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THE USE OF DIGITAL DENTAL CALCULATOR APPS AS AN PHPM CALCULATION TOOL: A QUASI-EXPERIMENTAL

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ABSTRACT
Background: *The Personal Hygiene Performance Modified (PHP-M) index is a widely used tool for assessing oral hygiene status, but manual calculations are time-consuming and susceptible to human error. Digital dental calculator apps may streamline this process, yet their efficacy in PHP-M scoring remains underexplored.* ***Objective:*** *This study evaluated the duration time of a digital dental calculator app for PHP-M calculations compared to traditional manual methods.* ***Methods:*** *A quasi-experimental study was conducted with 65 dental professional students. Convenience sampling technique was employed, and the selected samples satisfied the established inclusion and exclusion criteria. The inclusion criteria were students of the dental profession at Baiturrahmah University in Indonesia who were still enrolled or had passed the pedodontics module. Conversely, students who did not participate in the full study (manual and digital) were excluded from the study. Participants assessed PHP-M score used standard scenario. First, participants was conducted traditional manual methods and the two weeks later used digital calculator for calculate the PHP-M scores.* ***Results:*** *The mean time taken to calculate PHP-M results manually was 136.75 seconds, while the mean time taken to calculate the same results using the digital dental calculator application was 48.49 seconds. The results of the Mann-Whitney test demonstrate that there is a statistically significant discrepancy between manual and digital calculations utilizing the application, with a p-value of 0.000 (p <0.05).* ***Conclusion:*** *Digital dental calculator apps significantly enhance the speed, and usability of PHP-M index calculations. Their adoption in clinical and research settings can improve oral hygiene assessments and standardize reporting.*

Keywords: *Dental calculator app, Digital dentistry, Duration time, PHP-M index*

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INTRODUCTION

The assessment of dental plaque in children is a critical aspect of pediatric dentistry, serving to evaluate oral hygiene practices and risk of dental caries effectively. Various indices and methodologies are utilized to quantify plaque levels on primary teeth. The Personal Hygiene Performance Modified (PHP-M) assessment tool is a common indicator used to evaluate oral hygiene among diverse populations, with several applications in dental health research and education. The Personal Hygiene Performance Modified (PHP-M) index plays an essential role in this context by providing a standardized measure for evaluating oral hygiene performance through the quantification of plaque accumulation on tooth surfaces.The PHP-M index is particularly useful in assessing plaque in children due to its simplicity and effectiveness in reflecting the level of oral hygiene. This index scores the presence of plaque on specific tooth surfaces, enabling clinicians to pinpoint areas needing attention in children's oral care practices.[1] Studies have shown that low PHP-M scores correlate positively with effective brushing techniques and good oral hygiene habits, making it an excellent diagnostic tool in pediatric populations where proper dental habits are still being developed. This measure primarily quantifies dental plaque on mixed dentition and serves as an essential metric.[2] The PHP-M facilitates detailed assessments of plaque accumulation by categorizing tooth surfaces and calculating the index based on specific criteria related to plaque presence.[3]

Recent studies employing PHP-M have effectively utilized it as a tool to foster educational initiatives aimed at improving oral hygiene among schoolchildren. For instance, Rahmawati et al. found that a virtual reality educational intervention significantly enhanced oral hygiene status among elementary school students, demonstrating the practical applicability of PHP-M results in shaping health education programs.[4] This application of PHP-M highlights the necessity of oral care in managing systemic conditions while underscoring the need for

continual monitoring and education about dental hygiene.Research shows that enhancing awareness and practices surrounding oral hygiene can lead to improved health outcomes. The PHP-M is instrumental in these efforts, providing a standardized method for assessing plaque levels and correlating them with interventions aimed at improving personal hygiene habits.[5] Moreover, the versatility of PHP-M extends to various demographic groups, reflecting its robustness as a measure in diverse settings, including dental clinics and public health programs. Therefore, integrating insights gained from PHP-M assessments into broader health education initiatives can significantly promote community health and wellness. [6]

The calculation of the Personal Hygiene Performance Modified (PHP-M) score, when performed manually, has several disadvantages that can impact the reliability and efficiency of oral hygiene assessments. Manual evaluations can be affected by factors such as time requirements, subjectivity, and potential inaccuracies due to human error. One significant drawback of manual calculation of the PHP-M score is the considerable time needed for its completion. This can discourage regular dental visits, particularly among patients with mobility or dexterity impairments. This highlights the necessity for standardized protocols that enhance the reliability of oral hygiene assessments. The adoption of automated or technology-driven approaches for calculating PHP-M could streamline the assessment process and reduce human error, leading to improved overall efficiency.[7,8] Advances in dental technology hold the promise of automating PHP-M scores assessments, facilitating quicker evaluations and more accurate results, which can ultimately promote better patient engagement and adherence to oral hygiene practices. In Indonesia, a digital dental calculator has been developed as a web application designed to shorten the calculation time for the results of several oral assessment indexes, one of which is the PHP-M Index. This study evaluated the duration time of a digital dental calculator app for PHP-M calculations compared to traditional manual methods.

