,16] Data were collected using a structured interview questionnaire directly administered to the respon-dents. The data were collected by students specializing in the community nutrition division from the Depart-ment of Public Health and Preventive Medicine, Faculty of Medicine, Universitas Udayana, Bali, who had been trained by the research team. Height measurements were taken using a GEA brand microtoise with an accuracy of 0.1 cm. MUAC was measured using a measuring tape with an accuracy of 0.1 cm, and dietary diversity data were collected using the FAO Minimum Dietary Diversity for Women (MDD-W) (2021) questionnaire and a 24-hour recall form.

The principal investigator ensured the accuracy and completeness of the collected data. Any errors or discrepancies in the data collection were promptly addressed within 24 hours. Interviews were conducted in schools. Before the main data collection, validity and reliability tests were conducted on 30 respondents with similar characteristics to the research sample. Instruments demonstrated Cronbach's alpha value greater than 0.79, indicating high reliability. The results of the validity and reliability tests confirmed that the questionnaire was valid and reliable. Data entry and analysis were performed using the Statistical Package for Social Sciences (SPSS) version 20.0. Quantitative variables such as age and HAZ score were expressed as Mean ±SD, while categorical variables such as parental education levels, employment status, income, household size, stunting information, knowledge, attitudes, DDS, CED, and food group consumption were expressed as frequencies and percentages. Associat-ions between stunting and the general characteristics of adolescents were examined using the Chi-square test, with a p-value of ≤0.05 considered statistically significant. Binary logistic regression was also applied to identify potential determinants of stunting.

RESULTS

Of total 560 female adolescents, the mean age was 16.32 ±0.854 years. Most of the adolescents' father and mother had education levels below high school i.e., 335 (59.8%) and 389 (69.5%) respectively. Their fathers were employed 548 (97.8%) but earned less than the regional minimum wage in Bengal 464 (82.8%), and they came from small households 437 (78.0%). A number of adolescents did not obtain information about stunting 352 (62.8%) but their knowledge of stunting was fair 541 (96.6%), and had positive attitude towards stunting prevention i.e., 299 (53.4%) respectively. Low DDS was observed in 289 (51.6%) adolescents while CED was observed in 422 (75.3%) adolescents.

The dietary habits of adolescents revealed that nearly all of them consumed grains, white roots, tubers, and plantains, i.e., 559 (99.8%). However, other commonly consumed food groups included meat, poultry, and fish 492 (87.9%), pulses 331 (59.1%), and dark green leafy vegetables 301 (53.8%) (Table 1).

Stunting was observed in 66 (11.8%) adolescents with a mean HAZ score of -1.08 ±0.814. A significant association of stunting was found with knowledge of stunting prevention (p-value 0.046), attitude towards stunting prevention (p-value <0.001), DDS (p-value 0.019), and CED (p-value 0.041) (Table 2).

Table 3 reveals binary logistic regression analysis for predicting stunting among female adolescents. At the univariate level, the risk of stunting was approximately 2.55 times significantly higher among adolescents had negative attitude towards stunting prevention as compared to adolescents' had positive attitude towards stunting prevention (cOR 2.55, 95% CI 1.48 to 4.38, p-value <0.001). The chances of stunting were approximately 2 times significantly higher among adolescents had low DDS (cOR 1.88, 95% CI 1.10 to 3.22, p-value 0.021) and experienced CED (cOR 1.76, 95% CI 1.01 to 3.04, p-value 0.042) respectively. The findings of the multivariable analysis were also presented after adjusting the variables found significant in the univariable analysis. At this stage, attitude towards stunting prevention, DDS and CED showed significant odds ratios.

DISCUSSION

The prevalence of stunting among female adolescents in Bangli Regency highlighted the importance of future implications in public health. This study found that the negative attitudes of adolescents towards stunting prevention, low DDS, and CED status based on MUAC measurement were determinant factors associated with stunting in female adolescents. Moreover, the study found no significant association between the education and occupation of the father with the occurrence of stunting in female adolescents. Other studies found similar results, suggesting that parental characteristics, such as education and occupation, did not influence the occurrence of stunting in adolescents.[17] This occurs because almost all fathers of the research subjects were employed, although many of them had lower education levels than a high school level. The father's occupation is related to the family's economic status in meeting the nutritional needs of children.[18] Moreover, the father's occupation is associated with family income; the lack of income can disable individuals from obtaining or purchasing quality food according to their needs.[19] Furthermore, the role of the mother is usually more dominant than the father's in paying attention to the growth and development of children, including meeting their

Table 1: Female Adolescents' consumption of food groups and diversity in diet (n=560)

Food Groups	n (%)
Grains, White Roots and Tubers, and Plantains	559 (99.8)
Pulses (Beans, Peas, and Lentils)	331 (59.1)
Nuts and Seeds	35 (6.3)
Dairy	64 (11.4)
Meat, Poultry, and Fish	492 (87.9)
Eggs	204 (36.4)
Dark Green Leafy Vegetables	301 (53.8)
Other Vitamin A-Rich Fruits and Vegetables	125 (22.3)
Other Fruits	238 (42.5)
Other Vegetables	161 (28.8)
Low Dietary Diversity score	289 (51.6)

