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Periodontal status, knowledge, and dental barriers among Kuantan healthcare workers

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Abstract

Periodontal disease remains a pervasive global health challenge, affecting 94.6% of Malaysian adults. Despite this high national prevalence, data regarding healthcare workers remain scarce. This study addresses this gap by evaluating periodontal status, knowledge, and barriers to dental care among Ministry of Health (MOH) employees in Kuantan, Pahang, a cohort that is expected to exhibit high health literacy. Our objectives are to evaluate periodontal status and to determine associated factors for knowledge, barriers to dental attendance, and source of dental knowledge. A cross-sectional study was conducted among 224 MOH employees. Data were collected via a self-administered questionnaire and a clinical Basic Periodontal Examination (BPE). Simple and multiple linear regression analyses identified associated factors for each domain. Periodontal disease was highly prevalent (99.6%), with 42.0% exhibiting moderate (CPI 3) and 23.2% severe (CPI 4) forms. Multiple linear regression showed that being female (adjusted $\beta = 0.533$, $p = 0.001$) and having no deep periodontal pockets (adjusted $\beta = 0.428$, $p = 0.008$) were associated with higher knowledge scores. Conversely, being non-dental personnel (adjusted $\beta = -1.029$, $p < 0.001$) was the strongest factor associated with lower knowledge scores. No specific personal or clinical factors explained the barrier scores. This shows that obstacles like being 'busy' are widespread workplace hurdles rather than differences between individual employees. A striking knowledge–practice gap exists among MOH employees, marked by high disease prevalence despite adequate knowledge. Targeted education strategies addressing specific predictor groups particularly non-dental personnel and individuals with existing deep periodontal pockets are warranted.

Keywords: *barriers, BPE, healthcare workers, knowledge, periodontal disease*

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Introduction

Civil services are frequently utilised by the Malaysian population, particularly in the healthcare sector, where 60–80% of services are accessed through government clinics (NHMS, 2019). This is largely attributable to the wide availability and subsidised nature of such services (Kananatu, 2002). The role of civil servants, especially medical professionals, in promoting oral health is substantial, encompassing screening for oral diseases, emergency care, pain management, and referral (Cruz *et al.*, 2004; Heilbrunn-Lang *et al.*, 2015). These professionals are expected to serve as health educators, given the general public's perception that those working within health institutions possess sound health knowledge.

Several studies have investigated the knowledge, attitudes, and practices of medical professionals towards oral and periodontal health, with inconsistent results (Rodrigues *et al.*, 2024; Shah *et al.*, 2020).

While some groups demonstrate adequate knowledge, others remain poorly equipped regarding periodontal disease. The subsequent effect of this variability on their clinical practice, health promotion roles, and personal oral health outcomes remains insufficiently explored.

The periodontal health status of civil servants in Malaysia remains largely undocumented. While a 2003 government circular encouraged public sector employees aged 40 years and above to undergo physical, laboratory, and dental examinations at government clinics and hospitals, this policy may leave critical gaps. Data from the National Oral Health Survey of Adults (NOHSA) indicates that periodontal disease is highly prevalent, particularly within the 35–44 age group, suggesting that the current age-restricted screening framework is insufficient (Mohd-Dom *et al*., 2013; NOHSA, 2020). Consequently, available dental records for civil servants are typically limited to a single, baseline pre-employment screening, which is rarely updated throughout their careers.

Therefore, this study was conducted to provide baseline data on the periodontal status and oral health literacy of MOH employees in Kuantan, Pahang. This study aimed to: (1) evaluate the periodontal status among MOH personnel in Kuantan, Pahang; (2) determine associated factors for knowledge, barriers to dental attendance, and source of dental knowledge scores using multiple linear regression.

Materials and Methods

Prior to study commencement, ethical approval was obtained from the Medical Research Ethics Committee [Reference no: NMRR-21-1425-59959]. This cross-sectional study was conducted over two years (2021–2023) among MOH employees in Kuantan, Pahang. A one-stage stratified cluster sampling method was used to select participants from six divisions of the Pahang State Health Department (JKNP), which were public health, medical, dental, management, pharmacy, and safety and quality of food. Collectively, sixteen operational units within these divisions were involved in the study. All permanent and contract MOH personnel aged 18 years and above who were present during data collection and provided informed consent were included. Exclusion criteria comprised edentulous individuals, those with only one remaining tooth, mentally incapacitated or illiterate subjects, those who declined either component of the assessment, and individuals with contraindications to periodontal probing (*e.g.*, bleeding disorders, acute infectious diseases).

