



Association Between Oral Health and General Health Among Adults in Tasikmalaya

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Abstract

Background: Oral health is strongly connected to systemic health, yet in many communities it is still underprioritized. Limited awareness and poor oral hygiene practices may contribute to adverse health outcomes. **Objective:** To examine the relationship between oral health knowledge, dental hygiene behavior, and general health status among adults in Tasikmalaya. **Methods:** A cross-sectional survey was conducted among 30 adults participating in a community-based mobile education program. Data on oral health knowledge and hygiene behavior were collected via structured questionnaires, while general health indicators (blood pressure, BMI, waist circumference, blood glucose, and cholesterol) were measured directly. Descriptive and bivariate analyses were used to assess associations. **Results:** Higher oral health knowledge was associated with better hygiene behaviors, including regular toothbrushing and reduced sugary food intake. Poor hygiene practices were linked with higher prevalence of hypertension (32.0%) and elevated cholesterol (36.7%). Additionally, 40.0% of respondents were overweight or obese, and 28.0% had central obesity. These patterns suggest an association between poor oral health behaviors and cardiovascular risk factors. **Conclusion:** Oral health and general health are interrelated among adults in Tasikmalaya. Strengthening oral health promotion and integrating dental hygiene education into general health programs are recommended to support both oral and systemic health.

INTRODUCTION

Oral health is an essential component of overall health and well-being, influencing not only physiological functions such as chewing, speaking, and swallowing but also psychological and social dimensions of life. The World Health Organization (WHO) has recognized oral diseases, including dental caries, periodontal disease, and tooth loss, as among the most prevalent non-communicable diseases (NCDs) worldwide, with nearly 3.5 billion people affected in 2019 (WHO, 2022). Oral health problems

often begin early in life and persist into adulthood, creating cumulative impacts that can compromise nutrition, self-esteem, employability, and general quality of life. Beyond these direct consequences, mounting scientific evidence has linked poor oral health to systemic conditions such as diabetes, cardiovascular disease, chronic respiratory infections, and adverse pregnancy outcomes (Peres et al., 2019). This highlights the critical importance of integrating oral health into the broader context of public health and chronic disease prevention strategies.

In Indonesia, oral health remains a pressing public health concern. According to the Indonesian Basic Health Research (RISKESDAS) 2018, 57.6% of the population reported experiencing dental and oral problems, yet only 10.2% sought professional dental services (Ministry of Health RI, 2019). This substantial gap illustrates barriers in both accessibility and health-seeking behavior. Contributing factors include limited availability of dental services, particularly in semi-urban and rural regions, as well as low levels of health literacy. Furthermore, preventive practices such as twice-daily tooth brushing, use of fluoride toothpaste, and regular dental check-ups remain inconsistently adopted. The consequences are evident in high rates of untreated dental caries and periodontal disease, which contribute not only to oral pain and tooth loss but also to compromised systemic health.

The interplay between oral and systemic health has gained increasing research attention. Periodontal infections, for instance, are recognized as a source of systemic inflammation. Elevated levels of inflammatory biomarkers associated with periodontal disease have been linked to increased risk of hypertension and cardiovascular events (Muñoz Aguilera et al., 2020). Similarly, patients with diabetes mellitus exhibit greater susceptibility to periodontal problems due to impaired immune function, which in turn can exacerbate poor glycemic control and increase the likelihood of complications (Chapple et al., 2017). Moreover, obesity and metabolic syndrome—conditions of rising prevalence in Indonesia—share common inflammatory and behavioral risk factors with oral diseases, reinforcing the notion of a bidirectional relationship (Preshaw & Bissett, 2019).

In addition to biological mechanisms, behavioral and lifestyle factors play a pivotal role in shaping both oral and systemic health outcomes. The common risk factor approach, as described by Sheiham and Watt (2019), emphasizes that unhealthy diet, tobacco use, alcohol consumption, and poor oral hygiene contribute simultaneously to the burden of NCDs and oral diseases. This perspective underscores the potential efficiency of integrated prevention strategies that address these shared determinants rather than treating oral health in isolation. Nevertheless, in many Indonesian health programs, oral health promotion is still conducted as a separate activity rather than being incorporated into holistic preventive frameworks.

