KAP and Oral Hygiene Understanding Endocarditis Risk in Sindh's Low-Income Communities

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ABSTRACT

Background of the study: Poor oral hygiene has been associated with systemic health problems, including infective endocarditis, especially in socioeconomically deprived populations. This study explores the knowledge, attitudes, and practices (KAP) of low-income groups in Sindh, Pakistan, regarding oral hygiene and their relationship with the risk of endocarditis.

Methodology: A stratified purposive sampling method was used to collect data from 176 adults in various districts of Sindh through a structured questionnaire. Structural Equation Modeling (SEM) was used to explore the relationships between oral hygiene behaviors, knowledge, and the risk of endocarditis. In detail, key barriers, such as access to dental care, oral health literacy, and economic challenges, were examined.

Results: The study findings indicated significant knowledge and practice gaps in oral health, with a strong association between poor oral hygiene and increased risk of endocarditis. Low socioeconomic status was a critical determinant that underscored the need for accessible dental care and public health education. Targeted interventions, such as oral health awareness campaigns and affordable dental services, showed promise in reducing oral infections and systemic health risks.

Conclusions: The current research draws attention to the urgent need for the mitigation of endocarditis by tackling oral health disparities among vulnerable populations. Improving oral hygiene practices and systemic health outcomes among the low-income population in Sindh will be achievable through community-based programs and interventions that are designed accordingly.

Introduction

Bacteremia, a bacterial infection of the inner lining of the heart, usually associated with poor oral hygiene and is very prevalent in low-income populations who rarely visit dental practitioners. Oral diseases such as dental caries and periodontal conditions worsen since poor oral hygiene allows bacteria into the bloodstream and increases the chance of systemic diseases such as endocarditis (Ali & Tasneem, 2021; Gomes et al., 2023). Low awareness and fewer resources in the underdeveloped regions of Karachi restrict effective oral hygiene practice in residents, who are further exposed to bacteremia and lethal conditions like infective endocarditis (Ahmed et al., 2022).

Traditionally, these communities have relied on miswak sticks, but these are not as effective as fluoride toothpaste and toothbrushes (Anwar et al., 2020). A dearth of adequate dental education programs exacerbates the issue. Studies in Brazil and rural India have demonstrated that education on oral health

decreases oral diseases and systemic complications, such as endocarditis, that result from improved hygiene practices (Patel et al., 2018). Research from Nigeria and the U.S. also highlights the need for educational campaigns and low-cost dental services to ensure good oral health among low-income populations (Adeniyi et al., 2019).

In Karachi, clinic-based dental programs and community education have improved the oral health behavior of disadvantaged populations (Rehman et al., 2021). However, knowledge and practice still have gaps thanks to financial barriers (Zafar et al., 2023). This paper discusses, through the lens of the Knowledge, Attitude and Practice model, the oral hygiene impact on endocarditis in Sindh, as well as the need for low-cost, targeted interventions towards systemic health outcomes (Farooq et al., 2022). This study will identify the KAP barriers to oral hygiene and the risk of endocarditis among the poor in the province of Sindh, Pakistan.

Research Objectives
1. The primary aim of the present study was to determine the knowledge, attitude, and practice (KAP) of lower socioeconomic communities of Sindh, Pakistan, about oral hygiene.
2. This study will compare the level of oral hygiene in patients recently diagnosed with endocarditis and those with no risk at all in the lower socioeconomic class.
3. To assess the effectiveness of such targeted oral health interventions in enhancing oral hygiene knowledge and decreasing risks associated with bacteremia and endocarditis.
4. To suggest effective intervention measures about oral hygiene and the risk of acquiring endocarditis from lower income groups in the province of Sindh.

Research Questions
1. To what extent are the communities of the low-income class of Sindh aware, accepting, and compliant with practising good oral hygiene?
2. In what way does the high population density and poor oral hygiene likely increase the risk of endocarditis in these populations?
3. To what extent can we understand the lack of or poor oral hygiene among people of lower geographical areas?
4. How beneficial are specific outreach efforts in giving valuable information about proper dental care and preventing bacteremia and endocarditis?
5. What type of public health interventions can be recommended to cause good and germs-free oral health and decrease the lower socioeconomic communities of Sindh endocarditis rate?