Sample size calculation

The sample size for this study was calculated based on two primary objectives using Statulator (Statulator®, Sydney, Australia) and PS: Power and Sample Size Calculation software (Dupont & Plummer, 1990). For objective 1 (estimation of periodontal disease prevalence), assuming 6% of the population has a healthy periodontium (NOHSA, 2020) and a population size of 4,675 (JKNP, 2021), a minimum of 86 subjects was required (5% absolute precision, 95% confidence). For objective 2 (identifying associated factors for periodontal knowledge), sample size requirements were evaluated for both univariate and multivariate approaches. To detect a significant difference in continuous knowledge scores derived from an effect size ($\lambda = 0.39$)(Umeizudike *et al*., 2015), it was required to recruit 208 subjects ($\alpha = 0.05$, power = 0.80). The final recruited sample of 224 subjects successfully met these requirements. Furthermore, post-hoc power calculations confirmed that this sample of 224 provides robust power (>0.80) to evaluate up to six predictors simultaneously in the multiple linear regression model, detecting medium effect sizes $f^2 \geq 0.15$ and significance level of 0.05.

Questionnaire and clinical assessment

A dual-language (English and Malay) self-administered questionnaire, adapted from a

Malaysian study, was used (Yahya *et al*., 2010). The questionnaire comprised four sections: demographics, a knowledge scale, a barriers-to-dental-attendance scale, and a source-of-dental-knowledge scale. The knowledge scale on periodontal diseases comprised six items, scored dichotomously (1 point for correct, 0 points for incorrect or "don't know" responses), yielding a continuous total score ranging from 0 to 6, where higher scores reflect superior theoretical knowledge. The barriers-to-dental-attendance scale consists of six items measured on a reverse-coded 5-point Likert scale (1 = Strongly Agree, 5 = Strongly Disagree) designed to quantify qualitative obstacles, meaning higher scores signify lower perceived barriers. Conversely, the source-of-dental-knowledge comprises six items scored on a standard 5-point Likert scale (5 = Strongly Agree, 1 = Strongly Disagree) to measure information-seeking behaviours, where higher scores reflect a stronger agreement on the knowledge sources. Content and face validity were confirmed by a panel of two periodontists. Internal consistency was assessed using Cronbach's alpha (α); knowledge domain α = 0.589, barrier domain α = 0.709, and source of dental knowledge domain α = 0.853.

Periodontal status was assessed using the Basic Periodontal Examination (BPE) (British Society of Periodontology, 2019). Assessment was done by "walking" the probe around the teeth to find the highest score in each sextant. The dentition was divided into 6 sextants, and the highest score for each sextant was recorded. The score for each sextant was presented in CPI (Community Periodontal Index) score. All teeth in each sextant are examined (except for 3rd molars unless 1st and/or 2nd molars are missing). For a sextant to qualify for recording, it o0-/[xmust contain at least 2 teeth. Three investigators were calibrated against an experienced periodontist before data collection, achieving a Kappa score of 0.80 (substantial agreement). The highest CPI score across all sextants was recorded as the participant's final score.

Statistical analysis

Data were analysed using R Statistical Software (R Core Team, 2026). Descriptive statistics were used to characterise the study population. For each outcome domain (knowledge score, barriers-to-dental-attendance score, and source-of-dental-knowledge score), simple linear regression was first performed to examine unadjusted associations with sociodemographic and clinical variables. Variables with $p < 0.25$ in simple regression or those of clinical relevance were subsequently entered into multiple linear regression models. Backward elimination using the Akaike Information Criterion (AIC) was applied to derive the most parsimonious final models. Before interpreting final models, the four assumptions of multiple linear regression were assessed: linearity (Residuals vs. Fitted plots), normality of residuals (Q-Q plots and Shapiro-Wilk test), homoscedasticity (Scale-Location plots), and multicollinearity (Variance Inflation Factor; VIF). For the knowledge score model, robust standard errors (HC3) were applied due to minor heteroscedasticity. Statistical significance was set at $p < 0.05$.