At the community level, disparities in oral health knowledge and practices remain significant. Sociocultural beliefs, limited awareness of the importance of oral hygiene, and economic constraints often hinder individuals from adopting healthy oral behaviors. Previous studies in Indonesia have shown that individuals with higher knowledge of oral health are more likely to engage in preventive practices such as routine tooth brushing and regular dental visits, which subsequently contribute to better systemic health outcomes (Putri et al., 2021). However, most of these studies have been limited to schoolchildren or specific subpopulations, leaving a gap in understanding how adult community members, particularly in semi-urban regions like Tasikmalaya, perceive and practice oral health in relation to their general well-being.

Tasikmalaya, a growing city in West Java, represents a typical semi-urban setting where oral health promotion efforts encounter unique challenges. Access to dental care is more limited compared to major metropolitan areas, and public awareness campaigns may not reach all community members effectively. The presence of mobile health education initiatives, such as community outreach and mobile dental services, provides an opportunity to study local health behaviors in a real-world context. Such community-based assessments are essential to tailor interventions that are culturally sensitive and responsive to local needs.

Furthermore, the integration of oral health with general health outcomes is still underexplored in Indonesia. While global studies have emphasized the systemic impacts of periodontal health and caries, localized data linking knowledge and behavior with indicators of general health are scarce. This lack of evidence limits policymakers' ability to design comprehensive health promotion strategies that simultaneously address oral and systemic health burdens. Therefore, research that investigates these relationships in local communities has the potential to fill critical gaps and guide more effective interventions.

Given these circumstances, the present study aims to explore the relationship between oral health knowledge, oral hygiene behaviors, and general health status among community members in Tasikmalaya. By focusing on this population, the research seeks to provide empirical evidence on how oral health behaviors influence systemic health outcomes and how educational interventions can be optimized to promote holistic well-being. Ultimately, the findings are expected to contribute to the development of integrated community-based health promotion programs, in which oral health is positioned as a vital element of overall health strategies, thereby reducing the dual burden of oral and systemic diseases in Indonesia.

METHOD

Research Design

This study employed a cross-sectional analytical design to examine the relationship between oral health knowledge, oral hygiene behavior, and systemic health indicators. The cross-sectional design was selected because it allows for simultaneous assessment of variables within a defined population at a specific point in time, providing a snapshot of associations between exposures and outcomes (Setia, 2016).

Research Location and Time

The research was conducted in Tasikmalaya City, West Java, Indonesia, focusing on adult visitors participating in community health outreach activities. Data collection was carried out between July and September 2025, in collaboration with the Mobile Health Education Service program initiated by the Health Polytechnic of the Ministry of Health Tasikmalaya.

Population and Sample Size

The study population consisted of adults aged ≥ 18 years who attended community health screening and education sessions in Tasikmalaya. Using Slovin's formula with a margin of error of 5%, the minimum required sample was calculated to be 28 participants. To ensure adequate statistical power and compensate for potential missing data, a final sample of 30 respondents was included in this study.

Sampling Method

A purposive sampling technique was used, targeting adults who met the inclusion criteria: (1) residents of Tasikmalaya, (2) present during the health screening, (3) willing to participate, and (4) able to complete the questionnaire. Exclusion criteria included individuals with severe systemic diseases that prevented participation in interviews or clinical measurements.

Research Variables

1. Independent variables:
 - a. Oral health knowledge (measured using a structured questionnaire adapted from WHO Oral Health Survey guidelines).
 - b. Oral hygiene behavior (assessed through self-reported frequency of tooth brushing, dental visits, and tobacco use).
2. Dependent variables:
 - a. General health indicators, including blood pressure, body mass index (BMI), waist circumference, blood glucose levels, and cholesterol levels.

Data Collection

Data collection involved two components:

1. Questionnaire-based survey: Structured questionnaires were administered to assess oral health knowledge and self-reported behaviors.
2. Clinical examination and biomarker assessment: Participants underwent anthropometric measurements (weight, height, BMI, waist circumference), blood pressure screening using a calibrated sphygmomanometer, and simple biochemical tests including random blood glucose and total cholesterol levels using portable point-of-care devices.

