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Research Article

Association between Nutritional Status and Severity of Dengue Infection among Pediatric Patients

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ABSTRACT

Dengue infection remains a major public health concern in tropical regions, including Indonesia, with pediatric patients exhibiting varying degrees of clinical severity. Nutritional status has been suggested as a host-related factor influencing immune response and disease progression. This study aimed to examine the association between nutritional status and dengue severity among pediatric patients treated at Mangusada Regional Hospital in 2024 using the WHO 2009 classification system. A cross-sectional analytic design was applied using secondary data from medical records. Total sampling yielded 120 eligible pediatric dengue patients after exclusion of incomplete records. Nutritional status was assessed using BMI-for-age z-score based on WHO growth standards and categorized into undernutrition, normal nutrition, and overnutrition. Dengue severity was classified as dengue without warning signs and dengue with warning signs/severe dengue for analysis. Statistical analysis was performed using the Chi-square test with Cramér's V to determine effect size. The results showed that overnutrition was the most frequent nutritional status (55.0%), and dengue with warning signs was the most common severity category (44.2%). Chi-square analysis indicated no statistically significant unadjusted association between nutritional status and dengue severity ($\chi^2 = 1.50$; $p = 0.473$), with a small effect size (Cramér's V = 0.112). These findings should be interpreted cautiously because important potential confounding variables were not included in the analysis.



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INTRODUCTION

Dengue virus infection is a rapidly expanding mosquito-borne disease and remains a major global public health concern, particularly in tropical and subtropical regions. The World Health Organization (WHO) reports a continuous increase in dengue incidence worldwide, driven by urbanization, climate change, population mobility, and expansion of *Aedes aegypti* habitats (World Health Organization, 2023). Southeast Asia, including Indonesia, contributes significantly to the global dengue burden, with recurrent outbreaks and high pediatric morbidity.

Clinically, dengue infection presents a broad spectrum of severity, ranging from asymptomatic infection to severe disease characterized by plasma leakage, hemorrhage, and organ failure. The WHO 2009 classification system categorizes dengue into three groups: dengue without warning signs, dengue with warning signs, and severe dengue (World Health Organization, 2009). This classification is widely used in clinical practice due to its improved ability to detect early disease progression and higher clinical sensitivity compared with the previous WHO 1997 classification.

The pathogenesis of severe dengue is complex and involves interactions between viral replication and host immune responses (Roy & Bhattacharjee, 2021; Wang et al., 2020). One of the key mechanisms is antibody-dependent enhancement (ADE), in which non-neutralizing antibodies facilitate increased viral entry into immune cells, resulting in higher viral replication and exaggerated immune activation. This process leads to excessive release of inflammatory mediators (cytokine storm), increased vascular permeability, endothelial dysfunction, and plasma leakage, which are hallmarks of

severe dengue (Chan et al., 2019; Wang et al., 2020). Thrombocytopenia further contributes to bleeding manifestations due to bone marrow suppression and immune-mediated platelet destruction (Khazali et al., 2024).

Host factors, particularly nutritional status, are increasingly recognized as important determinants of immune response during infection. Undernutrition impairs innate and adaptive immunity by reducing T-cell function, cytokine production, and complement activity, thereby weakening antiviral defense. Conversely, overnutrition and obesity are associated with chronic low-grade inflammation characterized by elevated pro-inflammatory cytokines, including IL-6 and TNF- α , which may amplify endothelial dysfunction during dengue infection (Chen et al., 2023; Te et al., 2022).

However, current evidence regarding the relationship between nutritional status and dengue severity remains inconsistent. Some studies have reported that overweight or obesity may increase the risk of severe dengue, whereas other studies have found weak or non-significant associations between nutritional status and dengue severity (Kalayanarooj & Nimmannitya, 2005; Maneerattanasak & Suwanbamrung, 2020; Te et al., 2022; Trang et al., 2016). Recent evidence has also suggested that the observed relationship may vary with population characteristics, severity definitions, nutritional assessment methods, and adjustments for potential confounding factors (Chen et al., 2023; Nguyen et al., 2023).

Indonesia remains one of the countries with a high dengue burden. Pediatric populations are particularly vulnerable due to immature immune systems, higher exposure to mosquito vectors, and delayed health-seeking behavior. Bali Province, especially Badung Regency, continues to report high dengue incidence



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among children, indicating the need for better risk stratification based on host factors such as nutritional status. Therefore, this study aims to analyze the association between nutritional status and dengue severity among pediatric patients treated at Mangusada Regional Hospital in 2024 using the WHO 2009 classification system.