Results

Demographic characteristics

A total of 224 MOH employees participated. The mean age was 36.7 years (SD = 7.70), with 68.8% aged under 40 years. The majority were female (68.3%), Malay (88.8%), and held a diploma or degree qualification (83.0%). Supporting staff comprised 58.5% of the sample. The largest group had 6–14 years of working experience (42.9%). Only 10.3% reported having a comorbidity. Full demographic details are presented in Table 1. This table summarizes the distribution of age, gender, ethnicity, education level, job position, years of service, and comorbidity status among the Ministry of Health (MOH) employees in Kuantan.

Table 1. Characteristics of study sample (n=224).

Variables	N (%)
Age	
< 40 years old	154 (68.8)
⩾ 40 years old	70 (31.2)
Gender	
Male	71 (31.7)
Female	153 (68.3)
Race	
Malay	199 (88.8)
Chinese	12 (5.4)
Indian	7 (3.1)
Others	6 (2.7)
Education level	
Secondary school	38 (17.0)
Diploma	88 (39.2)
Degree	98 (43.8)
Job position	
Officers	93 (41.5)
Supporting staff	131 (58.5)
Dental personnel status	
Dental	20 (8.9)
Non- Dental	204 (91.1)
Working years	
Less than 1 year	13 (5.8)
1 year to 5 years	56 (25)
6 years to 14 years	96 (42.9)
15 years and above	59 (26.3)
Presence of comorbidity	
Yes	23 (10.3)
No	201 (89.7)

Periodontal status

Periodontal disease was highly prevalent, affecting 99.6% of participants. The most common finding was CPI 3 (pockets 3.5–5.5 mm), observed in 94 participants (42.0%), followed by CPI 2 (calculus and bleeding on probing) in 67 participants (29.9%). CPI 4 (pockets ≥ 5.5 mm) was recorded in 50 participants (23.2%). Only one participant (0.4%) had a healthy periodontium (CPI 0), and 4.5% had CPI 1 (Figure 1).

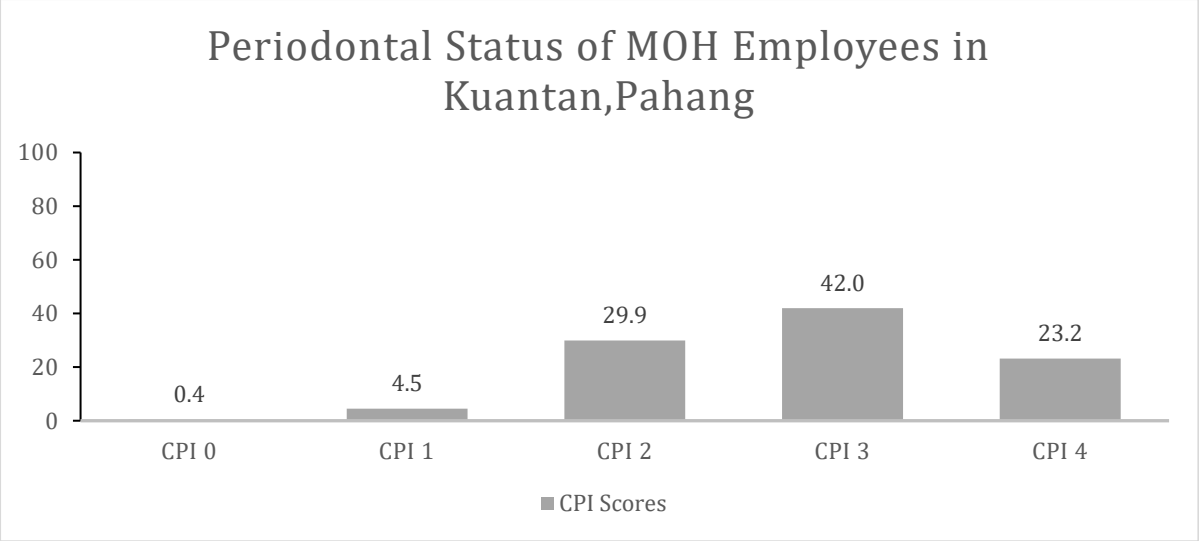

Figure 1. Periodontal status of MOH employees in Kuantan, Pahang (n=224).