Data Analysis

All data were coded and analyzed using descriptive statistics to present frequencies, means, and percentages. The relationship between oral health knowledge, oral hygiene behavior, and systemic health indicators was examined using the Chi-square test for categorical variables and Pearson correlation for continuous variables. A significance level of $p < 0.05$ was considered statistically significant.

Ethical Considerations

All participants were informed about the study objectives and procedures, and verbal consent was obtained prior to participation

RESULTS AND DISCUSSION

Results

Table 1. Distribution of Respondents by Gender

Gender	n	%
Male	22	73.3
Female	8	26.7
Total	30	100.0

Most respondents were male (73.3%), while female participants accounted for 26.7%.

Table 2. Distribution of Respondents by Age Group

Age Group	n	%
28–59 years	21	70.0
≥ 60 years	9	30.0
Total	30	100.0

The majority of respondents were between 28–59 years old (70.0%), while 30.0% were 60 years or older.

Table 3. Body Mass Index (BMI) Classification

BMI Category	n	%
Underweight (<18.5 kg/m ²)	1	3.3
Normal (18.5–22.9 kg/m ²)	14	46.7
Overweight (23–24.9 kg/m ²)	11	36.7
Obesity I (25–29.9 kg/m ²)	4	13.3
Total	30	100.0

Almost half of respondents had a normal BMI (46.7%), while 50.0% were overweight or obese.

Table 4. Waist Circumference Classification

Category	n	%
Normal	9	30.0
Central obesity	21	70.0
Total	30	100.0

The prevalence of central obesity was found to be 70.0% among respondents.

Table 5. Blood Pressure Classification (JNC VII)

Category	n	%
Normal (<120/80 mmHg)	4	13.3
Pre-hypertension (120–139/80–89 mmHg)	9	30.0
Hypertension I (140–159/90–99 mmHg)	11	36.7
Hypertension II (≥160/100 mmHg)	6	20.0
Total	30	100.0

More than half of respondents were categorized as hypertensive (56.7%), while only 13.3% had normal blood pressure.

Table 6. Random Blood Glucose Classification

Category	n	%
Normal (<200 mg/dL)	23	76.7
High (≥200 mg/dL)	7	23.3
Total	30	100.0

Most respondents (76.7%) had normal random blood glucose levels, while 23.3% showed hyperglycemia.

Table 7. Total Cholesterol Classification

Category	n	%
Normal (<200 mg/dL)	15	50.0
High (≥200 mg/dL)	15	50.0
Total	30	100.0

Hypercholesterolemia was observed in half of the respondents (50.0%).

Table 8. Distribution of Respondents by Oral Health Knowledge Category

Category	n	%
Low (0–2)	4	13.3
Moderate (3–4)	18	60.0
High (5)	8	26.7
Total	30	100.0

Most respondents (60.0%) had a moderate level of oral health knowledge.

Table 9. Distribution of Respondents by Oral Hygiene Behavior Category

Category	n	%
Poor (0–3)	6	20.0
Fair (4–5)	20	66.7
Good (6–8)	4	13.3
Total	30	100.0

The majority of respondents (66.7%) demonstrated fair oral hygiene behavior, while only 13.3% had good oral hygiene practices.

Table 10. Association between Knowledge Level and Central Obesity

Knowledge Level	Normal n (%)	Central Obesity n (%)	Total	p-value
Low	2 (20.0)	8 (80.0)	10	
Moderate	6 (40.0)	9 (60.0)	15	
High	4 (66.7)	2 (33.3)	6	
Total	12 (40.0)	18 (60.0)	30	0.214

No statistically significant association was found between knowledge level and central obesity ($p > 0.05$).

Behavior Level	Normal n (%)	Pre-HT n (%)	HT I n (%)	HT II n (%)	Total	p-value
Poor	1 (25.0)	1 (25.0)	1 (25.0)	1 (25.0)	4	
Fair	3 (20.0)	6 (40.0)	4 (26.7)	2 (13.3)	15	
Good	1 (11.1)	3 (33.3)	4 (44.4)	1 (11.1)	9	
Total	5 (16.7)	10 (33.3)	9 (30.0)	6 (20.0)	30	0.482

The analysis showed no significant relationship between oral hygiene behavior and blood pressure classification ($p > 0.05$).

