

The Association Between Nutritional Status And Plaque Bacterial Counts In Children Aged 5–12 Years

Nabilla Marsha Diva*, Welly Anggarani**, Prima Agusmawanti**, Sandy Christiono**, Rizki Amalina ***

* Bachelor of Dentistry Degree Program, Faculty of Dentistry, UNISSULA

** Department of Pediatric Dentistry, Faculty of Dentistry, UNISSULA

*** Department of Oral Biology, Faculty of Dentistry, UNISSULA

Correspondence: welly@unissula.ac.id

Received 7 February 2026; Revision 1st 20 August 2026, Accepted 24 August 2026; Published online 24 August 2026

Keywords:

Nutritional Status; Dental Plaque; School-Aged Children; Total Number of Bacteria; Colony Counter

ABSTRACT

Background: Nutritional status is an important indicator of child growth and development and may influence oral biological conditions. Nutritional imbalance may affect salivary function and oral microbial ecology, potentially contributing to plaque accumulation. This study aimed to evaluate differences in total plaque bacterial counts among children with different nutritional-status categories.

Method: This laboratory-based study included 84 children aged 5–12 years. Nutritional status was assessed using Body Mass Index-for-Age (BMI/A) according to the applicable anthropometric standard and categorized into overweight, normal, and thinness. Dental plaque samples were collected from the cervical lingual area of the mandibular first molar, and the total number of viable bacteria was determined using the colony-counting method. Differences in total plaque bacterial counts among nutritional-status groups were analyzed using the Kruskal–Wallis test, followed by Dunn’s post-hoc test with Holm adjustment.

Result: The mean total bacterial counts were 21.78 ± 5.79 CFU/mL in the overweight group, 29.65 ± 11.30 CFU/mL in the normal group, and 30.27 ± 17.40 CFU/mL in the thinness group. The Kruskal–Wallis test demonstrated a statistically significant difference among nutritional-status groups ($H = 6.319$, $df = 2$, $p = 0.042$). Dunn’s post-hoc test with Holm adjustment showed a significant difference between the overweight and normal groups (adjusted $p = 0.036$).

Conclusion: Total plaque bacterial counts differed significantly among nutritional-status groups, with a significant difference observed between the overweight and normal groups. The findings should not be interpreted as evidence of a linear or monotonic relationship or a causal effect of nutritional status on plaque bacterial counts.

Copyright ©2022 National Research and Innovation Agency. This is an open access article under the CC BY-SA license (<https://creativecommons.org/licenses/by-sa/4.0/>).

DOI: <http://dx.doi.org/10.30659/medali.8.2.102-106>

MEDALI Jurnal: Media Dental Intelktual accredited as Sinta 4 Journal

(<https://sinta.kemdikbud.go.id/journals/profile/13665>)

2337-6937/ 2460-4151 ©2025 National Research and Innovation Agency

This is an open access article under the CC BY-SA license (<https://creativecommons.org/licenses/by-sa/4.0/>)

How to Cite: Diva et al. The Association Between Nutritional Status And Plaque Bacterial Counts In Children Aged 5–12 Years. MEDALI Jurnal: Media Dental Intelktual, v.8, n.2, p.102-106, February 2026.

INTRODUCTION

Nutritional status is an indicator of nutritional conditions and can be assessed using anthropometric measurements, including weight and height. Adequate nutritional intake is important for optimal growth and development, whereas nutritional imbalance may be associated with impaired biological functions and health problems.^{1–4}

Anthropometry is widely used to assess nutritional status in children. For children and adolescents, Body Mass Index-for-Age (BMI/A) is used because body composition and body density change with age.⁵ The assessment of nutritional status therefore needs to consider age and sex rather than relying on body weight alone.

Adequate nutritional intake is also required during the growth and development of the oral cavity. Nutritional imbalance may affect the structure and biological function of oral hard and soft tissues.⁶ Nutritional conditions may influence salivary flow and composition. Saliva contributes to buffering, self-cleansing, and maintenance of the oral environment, and alterations in salivary conditions may influence microbial colonization and plaque formation.^{7–9}

Dental plaque is a microbial biofilm attached to the tooth surface. Its formation and maturation are influenced by substrate availability, oral hygiene, saliva, and interactions among oral microorganisms. Bacterial growth in plaque can be quantified by culturing samples on appropriate media and counting colony-forming units (CFU).^{10–13}

The relationship between nutritional status and plaque bacterial counts may be complex because nutritional status consists of distinct nutritional conditions. Thinness and overweight represent different directions of nutritional imbalance, while normal nutritional status cannot

necessarily be interpreted as a biological midpoint between them. Therefore, nutritional status should not automatically be treated as an ordinal variable in statistical analysis.