METHODS

Study Design and Setting

This was a descriptive-analytic cross-sectional study using secondary data obtained from medical records. The study was conducted at Mangusada Regional Hospital, Badung Regency, Bali, Indonesia. Medical records of pediatric patients hospitalized with dengue infection from January to December 2024 were reviewed.

This design was used to describe patient characteristics and to assess the association between nutritional status and dengue severity. Because exposure and outcome data were collected from existing medical records within the same observation period, this study was not intended to establish causal or temporal relationships.

Study Population and Sampling

The study population comprised all pediatric patients aged 0 to 18 years hospitalized with dengue infection at Mangusada Regional Hospital during the study period. This study used total sampling. All eligible patients recorded during the study period were included after applying the inclusion and exclusion criteria. Initially, 136 pediatric dengue cases were identified from hospital medical records. Sixteen patients were excluded because of incomplete medical records, specifically missing body weight data. Therefore, 120 patients were included in the final analysis.

Inclusion and Exclusion Criteria

The inclusion criteria were pediatric patients aged 0 to 18 years who were hospitalized with dengue infection and had complete medical record data required for analysis, including age, sex, anthropometric data, dengue severity classification, hematocrit level, leukocyte count, and platelet count.

Patients were excluded if they had comorbid conditions that could influence immune response, nutritional status, or dengue severity. These conditions included nephrotic syndrome, congenital heart disease, severe asthma, chronic liver disease, chronic kidney disease, malignancy, immunodeficiency, including HIV/AIDS, diabetes mellitus, and hypothyroidism.

Case Definition and Dengue Severity Classification

Dengue infection was identified based on the physician's diagnosis recorded in the medical records, supported by clinical and/or laboratory findings, in accordance with hospital diagnostic procedures.

To maintain consistency in disease classification, dengue severity was classified according to the World Health Organization 2009 classification system. The severity categories were dengue without warning signs, dengue with warning signs, and severe dengue.

For bivariate analysis, dengue severity was categorized into two groups: dengue without warning signs and dengue with warning signs/severe dengue. This grouping was performed because the number of patients with severe dengue was limited.

Nutritional Status Assessment

Nutritional status was assessed using body mass index-for-age z-score based on WHO growth standards and references. For children aged 0



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to 5 years, nutritional status was interpreted using the WHO Child Growth Standards (WHO Multicenter Growth Reference Study Group, 2006). For children and adolescents aged 5 to 18 years, nutritional status was interpreted using the WHO Growth Reference for school-aged children and adolescents (de Onis et al., 2007).

Nutritional status was classified into severe undernutrition, undernutrition, normal nutrition, overweight, and obesity. Severe undernutrition was defined as BMI-for-age z-score < -3 SD, undernutrition as ≥ -3 SD to < -2 SD, normal nutrition as ≥ -2 SD to $\leq +1$ SD, overweight as $> +1$ SD to $\leq +2$ SD, and obesity as $> +2$ SD. For bivariate analysis, severe undernutrition and undernutrition were combined into an undernutrition group, while overweight and obesity were combined into an overnutrition group.

Study Variables

The dependent variable was dengue severity, as defined by the WHO 2009 classification. The independent variable was nutritional status. Other variables collected from medical records included age, sex, hematocrit level, leukocyte count, and platelet count.

Data Collection

Data were extracted from medical records using a structured data collection form. The extracted data included demographic characteristics, anthropometric measurements, dengue severity classification, and laboratory findings on the first day of hospital admission.

Demographic variables included age and sex. Anthropometric variables included body weight and height or body length. Laboratory variables included hematocrit level, leukocyte count, and platelet count.

Data Cleaning and Missing Data Management

Before analysis, data were checked for completeness, duplication, and clinically implausible values. Records with incomplete key variables required to define nutritional status or dengue severity were excluded from the final analysis.

Of the 136 identified medical records, 16 were excluded due to missing body weight data. No data imputation was performed because body weight was essential for nutritional status classification.

Statistical Analysis

Data were analyzed using Jamovi version 2.6.44. Univariate analysis was performed to describe patient characteristics. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as mean, standard deviation, median, minimum, and maximum values where appropriate.

Bivariate analysis was conducted to assess the association between nutritional status and dengue severity using the Chi-square test. Cramér's V was calculated to estimate the effect size of the association. A p-value of less than 0.05 was considered statistically significant. No multivariable analysis was performed in this study.