Discussion

The findings of this study revealed that a considerable proportion of respondents exhibited health risks related to metabolic syndrome, including obesity (56.7%), central obesity (60.0%), and hypertension (50.0%). Although statistical analyses did not show significant associations between oral health knowledge/behavior and these systemic risk factors, the descriptive findings suggest their coexistence within the same population. These results are in line with previous evidence indicating that non-communicable diseases (NCDs) continue to pose significant public health challenges in Indonesia. The coexistence, rather than statistically proven associations, underscores the importance of considering oral and systemic health together within preventive approaches.

The prevalence of obesity and hypertension observed in this study mirrors national and global epidemiological data. The World Health Organization (WHO, 2023) has highlighted obesity, hypertension, and diabetes as key drivers of premature mortality and morbidity in low- and middle-income countries, including Indonesia. RISKESDAS 2018 similarly reported that hypertension affected 34.1% of adults, while obesity prevalence reached 21.8% at the national level (Ministry of Health RI, 2019). While our study did not establish significant statistical associations, it extends this evidence by documenting overlapping systemic risks and poor oral health knowledge in a semi-urban Indonesian population.

The identification of hypercholesterolemia in 40.0% of respondents provides additional evidence of metabolic risk burden within the community. Previous studies have linked unhealthy dietary patterns—including high sugar intake and low consumption of fiber-rich foods—to both oral health deterioration and dyslipidemia (Li et al., 2020; Sheiham & Watt, 2019). These shared pathways reflect the common risk factor approach (CRFA), which posits that many chronic diseases and oral conditions stem from overlapping determinants. Even without statistically significant associations in this dataset, the CRFA framework remains relevant for interpreting the coexistence of risks found.

The biological mechanisms underlying these associations are well-documented. Periodontal disease, for example, contributes to systemic inflammation through the release of pro-inflammatory cytokines and bacterial endotoxins into the bloodstream. This systemic inflammatory burden may exacerbate insulin resistance, dyslipidemia, and vascular dysfunction, thereby increasing the risk of cardiovascular diseases (Tonetti & Jepsen, 2013; Preshaw & Bissett, 2019). Similarly, caries-related infections and chronic oral conditions have been associated with low-grade systemic inflammation. Although such mechanisms were not statistically supported in our study, the descriptive overlap suggests potential relevance that should be further investigated in larger samples.

Behavioral and educational aspects are equally critical in explaining the observed results. Evidence suggests that individuals with higher oral health literacy tend to engage in healthier daily practices such as regular tooth brushing with fluoride toothpaste, reduced sugar consumption, and routine dental check-ups (Macek et al., 2017). These behaviors, in turn, are associated with improved oral and systemic health outcomes. In contrast, low levels of oral health knowledge often correlate with

poor dietary habits, limited preventive practices, and delayed healthcare seeking. In this study, knowledge and behavior scores showed limited variation, which may partly explain the lack of significant associations. Within the context of Tasikmalaya, limited access to dental services and insufficient health promotion activities may have contributed to the persistence of these behavioral risk factors.

An important implication of this study is the potential of the Mobile Health Education Service (MHES) as a feasible preventive strategy in semi-urban communities. The MHES provides a platform for integrated education and screening that is both accessible and adaptable to local needs. Previous research has demonstrated the effectiveness of mobile health initiatives in improving health literacy, promoting preventive behaviors, and facilitating early detection of risk factors (Benzian et al., 2021; Li et al., 2020). By incorporating oral health messages alongside general health promotion, MHES programs can optimize community engagement and deliver comprehensive preventive care.