This study addresses the critical link between oral hygiene and endocarditis in Sindh's lower-income population. It utilizes the Knowledge, Attitude, and Practice (KAP) framework to inform effective prevention strategies to improve public health outcomes and to raise public health policymakers' and healthcare providers' awareness of the importance of improving oral health literacy to prevent systemic health problems.

Literature Review
Theoretical background
The Health Belief Model (HBM) is a widely used model of predictors of health behaviours where the individual's interpretation of perceived risks and benefits of preventive actions are examined. Its

constructs include perceived susceptibility, severity, benefits, barriers, cues to action, and self-efficacy (Janz & Becker, 2019). Results from HBM have successfully and positively influenced behaviour related to oral health. For instance, Dyer et al. (2020) propose that people are encouraged by wanting to understand the risks of having severe oral diseases, like periodontitis, by brushing and flossing. According to them, perceived benefits are essential, and once people understand the value of prevention, positivity in behaviour changes comes along.

Al-Quran et al. (2021) found that perceived threats are positively associated with do's and preventive behaviours among pregnant women, underscoring the importance of perceived risks in supporting health actions. This is consistent with our study, which aims to show that awareness of poor oral hygiene's links to endocarditis can help prevent it in low-income populations. Other important cues to action for promoting oral health practices have also been identified (Hu & Liu, 2022), including community-based interventions.

Preventive behaviours are hampered by barriers such as limited access to dental care and financial constraints. Understanding these challenges is a central requirement for designing targeted solutions (Janz & Becker, 2019). Additionally, educational programs addressing these barriers can tip people to make behavioural changes through informing and adding action (Hu & Liu, 2022). Incredibly, these support our study goals directly and underscore the relevance of education to oral health outcomes in Sindh's low literacy communities.

Theoretical Development of Hypotheses

This is particularly the concern for research into the area of oral conditions and their influence on oral cleanliness, which in turn, creates a relation between knowledge and behavior. Pereira et al. (2018) examined low-income citizens of Brazil, revealing that ignorance augments susceptibility to oral and systemic diseases, including endocarditis. The authors further explained that targeted education reduces the morbidity of oral disease and its effect on systemic health. However, they did not see whether knowledge itself is enough to hold behavioural changes long term. By contrast, Lin et al. (2020) believe that although knowledge may be crucial, it must continually be reinforced if long-term impact is to be expected. This study found out that even patients with adequate knowledge can fail to continue proper oral care without continual education.

Farooq et al. (2021) elaborate that health education programs can bring behavioral change in the lives of the people of the low-income group by removing barriers in knowledge and access. The authors argue that knowledge exchange is as important as the removal of financial and logistical barriers. Nasir and Suliman (2018) also argue that knowledge is not enough to change behavior, and that perceived threats and psychological factors, such as fear, are necessary to motivate action. This view argues that knowledge of risks is essential to change behaviors, which Lin et al. (2020) fail to consider in their focus on knowledge alone. Similarly, Santham et al. (2022) also say the same in that models such as HBM have been effective due to the reduction of perceived barriers such as cost and availability as well as education.

H1: Greater patient knowledge about oral health significantly impacts the maintenance of proper oral hygiene.

Similarly, the link between patient attitudes and oral hygiene practices is interlinked too. Lee et al. (2021) conclude that better oral hygiene practices relate to a positive attitude towards dental care. However, Miller et al. (2020) highlighted that bad attitudes might be a source of dental anxiety, thus not upholding proper hygiene maintenance. Walker et al. (2023) further supported the fact that positive attitudes, mainly formed in childhood, contribute to the continuation of good oral health behaviours for a long time. Chen et al. (2022) stress that proactive attitudes are more effective in fostering adherence to preventive dental care. Martin et al. (2021) observe that, though positive attitudes are very important, socioeconomic status and educational levels influence oral hygiene practices. This therefore calls for interventions that would improve both positive and negative attitudes toward dental care.