Knowledge score

In simple linear regression, gender (female), dental personnel category, presence of deep periodontal pockets (CPI 3 and 4), education level, and job position were significantly associated with knowledge score (Table 2). Following backward elimination, the final multiple linear regression model was statistically significant ($p < 0.001$) and explained 14.9% of the variance in knowledge score (adjusted $R^2 = 0.149$). Non-dental personnel scored significantly lower than dental personnel (adjusted $\beta = -1.029$; 95% CI: −1.358, −0.701; $p < 0.001$), representing the strongest association. Being female was independently associated with a higher knowledge score (adjusted $\beta = 0.533$; 95% CI: 0.213, 0.853; $p = 0.001$). Absence of deep periodontal pockets (CPI 3 and 4) was associated with a higher score (adjusted $\beta = 0.428$; 95% CI: 0.114, 0.742; $p = 0.008$). Education level also showed a positive association with knowledge score (adjusted $\beta = 0.403$; 95% CI: 0.005, 0.801; $p = 0.049$). Full model results are presented in Table 2.

Barrier-to-dental-attendance score

Simple linear regression revealed no statistically significant associations between any of the examined sociodemographic or clinical variables and barrier scores. Nevertheless, multiple linear regression was performed to account for potential confounding, with variables selected based on clinical relevance. The final model, comprising education level, job position, presence of CPI 3 and 4, and presence of CPI 4, was not statistically significant ($p = 0.191$) and accounted for only 1.0% of the variance (adjusted $R^2 = 0.010$). No individual factor was statistically significant (Table 3).

Table 2. Factors associated with knowledge score using simple and multiple linear regression (n=224).

Factors	Simple linear regression		Multiple linear regression	
	β^a (95% CI)	*P*-value	β^b (95% CI)	*P*-value
Age	-0.02 (-0.04, 0.00)	0.092		
Gender				
Male	-	-	-	-
Female	0.63 (0.30, 0.97)	<0.001	0.533 (0.213, 0.853)	0.001
Race				
Malay	-	-		
Chinese	0.29 (-0.43, 1.01)	0.420		
Indian	0.09 (-0.84, 1.02)	0.850		
Others	0.04 (-0.96, 1.05)	0.930		
Presence of comorbidities				
Yes	-	-		
No	0.52 (0.00, 1.00)	0.052		
Education level				
Secondary school and lower	-	-	-	-
Diploma and degree	0.55 (0.13, 0.98)	0.011	0.403 (0.005, 0.801)	0.049
Working years				
Less than 1 year	-	-		
1–5 years	-0.33 (-1.10, 0.41)	0.378		
6–14 years	-0.21 (-0.93, 0.50)	0.554		
More than 15 years	-0.40 (-1.10, 0.34)	0.291		
Job Position				
Officers	-	-		
Supporting staff	-0.33 (-0.66, -0.01)	0.043		
Dental personnel status				
Dental	-	-	-	-
Non-dental	-1.10 (-1.65, -0.56)	<0.001	-1.029 (-1.358, -0.701)	<0.001
Presence of CPI 3 and 4				
Yes	-	-	-	-
No	0.49 (0.16, 0.82)	0.004	0.428 (0.114, 0.742)	0.008
Presence of CPI 4				
Yes	-	-		
No	0.31 (-0.07, 0.69)	0.108		

β^a = unstandardized coefficient from simple linear regression; β^b = unstandardized coefficient from multiple linear regression with robust standard errors (HC3); - = reference category; CI = confidence interval

Table 3. Factors associated with barrier score using simple and multiple linear regression (n=224).

Factors	Simple linear regression		Multiple linear regression	
	β[a] (95% CI)	*P*-value	β[b] (95% CI)	*P*-value
Age	0.01 (-0.06, 0.09)	0.734		
Gender				
Male	—	—		
Female	0.65 (-0.58, 1.90)	0.301		
Race				
Malay	—	—		
Chinese	-0.14 (-2.7, 2.40)	0.920		
Indian	-0.35 (-3.70, 3.00)	0.830		
Others	2.4 (-1.2, 5.9)	0.190		
Presence of comorbidities				
Yes	—	—		
No	-0.06 (-2.00, 1.80)	0.948		
Education level				
Secondary school and lower	—	—	—	—
Diploma and degree	0.85 (-0.68, 2.40)	0.272	1.37 (-0.25, 2.98)	0.098
Working years				
Less than 1 year	—	—		
1–5 years	-0.35 (-3.00, 2.30)	0.800		
6–14 years	0.22 (-2.3, 2.80)	0.870		
More than 15 years	0.23 (-2.40, 2.90)	0.860		
Job position				
Officers	—	—	—	—
Supporting staff	0.69 (-0.47, 1.90)	0.244	0.91 (-0.42, 2.24)	0.177
Dental personnel status				
Dental	—	—		
Non-dental	0.70 (-1.30, 2.70)	0.498		
Presence of CPI 3 and 4				
Yes	—	—	—	—
No	-0.77 (-2.00, 0.43)	0.207	-0.89 (-2.27, 0.49)	0.206
Presence of CPI 4				
Yes	—	—	—	—
No	0.29 (-1.10, 1.70)	0.677	0.92 (-0.58, 2.41)	0.228

[a] Unadjusted. [b] Adjusted for CPI 3&4, job position, education level, and CPI 4. — = reference category.