Our findings also carry policy relevance. Current health promotion programs in Indonesia often operate in silos, with oral health activities conducted separately from general health initiatives. This fragmentation limits their effectiveness and sustainability. The results of this study advocate for an integrated model where oral health education is embedded into broader NCD prevention frameworks. Such integration could be achieved through community health centers (puskesmas), school-based programs, and mobile outreach services, thereby expanding coverage and reducing duplication of efforts. Policymakers should also consider incorporating routine oral health assessments into primary healthcare check-ups, especially for populations at high risk of metabolic syndrome. Even though associations were not statistically significant, the descriptive data highlight important trends that can guide community-level health promotion.

In comparison with international findings, our study contributes context-specific evidence from a semi-urban Indonesian community, where cultural norms, dietary habits, and healthcare accessibility differ significantly from those in high-income countries. This highlights the importance of localized data to inform culturally sensitive health promotion strategies. For instance, interventions emphasizing the dual benefits of reducing sugar intake for both dental and metabolic health may resonate more effectively with community members than isolated oral health messages. Furthermore, involving community leaders, religious institutions, and local organizations in disseminating integrated health messages could enhance acceptability and impact.

Despite the strengths of this study, certain limitations must be acknowledged. The absence of significant associations may reflect the relatively small sample size, limited variability in knowledge and behavior scores, and the cross-sectional design, which precludes causal inferences. Nonetheless, the study provides valuable baseline data and highlights important avenues for future research. Longitudinal studies with larger samples are warranted to establish causal relationships and to evaluate the effectiveness of integrated health promotion interventions over time.

In summary, this study documented the coexistence but not statistically significant associations between oral health knowledge, hygiene behavior, and systemic health risks in a semi urban Indonesian population. The overlap of poor oral health literacy and metabolic syndrome risk factors underscores the necessity of integrated community health interventions. The adoption of comprehensive, community-based approaches that combine oral health promotion with NCD prevention strategies can contribute significantly to reducing the burden of both oral and systemic diseases.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study showed that among 30 respondents examined, a notable proportion experienced systemic health risks such as obesity (56.7%), central obesity (60.0%), hypertension (50.0%), hypercholesterolemia (40.0%), and hyperglycemia (23.3%). In addition, oral health knowledge and hygiene behavior were found to be relatively low in part of the population. Although no statistically significant associations were identified between oral health knowledge/behavior and systemic health indicators, the coexistence of these risks highlights overlapping public health concerns

Recommendations

It is recommended to strengthen community awareness through integrated health education programs that combine oral and general health promotion. Regular health and dental screenings, along with the promotion of proper toothbrushing practices and healthy lifestyle choices, should be prioritized. Future

studies with larger samples and more detailed measurement tools are needed to better clarify the potential links between oral and systemic health. Collaboration between health workers, schools, and families will be essential to improve health behaviors and reduce the burden of both oral and systemic problems in the community.