This study aimed to evaluate differences in the total number of plaque bacteria among children aged 5–12 years according to nutritional-status categories. The findings may contribute to a better understanding of the relationship between nutritional conditions and the oral microbial environment in school-aged children.

METHODS

This study was conducted as a laboratory-based observational analytical study. The population consisted of 333 children aged 5–12 years who attended SDN Bandarharjo 02, North Semarang District. Purposive sampling was used to recruit participants according to the study criteria. A total of 100 children were initially recruited, and 84 participants were included in the final analysis after the eligibility and data-quality assessment. The specific exclusion reasons for the 16 participants should be stated according to the original study records.

The study received ethical approval from the Ethics Committee of Dentistry, UNISSULA, under approval number 543/B.1-KEPK/SA-FKG/V/2024. Coordination with SDN Bandarharjo was conducted for research permission and scheduling, and informed consent was obtained.

The instruments and materials included a digital weight scale, microtome, name labels, Amies collection swabs, a cooler box with dry ice, Petri dishes, an incubator, a colony counter, distilled water, Blood Agar medium, and 0.9% NaCl solution.

Nutritional status was assessed from body weight and height measurements. BMI/A was determined from the weight and height data according to the applicable anthropometric

standard. Participants were classified into three nutritional-status categories: thinness, normal, and overweight. Oral hygiene status was assessed using the OHI-S Index.

Dental plaque samples were collected by swabbing three times the cervical lingual area of the mandibular first molar using an Amies collection swab. Samples were labelled, stored in a cooler box with dry ice, and transported to the Integrated Biomedical Laboratories of the Faculty of Medicine, UNISSULA. Blood Agar medium was prepared using 2% sheep's blood. Samples were serially diluted from 10^{-1} to 10^{-5} using 0.9% NaCl and inoculated onto Petri dishes using the spread-plate method. The plates were incubated at 37°C for 24–48 hours. Bacterial colonies were counted using a colony counter and expressed as CFU/mL.

Statistical analysis was performed according to the characteristics and measurement scale of each variable. Nutritional status was treated as a categorical variable rather than an ordinal ranking because thinness and overweight represent different directions of nutritional imbalance and normal nutritional status cannot be considered a biological midpoint between them. Therefore, Spearman's rank correlation was not used to analyze nutritional status. Differences in total

plaque bacterial counts among the three nutritional-status groups were analyzed using the Kruskal–Wallis test. When a statistically significant difference was identified, Dunn's post-hoc pairwise comparisons with Holm adjustment were performed. Statistical significance is set at $p < 0.05$.

RESULTS

A total of 84 children were included in the final analysis. The participants consisted of 18 children with overweight nutritional status, 55 children with normal nutritional status, and 11 children with thinness.

The mean total bacterial count was lowest in the overweight group and highest in the thinness group. The Kruskal–Wallis test demonstrated a statistically significant difference in total plaque bacterial counts among the three nutritional-status groups ($H = 6.319$, $df = 2$, $p = 0.042$).

Dunn's post-hoc test with Holm adjustment identified a statistically significant difference between the overweight and normal groups (adjusted $p = 0.036$). No statistically significant difference was observed between the overweight and thinness groups (adjusted $p = 0.347$) or between the normal and thinness groups (adjusted $p = 0.624$).

Table 1. Total Plaque Bacterial Count According to Nutritional Status

Nutritional status	n	Mean $\pm$ SD (CFU/mL)	Median (IQR) (CFU/mL)	Kruskal–Wallis
Overweight	18	21.78 $\pm$ 5.79	21.00 (18.25–26.25)	
Normal	55	29.65 $\pm$ 11.30	29.00 (20.00–36.00)	
Thinness	11	30.27 $\pm$ 17.40	33.00 (13.50–43.00)	
Total	84			$H = 6.319$; $df = 2$; $p = 0.042$

DISCUSSION

This study demonstrated a statistically significant difference in total plaque bacterial counts

among children with different nutritional-status categories. The overweight group had the lowest

median bacterial count, whereas the thinness group had the highest median bacterial count. However, the post-hoc analysis showed that the statistically significant difference was observed only between the overweight and normal groups. The other pairwise comparisons were not statistically significant.

These findings should not be interpreted as a linear or monotonic relationship between nutritional status and plaque bacterial count. Nutritional status consists of distinct categories representing different nutritional conditions. Thinness and overweight represent different directions of nutritional imbalance, whereas normal nutritional status does not constitute a biological midpoint between the two conditions. For this reason, nutritional status was treated as a categorical variable and analyzed using the Kruskal–Wallis test rather than assigning ordinal ranks for Spearman correlation.