METHODS

This research was conducted in accordance with a procedure that involved the acquisition of a research ethic approval from the Faculty of Medicine, Baiturrahmah University.

The sample was selected in accordance with established criteria for inclusion and exclusion. Convenience sampling technique was employed, and the selected samples satisfied the established inclusion and exclusion criteria. The inclusion criteria were met by students of the dental profession at Baiturrahmah University in Indonesia who were still enrolled or had passed the pedodontics module. Students who did not participate in the entirety of the study, encompassing both manual and digital components, were excluded from further analysis.

During the preliminary meeting, the research participants were instructed to read a scenario of the PHP-M index measurement that had been provided by the researcher. Firstly, 65 research participants were tasked with manually calculating the PHP-M index score using paper and pen. During the measurement, the researcher employed a stopwatch to meticulously record the duration. Two weeks later, the researcher provided a comprehensive explanation to the participants regarding the utilization of the digital dental calculator application. Following this, each participant was presented with the same scenario for manual index measurements. The researcher then calculated the PHP-M index measurement time using a web-based application called the digital dental calculator. Thereafter, the researcher analyzed the comparative data on the duration of the PHP-M index score measurement manually and digitally using the Mann-Whitney test with the support of SPSS software version 20.

RESULTS

This study aims to determine the comparison between manual and digital measurement times for the Modified Personal Hygiene Performance Index (PHP-M).

Table 1. Frequency Distribution of Respondents Based on Gender

Gender	*f*	%
Female	44	67.69%
Male	21	32.31%

Table 1 above shows that the majority of respondents were female, with 44 respondents (67.69%), while male respondents numbered 21 (32.31%).

Table 2. Frequency Distribution of Respondents Based on Age

	Mean	Standar Deviation	Minimum	Maximum
Age (year)	23,22	,91	21	25

Table 2 shows that the average age of respondents was 23 years, with the youngest being 21 years old and the oldest being 25 years old, among dental students at RSGM Baiturrahmah.

The results of this analysis show the frequency distribution of manual PHP-M measurements using pen and paper and digital measurements using a digital dental calculator based on the age and gender of the research subjects.

Table 3. Frequency Distribution of Manual and Digital PHP-M Measurement Times

Measurement	Min	Max	Mean	SD
Manually	90	195	136,75	26,15
Digitally	30	67	48,49	8,06

Table 3 above shows that out of 65 respondents, the average time taken to complete the PHP-M index measurement manually was 136.75 seconds, while the average time taken to complete the PHP-M index measurement digitally was 48.49 seconds. From this data, it can be seen that there is a significant difference in the time required to perform the PHP-M index measurement manually and digitally.

The results of this analysis were used to examine the difference in time required to measure the Personal Hygiene Performance Modified (PHP-M) index using pen and paper (manual) and using a digital dental calculator application, employing the Kolmogorov-Smirnov normality test to determine whether the data were normally distributed or not.

Table 5. *Mann Whitney's Test*

Variabel Penelitian	*P Value*
Waktu Pengukuran PHP-M secara manual dan digital	0.000

The results of the normality test showed a p-value <0.05, which means that the data is not normally distributed (p>0.05). The analysis was continued with the non-parametric Mann Whitney Test. Table 4 shows the results of the Mann Whitney test, which yielded a p-value of 0.000 or a probability <0.05, meaning that the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. From the above hypothesis, it can be concluded that the use of the digital dental calculator application influences the measurement time of the PHP-M index.

DISCUSSION

The study comparing manual calculations with a dental calculator application for PHP-M index scoring highlights the effectiveness of technological interventions in enhancing efficiency within dental practices. The findings revealed a reduction in calculation time when participants utilized the digital application (mean = 48.49 seconds) compared to manual computation (mean = 136.75 seconds). This significant difference demonstrates the potential of digital tools to streamline processes in dental hygiene assessments, aligning with findings from studies exploring the impact of technology in healthcare settings.

Digital interventions have been documented to reduce calculation errors and improve overall accuracy in various healthcare contexts. For instance, Zanden et al. reported that a digital dose calculator integrated into a pediatric formulary significantly mitigated calculation errors made by healthcare professionals in medication dosing.[9] This is relevant as it parallels the enhancements in efficiency observed in dental calculations. Furthermore, improvements in efficiency from the study are consistent with other studies, such as those evaluating automated systems in radiology, where the introduction of web-based calculators has been shown to enhance precision and consistency in reporting outcomes.[10] The automation of calculation processes not only optimizes time but also reduces cognitive load on practitioners, potentially leading to fewer errors and improved patient outcomes. For example, a significant time savings was noted in cataract evaluation and surgery, where digital devices streamlined workflows and minimized potential errors.[11] This consistency across multiple studies supports the notion that digital tools provide significant advantages, allowing healthcare practitioners to focus more on patient care rather than on labor-intensive manual processes.