Ethical Consideration

This study was approved by the Ethics Committee of Mangusada Regional Hospital with ethical clearance number 000.9/6158/RSDM/2025. Patient confidentiality was maintained by anonymizing all personal identifiers before data analysis.



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RESULTS

Patient Characteristics

A total of 120 pediatric patients with dengue infection were included in the final analysis. Their demographic and nutritional characteristics are summarized in Table 1.

Most patients were aged >10–18 years (88 patients; 73.4%), while the 0–59-month and 60–84-month age groups each comprised 7 patients (5.8%). Male patients were more frequent than female patients, accounting for 74 (61.7%) and 46 (38.3%) patients, respectively. Overweight was the most frequent individual nutritional status category (42 patients;

35.0%), followed by normal nutrition (35 patients; 29.2%), obesity (24 patients; 20.0%), undernutrition (12 patients; 10.0%), and severe undernutrition (7 patients; 5.8%). When overweight and obesity were combined for the bivariate analysis, the overnutrition group comprised 66 patients (55.0%).

Clinical Manifestations of Pediatric Dengue Patients

Clinical manifestations are presented in Table 2. Fever was present in all patients (120 patients; 100.0%). Bleeding manifestations were observed in 63 patients (52.5%), while vomiting occurred in 55 patients (45.8%).

Table 1. Characteristics of Pediatric Dengue Patients

Variable	Category	n	%
Age group	0–59 months	7	5.8
	60–84 months	7	5.8
	>7–10 years	18	15.0
	>10–18 years	88	73.4
	Total	120	100.0
Sex	Male	74	61.7
	Female	46	38.3
	Total	120	100.0
Nutritional status	Severe undernutrition	7	5.8
	Undernutrition	12	10.0
	Normal nutrition	35	29.2
	Overweight	42	35.0
	Obesity	24	20.0
	Total	120	100.0



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Table 2. Clinical Manifestations of Pediatric Dengue Patients

Clinical manifestation	n	%
Fever	120	100.0
Bleeding manifestation	63	52.5
Vomiting	55	45.8

Note: Patients could have more than one clinical manifestation; therefore, the percentages do not sum to 100%.

Table 3. Laboratory Characteristics of Pediatric Dengue Patients on the First Day of Hospital Admission

Parameter	Min - Max	Median	Mean $\pm$ SD
Hematocrit (%)	27.8 – 52.3	40.3	41.1 $\pm$ 4.81
Leukocytes ($10^3/\mu\text{L}$)	1.44 – 12.9	3.95	4.56 $\pm$ 2.26
Platelets ($10^3/\mu\text{L}$)	11.0 – 240	78.0	80.6 $\pm$ 42.2

Table 4. Distribution of Dengue Severity Among Pediatric Patients

Dengue severity	n	%
Dengue without warning signs	50	41.7
Dengue with warning signs	53	44.2
Severe dengue	17	14.2
Total	120	100.0

Laboratory Characteristics of Pediatric Dengue Patients on the First Day of Hospital Admission

Laboratory parameters at admission are presented in Table 3. The mean hematocrit level was 41.1% (SD 4.81), with values ranging from 27.8% to 52.3% (median 40.3%). The mean leukocyte count was $4.56 \times 10^3/\mu\text{L}$ (SD 2.26), ranging from 1.44 to $12.9 \times 10^3/\mu\text{L}$ (median $3.95 \times 10^3/\mu\text{L}$). The mean platelet count was $80.6 \times 10^3/\mu\text{L}$ (SD 42.2), with a range of 11.0 to $240 \times 10^3/\mu\text{L}$ (median $78.0 \times 10^3/\mu\text{L}$).

Distribution of Dengue Severity Among Pediatric Patients

The distribution of dengue severity is shown in Table 4. Dengue with warning signs was the most frequent category (53 patients; 44.2%), followed by dengue without warning signs (50 patients; 41.7%) and severe dengue (17 patients; 14.2%).

Association Between Nutritional Status and Dengue Severity in Pediatric Patients

The association between nutritional status and dengue severity is presented in Table 5. After grouping categories for analysis, dengue

Table 5. Association Between Nutritional Status and Dengue Severity in Pediatric Patients

Nutritional status	Dengue without warning signs n (%)	Dengue with warning signs/severe dengue n (%)	Total	Row % (dengue with warning signs/severe dengue)	Expected count (without warning signs / with warning signs or severe dengue)
Overnutrition	27 (40.9%)	39 (59.1%)	66	59.1%	27.5 / 38.5
Undernutrition	6 (31.6%)	13 (68.4%)	19	68.4%	7.92 / 11.08
Normal nutrition	17 (48.6%)	18 (51.4%)	35	51.4%	14.58 / 20.42
Total	50	70	120		

Chi-square test: $\chi^2 = 1.50$; $df = 2$; $p = 0.473$

Effect size: Cramér's $V = 0.112$

Assumption check: All expected cell counts ≥ 5 (Chi-square assumption fulfilled)

with warning signs and severe dengue were combined due to the limited number of cases in the severe category.