H2: Positive patient attitudes toward dental care significantly enhance oral hygiene practices.

Other researchers suggest that the frequency of the oral care practice results in better oral health. Ganss et al. (2021) indicated that regular oral care practice overtime develops the habit of good oral health. Similarly, Lee et al. (2020) in the same study found that quality oral hygiene practice is correlated with better healthy status, especially among high-risk populations. All these results highlight the need for long-term dedication to dental care. However, Khalid et al. (2019) reported that children from public schools of Karachi had poor oral hygiene mainly due to low access to dental education and care. This suggests the need for targeted interventions in the low-income communities to improve oral health outcomes.

H3: Consistent and healthy dental care practices significantly improve oral hygiene.

The connection between oral hygiene and the prevention of endocarditis (IE) has also been investigated. Lean et al. (2022) stressed that prophylactic antibiotics are still required for high-risk IE patients even if good oral hygiene is maintained. Vähäsarja et al. (2021) identified poor oral hygiene as a significant risk factor for the development of IE, especially in high-risk populations. Extending on this idea, Gomes et al. (2022) demonstrated improved oral hygiene decreased harmful bacteria causing IE mainly among low-income people who might lack access to dental care services. Mougeot et al. (2021) indicated that although there's oral hygiene to a certain point, other contributory factors range from genetic causes and predisposition factors such as IE. From the variation in opinions it still seems oral hygiene is quite the main factor needed for the decreased IE risk.

H4: Improved oral hygiene, supported by knowledge, attitudes, and consistent dental care, reduces the risk of developing endocarditis.

The research highlighted knowledge, attitude, and consistent practices in oral hygiene in improving the status of oral health. Knowing alone is inadequate but must be supported by continuing reinforcement and a full understanding of the perceived barriers to change in behaviour. Positive attitude has a greater influence, and fear and anxiety factors must also be dealt with in order for such behaviour changes to be continued over time. In conclusion, a holistic approach that encompasses education, attitude change, and structural support is vital for enhancing oral health outcomes and prevention of systemic diseases such as endocarditis.
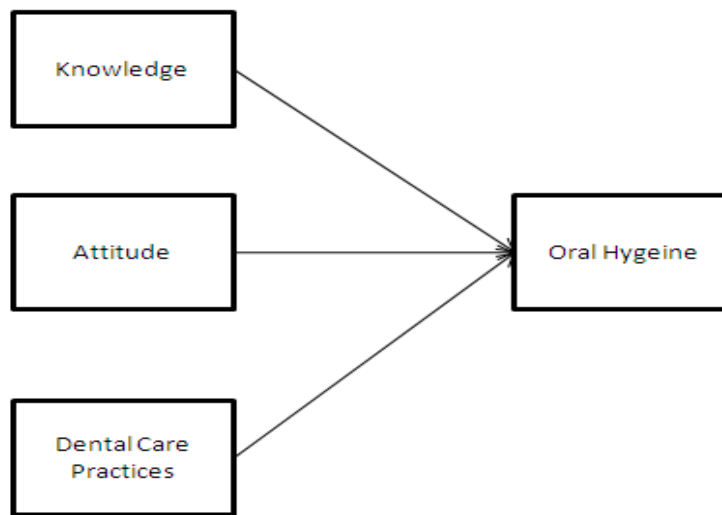
Knowledge

Attitude

Oral Hygeine

Dental Care Practices

Figure 01: Theoretical Model (Ahmed et al., 2022)

Methodology

This study's methodology was deductive research correlating poor oral health with other systemic issues: endocarditis (Ahmed et al., 2022). An efficiency in collecting the data on a large scale across diverse populations in the case of a survey-based methodology (Ali & Tasneem, 2021). The study was done using a quantitative correlation design to explore the natural relationship between oral hygiene and risk of developing endocarditis and whether the causal aspects of poor oral hygiene affect health outcomes. Data were cross-sectional, giving a snapshot of the current behaviors and attitudes (Lee et al., 2022).