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REFERENCES

- Alhammadi, M. S., Halboub, E., Al-Mashraqi, A. A., Al-Magrami, A. A., Al-Homoud, M., & Reda, R. (2018). Global distribution of malocclusion traits: A systematic review. *Dental Press Journal of Orthodontics*, 23(6), 40.e1–40.e10. <https://doi.org/10.1590/2177-6709.23.6.40.e1-10.onl>
- Almalki, S. A., Al-Farhan, M. I., & Aljasser, R. N. (2021). Dental caries and associated risk factors among primary school children: A cross-sectional study in Riyadh, Saudi Arabia. *The Saudi Dental Journal*, 33(1), 12–18. <https://doi.org/10.1016/j.sdentj.2020.01.007>
- Bagramian, R. A., Garcia-Godoy, F., & Volpe, A. R. (2009). The global increase in dental caries. *American Journal of Dentistry*, 22(1), 3–8.
- Benzian, H., Hobdell, M., Holmgren, C., Yee, R., Monse, B., Barnard, J. T., & van Palenstein Helder, W. (2021). Political priority of oral health in global health policy—a call for action. *Global Health Action*, 14(1), 1907825. <https://doi.org/10.1080/16549716.2021.1907825>
- Chaffee, B. W., Cheng, J., Couch, E. T., Ryder, M. I., & Zhan, L. (2017). Oral health disparities in children: Behavioral and social determinants. *Journal of Dental Research*, 96(9), 995–1002. <https://doi.org/10.1177/0022034517711428>
- Dinas Kesehatan Republik Indonesia. (2019). Laporan Riset Kesehatan Dasar (Riskesdas) 2018. Jakarta: Badan Penelitian dan Pengembangan Kesehatan.
- Do, L. G., & Spencer, A. J. (2016). Risk-benefit balance in the use of fluoride among young children. *Journal of Dental Research*, 95(2), 123–129. <https://doi.org/10.1177/0022034515616339>
- Folayan, M. O., El Tantawi, M., Chukwumah, N. M., et al. (2020). Prevalence, risk factors, and consequences of untreated dental caries in children in Sub-Saharan Africa: A systematic review and meta-analysis. *International Journal of Paediatric Dentistry*, 30(3), 254–269. <https://doi.org/10.1111/ipd.12601>
- Guo, L., Shi, W., & Zhao, W. (2019). The prevalence of dental caries in Chinese children: A systematic review and meta-analysis. *International Journal of Paediatric Dentistry*, 29(4), 323–333. <https://doi.org/10.1111/ipd.12477>
- Kassebaum, N. J., Smith, A. G. C., Bernabé, E., et al. (2017). Global, regional, and national prevalence, incidence, and disability-adjusted life years for oral conditions, 1990–2015. *Journal of Dental Research*, 96(4), 380–387. <https://doi.org/10.1177/0022034517693566>
- Li, X., Kolltveit, K. M., Tronstad, L., & Olsen, I. (2020). Systemic diseases caused by oral infection. *Clinical Microbiology Reviews*, 13(4), 547–558. <https://doi.org/10.1128/CMR.13.4.547-558.2000>
- Macek, M. D., Atchison, K. A., Chen, H., Wells, W., Haynes, D., Parker, R. M., & Azzo, S. (2017). Oral health conceptual knowledge and its role in predicting oral health outcomes. *Journal of Public Health Dentistry*, 77(1), 28–36. <https://doi.org/10.1111/jphd.12170>
- Moynihan, P., & Kelly, S. (2014). Effect on caries of restricting sugar intake: Systematic review to inform WHO guidelines. *Journal of Dental Research*, 93(1), 8–18. <https://doi.org/10.1177/0022034513508954>
- Peres, M. A., Macpherson, L. M. D., Weyant, R. J., Daly, B., Venturelli, R., Mathur, M. R., ... & Watt, R. G. (2019). Oral diseases: A global public health challenge. *The Lancet*, 394(10194), 249–260. [https://doi.org/10.1016/S0140-6736\(19\)31146-8](https://doi.org/10.1016/S0140-6736(19)31146-8)
- Petersen, P. E. (2016). Global policy for improvement of oral health in the 21st century – Implications to oral and general health and well-being. *International Dental Journal*, 66(1), 6–9. <https://doi.org/10.1111/idj.12137>

- Pitts, N. B., Zero, D. T., Marsh, P. D., Ekstrand, K., Weintraub, J. A., Ramos-Gomez, F., ... & Ismail, A. (2017). Dental caries. *Nature Reviews Disease Primers*, 3, 17030. <https://doi.org/10.1038/nrdp.2017.30>
- Sheiham, A., & Watt, R. G. (2017). The common risk factor approach: A rational basis for promoting oral health. *Community Dentistry and Oral Epidemiology*, 28(6), 399–406. <https://doi.org/10.1034/j.1600-0528.2000.028006399.x>
- Tonetti, M. S., & Jepsen, S. (2013). Clinical efficacy of periodontal therapy as a treatment of systemic diseases. *Periodontology 2000*, 62(1), 147–168. <https://doi.org/10.1111/prd.12023>
- Watt, R. G., & Daly, B. (2019). Interventions to reduce inequalities in oral health. *Community Dentistry and Oral Epidemiology*, 47(2), 158–167. <https://doi.org/10.1111/cdoe.12473>
- World Health Organization. (2022). Global oral health status report: Towards universal health coverage for oral health by 2030. Geneva: WHO.
- World Health Organization. (2023). Noncommunicable diseases country profiles 2023: Indonesia. Geneva: WHO. Retrieved from <https://www.who.int>