Source-of-dental-knowledge score

In simple linear regression, being female, job position (supporting staff), and working years (6–14 years) showed associations with this domain. Following backward elimination (race removed), the final multiple linear regression model was statistically significant ($p < 0.001$) and explained 6.5% of the variance (adjusted $R^2 = 0.065$). Female was the strongest predictor (adjusted β = 0.211; 95% CI: 0.074, 0.347; p = 0.005). Working experience of 6–14 years (adjusted β = −0.346; 95% CI: −0.649, −0.043; p = 0.026) and more than 15 years (adjusted β = −0.340; 95% CI: −0.666, −0.014; p = 0.042) were independently associated with lower scores compared to those with less than one year of experience. Supporting staff scored significantly higher than officers (adjusted β = 0.172; 95% CI: 0.019, 0.326; p = 0.029). Presence of comorbidities showed a borderline inverse association (adjusted β = 0.220; p = 0.054) (Table 4).

Table 4. Simple and multiple linear regression of factors associated with source-of-dental-knowledge score (n=224).

Factors	Simple linear regression		Multiple linear regression	
	β[a] (95% CI)	*P*-value	β[b] (95% CI)	*P*-value
Age	-0.006 (-0.015, 0.004)	0.247		
Gender				
Male	—	—	—	—
Female	0.235 (0.083, 0.387)	0.003	0.211 (0.074, 0.347)	0.005
Race				
Malay	—	—		
Chinese	-0.092 (-0.412, 0.229)	0.574		
Indian	0.156 (-0.258, 0.571)	0.458		
Others	0.394 (-0.052, 0.841)	0.083		
Presence of comorbidities				
Yes	—	—	—	—
No	0.226 (-0.011, 0.464)	0.061	0.220 (-0.003, 0.443)	0.054
Education level				
Secondary school and lower	—	—		
Diploma and degree	-0.029 (-0.222, 0.164)	0.765		
Working years				
Less than 1 year	—	—	—	—
1–5 years	-0.174 (-0.503, 0.156)	0.303	-0.214 (-0.525, 0.097)	0.178
6–14 years	-0.306 (-0.624, 0.012)	0.059	-0.346 (-0.649, -0.043)	0.026
More than 15 years	-0.211 (-0.540, 0.119)	0.210	-0.340 (-0.666, -0.014)	0.042
Job position				
Officers	—	—	—	—
Supporting staff	0.143 (-0.003, 0.289)	0.054	0.172 (0.019, 0.326)	0.029
Dental personnel status				
Dental	—	—		
Non-dental	0.027 (-0.226, 0.280)	0.835		
Presence of CPI 3 and 4				
Yes	—	—		
No	0.101 (-0.051, 0.252)	0.192		
Presence of CPI 4				
Yes	—	—		
No	-0.070 (-0.241, 0.101)	0.421		

[a] Unadjusted. [b] Adjusted; final model selected by backward elimination (removed: race). — = reference category

Discussion

This study reveals a critical knowledge–practice gap in oral health among MOH employees in Kuantan, Pahang. Despite reporting generally adequate knowledge levels and broad endorsement of various dental information sources, 99.6% of participants demonstrated clinical evidence of periodontal disease, including 42.0% with moderate (CPI 3) and 23.2% with severe forms (CPI 4). These findings are consistent with the high national prevalence of periodontal disease reported in NOHSA 2020 and support earlier work demonstrating that health literacy does not invariably translate into appropriate health behaviour (Nordin *et al*., 2021; Shah *et al*., 2020; Zadik *et al*., 2008). Healthcare workers may be particularly susceptible to this gap due to a tendency to prioritise acute medical

concerns over their own preventive dental care, compounded by professional overconfidence in self-monitoring oral health.