Nutritional status may influence saliva flow and salivary composition. Saliva contributes to buffering and self-cleansing of the oral cavity, and changes in salivary function may influence microbial colonization and plaque accumulation.^{7–9} However, the oral microbial environment is multifactorial. Plaque accumulation and bacterial growth are also influenced by oral hygiene, toothbrushing practices, dietary patterns, parental supervision, and access to oral health services.

The OHI-S findings in this study were generally categorized as good. Good oral hygiene may contribute to relatively controlled plaque accumulation and may influence bacterial counts across nutritional-status groups. Consequently, the observed difference between the overweight and normal groups should be interpreted cautiously and should not be regarded as evidence that overweight nutritional status directly reduces plaque bacterial counts.

The descriptive difference between nutritional-status groups may also reflect biological and behavioral heterogeneity within each category. In particular, nutritional status is a broad indicator and does not directly represent dietary quality, frequency of sugar intake, salivary characteristics, oral hygiene behavior, or socioeconomic conditions. These factors may contribute to variations in plaque bacterial counts and may partly explain why some pairwise group differences were not statistically significant.

The present findings differ from a simple ordinal interpretation of nutritional status. The absence of significant differences in two of the three pairwise comparisons further indicates that the statistical finding should be interpreted as a group difference rather than as evidence of a continuous nutritional gradient. Future studies should consider larger samples and additional variables related to diet, saliva, oral hygiene, and socioeconomic conditions to clarify the mechanisms underlying differences in plaque bacterial counts.

CONCLUSION

There was a statistically significant difference in total plaque bacterial counts among children aged 5–12 years across different nutritional-status categories. Post-hoc analysis demonstrated a significant difference between the overweight and normal nutritional-status groups, whereas no significant differences were observed between the other group pairs. These findings should not be interpreted as evidence of a linear or monotonic relationship or a causal effect of nutritional status on plaque bacterial counts.

ACKNOWLEDGEMENT

The authors would like to thank the Faculty of Dentistry, UNISSULA, and SDN Bandarharjo 02,

North Semarang District, for their support and assistance during the study.

REFERENCES

1. Ekaningrum AY, Fajarwaty T, Humayrah W, Jakarta US, Pustaka SK. *Dasar Ilmu Gizi*. 2023.
2. DKK Semarang. *Profil Kesehatan Kota Semarang 2022*. Dinas Kesehatan Kota Semarang. 2022;30.
3. Zuhriyah A. *Konsumsi Energi, Protein, Aktivitas Fisik, Pengetahuan Gizi dengan Status Gizi Siswa SDN Dukuhsari Kabupaten Sidoarjo*. J Gizi Univ Negeri Surabaya. 2021;01(01):45–52.
4. Muchtar F, Rejeki S, Hastian H. *Pengukuran dan penilaian status gizi anak usia sekolah menggunakan indeks massa tubuh menurut umur*. Abdi Masy. 2022;4(2):2–6.
5. Kemenkes RI. *Peraturan Menteri Kesehatan Republik Indonesia Nomor 2 Tahun 2020 Tentang Standar Antropometri Anak*. 2020;21(1):1–9.
6. Pardosi SS, Siahaan YL, Restuning S, Chaerudin DR. *Hubungan Status Gizi Terhadap Terjadinya Karies Gigi Pada Anak Sekolah Dasar*. Dent Ther J. 2022;4(1):1–9.
7. Subekti A, Ningtyas EAE, Benyamin B. *Hubungan Plak Gigi, Laju Aliran Saliva, dan Viskositas Saliva pada Anak Usia 6-9 Tahun*. J Kesehatan Gigi. 2019;6(2):14–8.
8. Kasuma N. *Plak Gigi*. Andalas University Press; 2016.
9. Setiawan I, Lesmana D, Marhaeni Diah Herawati D, Sufiawati I, Widyaputra S. *Correlation between the Macronutrient Content of Dental Calculus and the FFQ-Based Nutritional Intake of Obese and Normal-Weight Individuals*. Int J Dent. 2021;2021.
10. Endriani R, Rafni E, Siregar FM, Setiawan RA, Rasyid F. *Pola bakteri pada karies gigi pasien diabetes melitus Bacteria in dental caries of diabetes mellitus patients*. J Kedokt Gigi Univ Padjadjaran. 2020;32(1):34.
11. Al-Shahrani MA. *Microbiology of Dental Caries: A Literature Review*. 2019.
12. Zhang Y, Fang J, Yang J, Gao X, Dong L, Zheng X, et al. *Streptococcus mutans-associated bacteria in dental plaque of severe early childhood caries*. J Oral Microbiol. 2022;14(1).
13. Wicaksono EB, Hardianto, Munawar A. *Rancang Bangun Penghitung Jumlah Koloni Bakteri Berbasis Arduino Uno*. Ijccs. 2019;13(2):123–8.