Dietary diversity was scored using 10 food group categories and a cut-off of <5 was considered as low dietary diversity
All data presented as number (%)

Table 2: Association of stunting with the general characteristics of adolescents (n=560)

Variables	Total	Stunting		p-value
		Yes (n =66)	No (n= 494)	
Father's Education				
< High Schools	335	44 (13.1)	291 (86.9)	0.227^
≥ High Schools	225	22 (9.8)	203 (90.2)	
Mothers' Education				
< High School	389	49 (12.6)	340 (87.4)	0.370^
≥ High School	171	17 (9.9)	154 (90.1)	
Fathers' Employment Status				
Unemployed	12	3 (25.0)	9 (75.0)	0.158~
Employed	548	63 (11.5)	485 (88.5)	
Income				
< Bangli Regional Minimum Wage	464	57 (12.3)	407 (87.7)	0.421^
≥ Bangli Regional Minimum Wage	96	9 (9.4)	87 (90.6)	
Household Size				
Large	123	12 (9.8)	111 (90.2)	0.429^
Small	437	54 (12.4)	383 (87.6)	
Obtaining Information about Stunting				
No	352	43 (12.2)	309 (87.8)	0.681^
Yes	208	23 (11.1)	185 (88.9)	
Knowledge of Stunting Prevention				
Poor	19	5 (26.3)	14 (73.7)	0.046~*
Fair	541	61 (11.3)	480 (88.7)	
Attitude towards Stunting Prevention				
Negative	261	44 (16.9)	217 (83.1)	0.001^*
Positive	299	22 (7.4)	277 (92.6)	
Dietary Diversity Score				
<5	289	43 (14.9)	246 (85.1)	0.019^*
≥5	271	23 (8.5)	248 (91.5)	
Chronic Energy Deficiency				
Yes	138	23 (16.7)	115 (83.3)	0.041^*
No	422	43 (10.2)	379 (89.8)	

- Bangli Regional Minimum Wage: 2,516.971 Indonesian Rupiah (IDR), household size categorized as large if ≥4 members in the family and small if <4 members in the family

*p-value ≤ 0.05 (^Chi-Square test/~Fisher Exact test)

nutritional needs.[17] In adolescence, the determination of food consumption is not solely determined by parents, whether it is the mother or the father. Therefore, the parental role, such as fathers' education or occupation, did not impact the occurrence of stunting in female adolescents.

A person with low knowledge is more likely to engage in unhealthy dietary behaviors, especially in determining the types and frequency of food consumed.[20] This study found that several female adolescents still had inadequate knowledge regarding stunting prevention. These findings suggest that female adolescents still require information about stunting prevention. However, their knowledge did not significantly impact the occurrence of stunting. Similar results have been found in other studies, deploying that nutritional knowledge does not have a significant relationship with the nutritional status of adolescents.[21,22] This is because having good nutritional knowledge is not enough to change unhealthy habits that increase the risk of nutritional problems.[23] They may be aware of the importance of consuming a diverse range of foods or avoiding consuming food with high sugar and salt, but that knowledge may not necessarily be applied in their daily lives. This statement supported by high prevalence of stunting in female adolescents with go od knowledge.

Table 3: Binary logistic regression analysis for predicting stunting among female adolescents (n = 560)

Variables	Univariable analysis		Multivariable analysis	
	cOR (95% CI)	p-value	aOR (95% C.I)	p-value
Knowledge of Stunting Prevention				
Poor	2.81 (0.97 to 8.07)	0.055		
Fair	1			
Attitude towards Stunting Prevention				
Negative	2.55 (1.48 to 4.38)	<0.001*	2.71 (1.56 to 4.72)	0.001*
Positive	1		1	
Dietary Diversity Score				
<5	1.88 (1.10 to 3.22)	0.021*	1.87 (1.08 to 3.23)	0.024*
≥5	1		1	
Chronic Energy Deficiency				
Yes	1.76 (1.01 to 3.04)	0.042*	2.06 (1.13 to 3.54)	0.012*
No	1		1	

cOR: Crude odds ratio, aOR: Adjusted odds ratio, CI: confidence interval, *p-value ≤ 0.05