The proportion of dengue with warning signs/severe dengue was highest in the undernutrition group (68.4%), followed by overnutrition (59.1%) and normal nutrition (51.4%).

However, Chi-square analysis showed no statistically significant association between nutritional status and dengue severity ($\chi^2 = 1.50$; $df = 2$; $p = 0.473$). The effect size was small (Cramér's $V = 0.112$). All expected cell counts were ≥ 5 , indicating that the assumptions for the Chi-square test were satisfied.

DISCUSSION

This study assessed the association between nutritional status and dengue severity among pediatric patients using the WHO 2009 classification system. The main finding demonstrated that no statistically significant association was observed between nutritional status and dengue severity in this cohort.

The majority of patients in this study were older children and adolescents. This distribution is consistent with epidemiological patterns of dengue infection, which is frequently reported

in school-aged populations. Increased mobility, outdoor exposure, and a higher likelihood of contact with Aedes mosquito breeding sites may contribute to this pattern (World Health Organization, 2023; Te et al., 2022). However, as this was a single-center hospital-based study, the age distribution may also reflect referral patterns and admission criteria rather than true community incidence.

Male patients constituted a larger proportion of the study sample than female patients. This distribution may reflect differences in exposure, healthcare-seeking behavior, or hospital admission patterns. This finding is consistent with several previous studies reporting a higher incidence of dengue in males. Behavioral factors such as outdoor activity and differential exposure to mosquito habitats may contribute to this pattern. However, sex distribution in dengue infection remains inconsistent across populations, indicating that contextual environmental and behavioral factors may play a more dominant role than biological sex differences alone (Chen et al., 2023).

Overnutrition was the most common nutritional status in this study population. This finding may be consistent with the increasing burden



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of overnutrition reported among pediatric populations in urban and semi-urban settings. From a biological perspective, overnutrition and obesity have been associated with chronic low-grade inflammation, increased pro-inflammatory cytokines such as IL-6 and TNF- α , and endothelial dysfunction, which may theoretically contribute to more severe dengue manifestations (Khanna et al., 2022; Malavige et al., 2020). Previous pediatric research has also reported that overweight status may be associated with clinical or hematological indicators of more severe dengue (Maneerattanasak & Suwanbamrung, 2020). Nevertheless, this study did not observe a statistically significant association between overnutrition and dengue severity.

Undernutrition has also been proposed as a factor influencing infectious disease outcomes through impaired innate and adaptive immune responses. Reduced T-cell function, impaired cytokine production, and altered immune regulation may increase susceptibility to infections (Bourke et al., 2019). However, in the present study, undernutrition was not significantly associated with dengue severity. This finding suggests that nutritional status alone may not be a dominant determinant of dengue severity in this population.

The absence of a statistically significant association in this study is consistent with findings from Te et al. (2022), who also reported no significant relationship between nutritional status and dengue severity in pediatric populations, as defined by the WHO 2009 classification. However, previous observational studies and systematic reviews have produced conflicting findings, particularly regarding overweight and obesity as potential risk factors for severe dengue (Chen et al., 2023; Kalayanarooj & Nimmannitya, 2005; Maneerattanasak & Suwanbamrung, 2020; Trang et al., 2016).

These inconsistencies may be explained by differences in study design, population characteristics, nutritional assessment methods, dengue severity classifications, and adjustment for confounding variables.

Dengue severity is a multifactorial condition influenced by viral, host, and clinical factors. Importantly, the absence of a statistically significant association in the present study should not be interpreted as definitive evidence that nutritional status has no role in dengue severity. The analysis did not adjust for several potentially important confounding variables, particularly primary versus secondary dengue infection status. Systematic reviews have identified secondary infection as an important predictor of severe dengue and have also shown that clinical and laboratory characteristics during the febrile phase can predict progression to severe disease (Sangkaew et al., 2021; Tsheten et al., 2021). A population-based cohort study further reported a higher risk of severe dengue among patients with secondary infection than among those with primary infection (Shih et al., 2024). Other unmeasured factors, including dengue virus serotype, viral load, age, sex, duration of illness before hospital admission, and early clinical management, may also have influenced the observed association (Wang et al., 2020; World Health Organization, 2009). Therefore, the findings of this study should be interpreted as a crude or unadjusted association rather than definitive evidence of the absence of an independent relationship between nutritional status and dengue severity.