Target participants for this study were adults from low socioeconomic groups in Sindh, Pakistan, susceptible to oral health issues and endocarditis (Adeniyi et al., 2019). For this purposeful selection of participants, we utilized stratified sampling on those above the age of 20 who have spent more than one year in Sindh and do not have plans to visit the dentist (Nasir & Suliman, 2020). In addition, Hlatshwako et al. (2023) selected 176 participants from diverse demographics, oral hygiene practices, and health status to increase the statistical reliability of the sample.

The analysis of demographic information, oral hygiene practices, and dental check-ups was conducted through a standardized questionnaire with a 5-point Likert scale (Ganss et al., 2019). Innovative PLS software was used within a Structural Equation Modeling (SEM) framework to analyze data to test relationships between knowledge, attitudes, and practices. Further multi-group analysis was conducted to compare outcomes between at-risk and healthy participants to identify disparities in oral health impacts (Handayani et al., 2023).

Ethical Considerations

This research concerned ethical considerations, ensuring participants' rights were represented. Clear explanations about how informed consent was obtained, even from the illiterate, was that patients participate voluntarily. Here, the data was kept confidential, and the participants were anonymized.

Ethical standards were adhered to while promoting health improvements for low-income men and women through practical insights in the study.

Result and Data Analysis

Category	Sub-Category	Frequency	Percentage (%)
Gender	Male	85	48.3
	Female	91	51.7
	Total	**176**	**100.0**
Age	20-25	39	22.2
	26-30	33	18.8
	31-35	38	21.6
	36-40	35	19.9
	40+	31	17.6
	Total	**176**	**100.0**
Income	37,000-43,000	31	17.6
	43,000-48,000	37	21.0
	48,000-53,000	30	17.0
	53,000-58,000	42	23.9
	58,000+	36	20.5
	Total	**176**	**100.0**
Region	Karachi	48	27.3
	Hyderabad	29	16.5
	Badin	36	20.5
	Thatta	24	13.6
	Jamshoro	39	22.2
	Total	**176**	**100.0**
Strata I	Patients with Risk of Endocarditis	78	44.3
Strata II	No Risk of Endocarditis	98	55.7
	Total	**176**	**100.0**

Table 01: Demographics analysis

The study's demographic analysis found a female participation of 51.7% and a male participation of 48.3%; many of the respondents were in the ages 20–25 (22.2%) and 31–35 (21.6%). Low income status was evident because most earned 53,000–58,000 PKR monthly. Regional data suggested that Karachi (27.3%) and Jamshoro (22.2%), 44.3%, were at risk for endocarditis, allowing insight into targeted oral health.

	Attitude	Dental Care Practices	Knowledge	Oral Hygiene
Att1	0.834			
Att2	0.875			
Att3	0.874			
Att4	0.902			
DCP2		0.858		
DCP3		0.816		
DCP4		0.828		
K1			0.822	
K2			0.861	
K3			0.876	
K5			0.824	
OH1				0.852
OH2				0.824
OH3				0.776
OH4				0.731

Table 02: Outer Loadings – Strata I - Patients with Risk of Endocarditis

Outer loadings for Strata I are presented in Table 02, which shows that all the constructs are highly correlated. Positive attitude-related items (Att1-Att4) had high loading coefficients, with Att4 having a coefficient of 0.902, illustrating the significance of having a positive attitude towards dental care. Knowledge and oral hygiene measures also had relatively high factor loadings, confirming their relevance for the patients. However, to address the problem with the loading, DCP1 and K4 were cut off from the construction.