This study revealed that the attitude of female adolescents was associated with the occurrence of stunting. A negative attitude in adolescents regarding stunting increases the risk of having a short stature or experiencing stunting by two times. Another study conducted in 2021 also showed a relationship between attitude and nutritional status.[24] This study found that female adolescents' attitude refers to their responses or reactions to statements about stunting prevention. Attitude serves as a predisposing factor in performing or not performing certain behaviours. The attitude of female adolescents is associated with the emergence of positive or negative behaviours in stunting prevention. Adolescents with a positive attitude tend to have positive behaviors.[22] Attitudes can be influenced by factors originating from the individual, such as age, education, and personal experiences, as well as external factors, such as the influence of significant others, culture, and mass media.[26] This study found that many female adolescents had a negative attitude towards stunting prevention. Therefore, support and motivation from friends, family, and healthcare providers are needed to improve their attitudes to prevent stunting; this can be done by implementing balanced dietary practices to achieve optimal nutritional status.[27] Additionally, the promotion of nutritious and diverse food consumption has become increasingly important, considering the widespread availability of fast food in society today. The diversity of food consumption calculated using the DDS. The DDS is a measure of the variety of foods consumed, which reflects household access to food and the nutritional adequacy of individuals over a specific period of time.[28] The diversity or lack of food consumption is related to the availability and affordability of food for the community. Consuming a diverse range of foods contributes to meeting the body's nutritional needs, leading to improve nutritional status.[16] This study found that female adolescents had shallow dietary diversity. Almost all of them consumed grains and tubers as their primary food groups. However, they rarely consumed other animal protein sources, such as eggs, milk, and dairy products. The Indonesian Ministry of Health states that the high prevalence of stunting is attributed to various factors, including low consumption of essential nutrient sources, such as animal protein, plant protein, and iron-rich foods.[29] A study by Headey *et al*. found a strong association between stunting and low consumption of animal protein sources, such as meat, fish, eggs, milk, and dairy products. The study also stated that consuming multiple animal protein sources provided greater benefits to the body than consuming only one type.[30] Animal protein sources contain complete nutritional content, including essential amino acids, vitamins, and minerals that are crucial for growth, development, and immune system support.[31] Additionally, very few female adolescents consumed vegetables, fruits, legumes, and nuts. Green leafy vegetables contain iron, which is necessary for female adolescents to prevent anemia caused by blood loss during menstruation. Vegetables and fruits also contain vitamin C, which absorbs iron to produce blood hemoglobin.[32]

Therefore, low consumption of vegetables and fruits increases the risk of anemia, which also affects the nutritional status of female adolescents, including stunting. Iron -deficiency anemia is one of the risk factors for stunting in female adolescents.[33] This study discovered that the DDS variable had a significant

relationship with the occurrence of stunting in female adolescents. Female adolescents with LDD tended to have a two times higher risk of stunting compared to those who consumed a diverse range of foods. Similar results were found in other studies showing a relationship between dietary diversity and the nutritional status of adolescents in Labuhan Batu District.[34] Consuming a diverse range of foods is one of the efforts to prevent nutritional problems. Dietary diversity is necessary to meet the macro and micronutrient requirements. Furthermore, consuming a diverse range of foods is recommended because each food item contains different types and amounts of nutrients. Nutritional deficiencies can be avoided by consuming a variety of food since the nutritional content lacking in one food item can be compensated by other food items. This is because no single food item contains all the necessary nutrients for the body except for breast milk.[35]

This study demonstrates a significant association between CED in female adolescents and the occurrence of stunting. Female adolescents with CED had a two times higher risk of experiencing stunting than those without CED. This finding is consistent with a study, who revealed that respondents with a history of CED had a greater likelihood of experiencing stunting.[36]

This study provides an approach that can be included in the stunting reduction program at the priority locus of stunting intervention in Bali Province. The nutritional improvement program approach is not only for toddlers and pregnant women but also further upstream, especially for female adolescents who enter the pre-conception phase. Positive attitudes to prevent stunting must be continuously instilled in young women so that these become their habits and culture in daily life. This study highlights the need to provide special attention to reduce stunting in Bali Province by improving the education on risk factors for female adolescents.

This study did not include female adolescents who did not earn a high school level as the respondents. This is a limitation of this research because there may be other risk factors outside the research variables found in adolescents who did not attend school or dropped their schools. In Bali, there are several areas categorized as poor areas and having many young women who dropped their schools.

CONCLUSION

In conclusion, this study identified a stunting prevalence of 11.8% among female adolescents in the Bangli Regency, Bali Province, Indonesia. Stunting was significantly associated with their knowledge and attitudes towards stunting prevention, as well as their dietary diversity and CED. Negative attitudes towards stunting prevention were linked to a higher risk of stunting, as were LDD and CED. These results highlight the need for targeted interventions to enhance knowledge, improve attitudes, and ensure better dietary practices to effectively address and prevent stunting in this population.

ETHICAL APPROVAL: This study was approved by the Ethics Committee of the Faculty of Medicine, Udayana University (Registration number: 1448/UN14.2.2.VII. 14/LT/2022, dated: 27.05.2022).

AUTHORS' CONTRIBUTIONS: KTA, PPJ, NLPS: Conceptualization. KTA, PPJ, NPW, DHT: Methodology. KTA: Data curation. KTA, NLPS, NPW, DHT, NMESA: Writing-original draft preparation. KTA, PJJ, NLPS, NPW, DHT, NMESA: Writing-review and editing. All authors reviewed the results and approved the final version of the manuscript.

CONFLICT OF INTEREST: The authors declare no conflict of interest.

FUNDING: The fund resources of this study were from the Institute for Research and Community Services Udayana University based on an Assignment Agreement Letter for the Implementation of Research on PNBP Funds in 2022 No: B/78.190/UN14.4.A/PT. 01.03/2022.

Received: 19 April, 2024
Accepted: 30 July, 2024

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