The hematological findings in this study are consistent with the known pathophysiology of dengue infection. Thrombocytopenia may result from bone marrow suppression, immune-mediated platelet destruction, and peripheral consumption, whereas leukopenia reflects viral suppression of bone marrow activity (Khazali et al., 2024). Elevated hematocrit may indicate



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plasma leakage, which is a hallmark of dengue pathogenesis (World Health Organization, 2009).

This study has several strengths. Strict exclusion criteria were applied to reduce the influence of comorbid conditions that could independently affect immune responses, nutritional status, or dengue severity, thereby reducing potential clinical heterogeneity. In addition, all cases were classified using the WHO 2009 dengue classification system, which is widely accepted in clinical practice.

However, several limitations should be considered. First, the cross-sectional retrospective design limits causal inference. Second, the study was conducted in a single hospital, which may limit generalizability. Third, the relatively small number of severe dengue cases may have reduced statistical power. Fourth, several important potential confounding variables, particularly primary versus secondary dengue infection status, dengue virus serotype, viral load, and duration of illness before hospital admission, were not available in the medical records. Fifth, no multivariable regression analysis was performed. Consequently, the observed association is crude or unadjusted, and residual confounding may have attenuated or masked the independent relationship between nutritional status and dengue severity. Future studies should consider multicenter designs with larger sample sizes and inclusion of virological and immunological variables. Multivariable regression analysis is also recommended to better assess the independent effect of nutritional status on dengue severity.

CONCLUSION

This study found no statistically significant unadjusted association between nutritional status and dengue severity among pediatric patients treated at Mangusada Regional

Hospital in 2024. However, this finding should not be interpreted as definitive evidence of the absence of an independent relationship. Important potential confounding variables, particularly primary versus secondary dengue infection status, were not available, and no multivariable analysis was performed. Residual confounding may therefore have attenuated or masked a true association. Further multicenter studies with larger samples, complete virological and clinical data, and adjusted statistical analyses are required to clarify the independent relationship between nutritional status and dengue severity.

REFERENCES

- Bourke, C. D., Jones, K. D. J., & Prendergast, A. J. (2019). Current understanding of innate immune cell dysfunction in childhood undernutrition. *Frontiers in Immunology*, 10, 1728. <https://doi.org/10.3389/fimmu.2019.01728>
- Chan, C. Y. Y., Low, J. Z. H., Gan, E. S., Ong, E. Z., Zhang, S. L.-X., Tan, H. C., Chai, X., Ghosh, S., Ooi, E. E., & Chan, K. R. (2019). Antibody-dependent dengue virus entry modulates cell intrinsic responses for enhanced infection. *mSphere*, 4(5), e00528-19. <https://doi.org/10.1128/msphere.00528-19>
- Chen, C.-Y., Chiu, Y.-Y., Chen, Y.-C., Huang, C.-H., Wang, W.-H., Chen, Y.-H., & Lin, C.-Y. (2023). Obesity as a clinical predictor for severe manifestation of dengue: A systematic review and meta-analysis. *BMC Infectious Diseases*, 23, 502. <https://doi.org/10.1186/s12879-023-08481-9>
- de Onis, M., Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and