	Attitude	Dental Care Practices	Knowledge	Oral Hygiene
Att1	0.844			
Att2	0.826			
Att3	0.867			
Att4	0.891			
DCP2		0.904		
DCP3		0.831		
DCP4		0.865		
K1			0.845	
K2			0.857	
K3			0.882	
K5			0.814	
OH1				0.858
OH2				0.899
OH3				0.853
OH4				0.827

Table 03: Outer Loadings - Strata II - No Risk of Endocarditis

As shown in Table 03, the outer loadings of Strata II demonstrate reasonable reliability of the constructs. The attitude items (Att1 to Att4) showed acceptable loadings, whereas attitude 4 had the highest loading of 0.891, which indicates the importance of a positive attitude towards enhancing good dental practices. Knowledge and oral hygiene also demonstrated relatively high coefficients of loadings, which is important.

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	Strata I - Patients with Risk of Endocarditis		Strata II - No Risk of Endocarditis	
	R-square	R-square adjusted	R-square	R-square adjusted
Oral Hygiene	0.728	0.719	0.821	0.814

Table 04: Quality Criteria

Table 04 describes the quality criteria of both strata assessing the model's explanation concerning oral hygiene. The R-squared value is 0.728 in Strata I with patients at risk of endocarditis, which means the model can explain 72.8 % of the variability in oral hygiene. The adjusted R-squared of 0.719 also supports the firm fit of the model, but at the same time, considering the model's complexity. On the other hand, for Strata II, we get an R-squared of 0.821 and an adjusted R-squared of 0.814, which indicates a strong positive relationship between the variables. This shows that favourable attitudes, knowledge, and dental care practices significantly improve oral hygiene in people with no endocarditis threat.

	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Attitude	0.894	0.899	0.759
Dental Care Practices	0.782	0.783	0.696
Knowledge	0.867	0.869	0.716
Oral Hygiene	0.808	0.815	0.636

Table 05: Convergent Reliability –Strata I - Patients with Risk of Endocarditis

Reliability statistics for Strata I are presented in Table 05, which shows the convergent reliability of the various constructs. Our Cronbach's alpha values are above the acceptable level of 0.7, as highlighted in table 3 and 4, with an exceptionally high value of 0.894 for the attitude construct. The AVE values are moderate and above, which confirm the criterion validity of constructs attitude and knowledge in particular, thus supporting the reliability of the factors under investigation in the oral hygiene domain.

	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Attitude	0.880	0.888	0.735
Dental Care Practices	0.835	0.835	0.752
Knowledge	0.872	0.883	0.722
Oral Hygiene	0.882	0.884	0.739

Table 06: Convergent Reliability - Strata II - No Risk of Endocarditis

Table 06 shows the convergent reliability statistics, and the internal consistency estimate for the constructs of Strata II was high. All obtained Cronbach's alpha coefficients are above the minimum standard of 0.7, with the highest score being 0.880 in the attitude subscale. The average AVE values, especially for dental care practices, confirm sufficient construct validity, supporting the reliability of the measures.

	Attitude	Dental Care Practices	Knowledge	Oral Hygiene
Attitude				
Dental Care Practices	0.706			
Knowledge	0.833	0.719		
Oral Hygiene	0.787	0.827	0.695	

Table 07: Discriminant Validity (HTMT) - Strata I - Patients with Risk of Endocarditis

The discriminant validity for Strata I is presented in Table 07 using the Heterotrait-Monotrait Ratio (HTMT). Discriminant validity below 0.85 is considered acceptable for the constructs. The obtained data revealed a relatively high correlation between the levels of knowledge and oral hygiene, equal to 0.833, while the correlation between the dental care practices and attitude was 0.706, indicating appreciable differences between the measures.

	Attitude	Dental Care Practices	Knowledge	Oral Hygiene
Attitude				
Dental Care Practices	0.824			
Knowledge	0.813	0.805		
Oral Hygiene	0.763	0.791	0.693	

Table 08: Discriminant Validity (HTMT) - Strata II - No Risk of Endocarditis

Table 08 shows the discriminant validity test of Strata II using HTMT. These values show good discriminant validity, with all the correlation values below .85. Interestingly, the highest coefficient is between attitude and practice (p=0.824) to minimize construct similarity. However, knowledge and actual oral hygiene have a significant, though not decisive, correlation of 0.693.