The multiple linear regression model for knowledge scores identified dental personnel status as the strongest associated factor, with non-dental staff scoring approximately 1.03 points lower than their dental colleagues. This is consistent with prior studies demonstrating that formal dental training substantially enhances oral health knowledge (Silk *et al*., 2009; Yao *et al*., 2019). Non-dental healthcare workers typically receive minimal oral health education during undergraduate training, and continuing professional development in this domain remains limited outside the dental profession (Barzoki *et al*., 2025; Sarioglu & Kirtiloglu, 2026). Being female was independently associated with a higher knowledge score, consistent with broader evidence that women demonstrate greater engagement with health information and preventive health behaviours (Baker *et al*., 2014; Rata Mohan *et al*., 2025). The independent association between absence of deep periodontal pockets (CPI 3 and 4) and higher knowledge scores suggests that greater knowledge may be protective against disease progression though the cross-sectional design limits the causal inference.

The multiple linear regression model for barrier-to-dental-attendance scores was non-significant and explained only 1.0% of the variance, indicating that the sociodemographic and clinical variables examined in this study do not adequately predict perceived barriers to dental care. This finding underscores the multidimensional nature of dental care barriers, which are likely driven by psychosocial constructs, including dental anxiety, self-efficacy, perceived susceptibility, and financial considerations that were not captured in the present study (van der Zande *et al*., 2021). The borderline trend for education level ($p = 0.098$) may hint that more educated workers are more aware of unmet dental needs, though this interpretation requires cautious handling given the non-significant overall model. Regardless of the severity of the periodontal disease, most participants reported being 'too busy' or facing 'long waiting times' as their main barriers. This suggests that the real issues are scheduling and long waits, which require clinic-level changes rather than just trying to change individual patient behaviour.

The source-of-dental-knowledge model was significant ($p < 0.001$), though it accounted for modest variance (adjusted $R^2 = 0.065$). Being female emerged as the strongest predictor, consistent with evidence that women engage with a broader range of health information channels (Dluhos-Sebesto *et al*., 2021). The significant drop in scores among workers with 6 or more years of experience suggests they may rely primarily on established routines rather than actively seeking out new dental knowledge. Supporting staff scored higher than officers, possibly reflecting greater engagement with informal and community-based knowledge sources. The Internet and clinical advice were rated as the most influential knowledge sources (mean scores 4.45 and 4.44, respectively), with 97% of respondents endorsing each. These findings highlight the importance of digital health communication strategies for oral health promotion in this population.

The findings from these three regression models suggest that targeted interventions should prioritise non-dental healthcare workers, who demonstrate both lower knowledge and equivalent disease burden. To improve oral health, the most efficient strategy is to add basic oral health training to professional development programs for non-dental personnel and deliver it through user-friendly online platforms. However, online education cannot overcome practical hurdles like busy work schedules and long wait times. These systemic issues require administrative solutions, such as adding quick oral health checks directly into employees' routine annual medical exams.

Several limitations should be considered. The cross-sectional design impedes causal inference; therefore, the associations

identified in the regression models may be influenced by unmeasured confounders. Additionally, Cronbach's alpha for the knowledge domain was 0.589, which is below the conventional threshold of 0.70; thus, these specific results must be interpreted with caution. Finally, this study was conducted within a single district in Pahang, limiting the generalizability of the findings to other regions or institutional contexts within Malaysia.

Conclusions

This study demonstrates a widespread prevalence of periodontal disease among MOH employees in Kuantan, coexisting with generally adequate knowledge levels, a finding indicative of a significant knowledge–practice gap. Our analysis found that an individual's specific dental background, gender, and the severity of their periodontal disease directly influence their knowledge scores. Furthermore, factors like job position and work experience shape where employees look for dental information, while daily logistical barriers to seeking care affect everyone uniformly. Ultimately, these insights underscore the need for tailored, accessible oral health initiatives that target vulnerable employee groups, utilize digital platforms, and systematically remove the workplace barriers preventing staff from scheduling visits. This research provides a valuable foundation for future, larger-scale studies among healthcare workers throughout Malaysia.

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Declaration of Generative AI and AI-Assisted Technologies Use

During the preparation of this work, the authors used Google Gemini (Gemini 3.5 Flash) to polish the rough draft for academic tone and clarity. Additionally, Claude 4.6 Sonnet (Anthropic) was utilized to help generate code for the R statistical software. However, data analysis, statistical interpretation, and research conclusions were performed by the first author. Lastly, after using these tools, the authors reviewed and edited the content as needed and took full responsibility for the content of the published article.

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