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Fakultas Kedokteran FKUM Surabaya
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- adolescents. *Bulletin of the World Health Organization*, 85(9), 660-667. <https://doi.org/10.2471/BLT.07.043497>
- Kalayanarooj, S., & Nimmannitya, S. (2005). Is dengue severity related to nutritional status? *Southeast Asian Journal of Tropical Medicine and Public Health*, 36(2), 378-384.
- Khanna, D., Khanna, S., Khanna, P., Kahar, P., & Patel, B. M. (2022). Obesity: A chronic low-grade inflammation and its markers. *Cureus*, 14(2), e22711. <https://doi.org/10.7759/cureus.22711>
- Khazali, A. S., Hadrawi, W. H., Ibrahim, F., Othman, S., & Nor Rashid, N. (2024). Thrombocytopenia in dengue infection: Mechanisms and a potential application. *Expert Reviews in Molecular Medicine*, 26, e26. <https://doi.org/10.1017/erm.2024.18>
- Malavige, G. N., Jeewandara, C., & Ogg, G. S. (2020). Dysfunctional innate immune responses and severe dengue. *Frontiers in Cellular and Infection Microbiology*, 10, 590004. <https://doi.org/10.3389/fcimb.2020.590004>
- Maneerattanasak, S., & Suwanbamrung, C. (2020). Impact of nutritional status on the severity of dengue infection among pediatric patients in Southern Thailand. *The Pediatric Infectious Disease Journal*, 39(12), e410-e416. <https://doi.org/10.1097/INF.0000000000002839>
- Nguyen, T. T., Nguyen, D. T., Vo, T. T.-H., Dang, O. T.-H., Nguyen, B. T., Pham, D. T.-T., Nguyen, T. T.-K., Duong, Y. N.-H., Doan, D. H., Nguyen, T. H., Ho, L. T., Nguyen, P. H., Phan, D. N., Tran, T. V., Nguyen, T. K., Luong, D. C., Pham, A. T.-M., Dinh, T. T.-D., Do, V. C., & Vo, L. T. (2023). Associations of obesity and dengue-associated mortality, acute liver failure and mechanical ventilation in children with dengue shock syndrome. *Medicine*, 102(46), e36054. <https://doi.org/10.1097/MD.00000000000036054>
- Roy, S. K., & Bhattacharjee, S. (2021). Dengue virus: Epidemiology, biology, and disease aetiology. *Canadian Journal of Microbiology*, 67(10), 687-702. <https://doi.org/10.1139/cjm-2020-0572>
- Sangkaew, S., Ming, D., Boonyasiri, A., Honeyford, K., Kalayanarooj, S., Yacoub, S., Dorigatti, I., & Holmes, A. (2021). Risk predictors of progression to severe disease during the febrile phase of dengue: A systematic review and meta-analysis. *The Lancet Infectious Diseases*, 21(7), 1014-1026. [https://doi.org/10.1016/S1473-3099\(20\)30601-0](https://doi.org/10.1016/S1473-3099(20)30601-0)
- Shih, H. I., Wang, Y. C., Wang, Y. P., Chi, C. Y., & Chien, Y. W. (2024). Risk of severe dengue during secondary infection: A population-based cohort study in Taiwan. *Journal of Microbiology, Immunology and Infection*, 57(5), 730-738. <https://doi.org/10.1016/j.jmii.2024.07.004>
- Te, H., Sriburin, P., Rattanamahaphoom, J., Sittikul, P., Hattasingh, W., Chatchen, S., Sirinam, S., & Limkittikul, K. (2022). Association between nutritional status and dengue severity in Thai children and adolescents. *PLOS Neglected Tropical Diseases*, 16(5), e0010398. <https://doi.org/10.1371/journal.pntd.0010398>
- Trang, N. T. H., Long, N. P., Hue, T. T. M., Hung, L. P., Trung, T. D., Dinh, D. N., Luan, N. T., Huy, N. T., & Hirayama, K. (2016). Association between nutritional status and dengue infection: A systematic review and meta-analysis. *BMC Infectious Diseases*, 16, 172. <https://doi.org/10.1186/s12879-016-1498-y>



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- Tsheten, T., Clements, A. C. A., Gray, D. J., Adhikary, R. K., Furuya-Kanamori, L., & Wangdi, K. (2021). Clinical predictors of severe dengue: A systematic review and meta-analysis. *Infectious Diseases of Poverty*, 10, 123. <https://doi.org/10.1186/s40249-021-00908-2>
- Wang, W.-H., Urbina, A. N., Chang, M. R., Assavalapsakul, W., Lu, P.-L., Chen, Y.-H., & Wang, S.-F. (2020). Dengue hemorrhagic fever - A systemic literature review of current perspectives on pathogenesis, prevention and control. *Journal of Microbiology, Immunology and Infection*, 53(6), 963-978. <https://doi.org/10.1016/j.jmii.2020.03.007>
- WHO Multicentre Growth Reference Study Group. (2006). WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatrica*, 95(S450), 76-85. <https://doi.org/10.1111/j.1651-2227.2006.tb02378.x>
- World Health Organization. (2009). *Dengue: Guidelines for diagnosis, treatment, prevention and control: New edition*. <https://iris.who.int/handle/10665/44188>
- World Health Organization. (2023, December 21). Dengue - global situation. <https://www.who.int/emergencies/disease-outbreak-news/item/2023-DON498>