Structured Equation Model

Further, bootstrapping analysis was performed at this stage to test internal validity and reliability and assess the cross-strata construct correlations. This method offered CI and SE for evaluating the stability and precision of the structural model and thus made it easier to compare the findings between groups of patients with and without risk of endocarditis.

	Strata I – Patients with Risk of Endocarditis			Strata II – No Risk of Endocarditis		
Hypotheses	Original sample (O)	T statistics (|O/STDEV|)	P values	Original sample (O)	T statistics (|O/STDEV|)	P values
Attitude -> Oral Hygiene	0.307	2.527	0.006	0.415	3.745	0.000
Dental Care Practices -> Oral Hygiene	0.657	5.134	0.000	0.434	4.216	0.000
Knowledge -> Oral Hygiene	0.031	2.983	0.004	0.119	2.742	0.007

Table 09: Structured Equation Modeling Combined

Finally, the SEM analysis demonstrates the interaction effects of attitude, dental care practises, knowledge and oral hygiene in Strata II (not at risk of endocarditis) and Strata I (at risk). First, in Strata I, dental care practices (O = 0.657, p = 0.000) are the most influential, with attitude (O = 0.307, p = 0.006) and knowledge (O = 0.031, p = 0.004) next. Attitude (O = 0.415, p = 0.000) and knowledge (O = 0.119, p = 0.007) are more substantial roles in Strata II as well, while dental care practices (O = 0.434, p = 0.000) remain significant. Hypotheses H1-H3 were accepted and H4 was shown by multi-group analysis to be valid, corroborating the importance of preventive oral hygiene practices.

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Hypotheses	Difference (Strata_1 - Strata_2)	1-tailedStrata_1 vsStrata_2 P value	2- tailed Strata_1 vsStrata_2 p-value
Attitude -> Oral Hygiene	-0.108	0.023	0.046
Dental Care Practices -> Oral Hygiene	-0.223	0.021	0.042
Knowledge -> Oral Hygiene	-0.150	0.018	0.036

Table 10: Multi-group Analysis

Unlike Strata II (not at risk), Strata I (at risk of endocarditis) is immunologically affected by attitude, dental care practices and oral hygiene knowledge. The below zero differences reflect weaker Strata I than Strata II; practices of knowledge do (-0.150, p = 0.036), and attitudes do (-0.108, p = 0.046). Results support H4, learning, attitudes, and practices, which will help decrease endocarditis. Targeted interventions, such as dental education for Strata I patients, better dental care access and personalized prevention procedures are necessary for Strata I patients. Community-based programs exist that significantly reduce the risk of endocarditis (these programs address these needs).

Conclusion & Future Directions

The present investigation underscores the awareness, behaviours, and practices that may help improve oral care for people with endocarditis risks. Research evidence suggests a positive correlation exists between attitudes and oral hygiene where patients have no risk of endocarditis. On the other hand, proper dental healthcare practices are helpful to the endangered population as they support the importance of health-related hygiene practices to prevent diseases.

The multi-group analysis indicates that at-risk patients are less responsive to knowledge and attitudes and require further educational interventions. Thus, to bridge these gaps, the introduction and practice of health functions that will improve dental education and availability, particularly to lower-class citizens across the region, should be employed thoroughly. Finally, this paper proposes population-specific approaches to enhancing oral hygiene to reduce endocarditis hazards and enhance the overall quality of life of the target group.

This research was not without limitations; first, the data set used here was self-reported, and the participants may have inaccurate information due to the result of social desirability bias or memory decay when reporting their oral hygiene practices. Moreover, the cross-sectional data collection approach limits the options for a well-defined causal link between oral hygiene practices and the susceptibility to endocarditis. Future work might utilize longitudinal designs to measure changes longitudinally and include higher numbers and a more diverse population to increase the generalisability of the findings. However, incorporating qualitative approaches may expand knowledge of these populations' obstacles, thereby improving the aimed subsequent population health initiatives.

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