In a dental context, Alhazmi et al. evaluated preferences between manual and digital methods for cephalometric landmark identification among dental students. Their study found that digital methods offered increased reliability and preference among users due to ease of use and quicker results.[12] This supports the assertion that digital applications not only enhance efficiency but also cater to user preferences, underscoring the importance of technology integration into daily dental practices. Moreover, the implications of reduced calculation time through digital tools extend beyond mere efficiency; they can positively impact clinical decision-making and patient interactions. Improved time management through such applications allows practitioners to devote more time to patient education and management, enhancing the overall quality of care. A study by Leinum et al. highlighted that employing digital monitoring technologies improves efficiency in physiologic monitoring systems, suggesting that similar benefits may be seen across various healthcare domains, including dentistry.[13]
The current study aligns with the broader narrative of a shift in healthcare systems towards digitization, where technology is crucial in supporting healthcare professionals in delivering high-quality care. Insights from Wang et al.'s work on wound management indicate that digital applications can facilitate quicker assessments and

enhance measurement accuracy, underscoring the necessity of integrating technology into more complex clinical evaluations.[14] As the demand for accuracy and efficiency in healthcare practices grows, the successful implementation of digital tools, such as the dental calculator application for PHP-M indexing, reflects an emergent trend towards technologically driven healthcare environments. Studies suggest that the adoption of digital solutions helps practitioners navigate the complexities of patient care more effectively while providing insights into operational efficiency. This incorporation of advanced technologies not only complements existing practices but also addresses issues related to traditional manual computations, which often involve high workloads and susceptibility to human error. A broad evaluation of the literature suggests a consensus that adopting digital solutions in professional healthcare settings results in enhanced performance. Lestari et al. confirm that while manual methods can be time-consuming and subjective, transitioning to automated approaches presents promising potential for future applications.[15] The emphasis on swift calculations facilitated by digital tools resonates with the growing recognition of the need for standardized methods, ensuring reproducibility and accuracy. Studies assessing various automated systems in medical imaging and diagnostics consistently illustrate the advantages of embracing technology in these domains.[16,17]

The effectiveness of digital applications in enhancing the time efficiency of dental assessments aligns with national health initiatives promoting the adoption of technology in practice. In line with the research results, Lee et al. evaluated the PHP index in their study, but they specifically discussed the effectiveness of educational programs using digital tools and did not directly assert that digital integration improved efficiency in dental assessments.[5] However, the underlying principle of integrating technology to engage patients, as exemplified by intelligent systems like smart toothbrushes, remains vital. Furthermore, the comparative analysis in our study not only emphasizes the time-saving aspect but also points to potential impacts on overall treatment compliance and patient satisfaction. Previous trials, such as those conducted by Scribante et al., have explored the interactions between patient education and adherence to hygiene regimens, indicating that streamlined processes can improve the clinician-patient dynamic.[18] The time saved through digital calculations may translate into increased opportunities for patient education, directly fostering better hygiene practices amongst patients.

In juxtaposition, the resistance towards adopting digital methods within various healthcare contexts is often echoed due to concerns regarding usability, integration, and cost implications. Meşeli et al. discussed the challenges of implementing digital tools; however, their focus was on imaging systems and did not specifically address the PHP-M index.[19] Despite this, the general sentiment around overcoming technological hurdles reflects the ongoing evolution in dental practices, as training programs increasingly incorporate digital solutions in their curricula, urging future dental professionals to embrace technological advancements.[20] The evaluation of digital versus manual methods in our study demonstrated that employing a dental calculator application resulted in significant time efficiency gains. The average time savings observed across participant calculations were measurable, providing a compelling argument for the wider implementation of such technologies in practice, echoing sentiments within the dental education community regarding the integration of digital technologies in curricula. Moreover, while the digital application provided notable efficiency enhancements, a multifaceted framework for implementation must also address the alignment of educational strategies that instill confidence and competence in students. The study conducted by Han and Cho on motivational interviewing techniques for dental hygiene students can be instrumental in blending practical skills with technology integration. Training students not only to use digital tools but also to communicate effectively with patients remains essential.[21]

As technological adoption flourishes, it is critical to continually assess the efficacy and usability of digital applications in dental hygiene practices. Our findings contribute valuable evidence supporting the transition to digital platforms for calculating PHP-M index scores, showing tangible benefits in terms of time management and possibly improving patient engagement and care, aligning with existing literature advocating for efficient digital methodologies within clinical practices.[22] In conclusion, by exploring the time efficiency of digital versus manual calculations in dental hygiene assessments, the present study contributes significantly to the discourse regarding integrating digital solutions in healthcare practices. The evident enhancements in operational efficiency, accuracy, and user preference indicated by existing literature underscore the increasing importance of technology adoption in healthcare settings. Continuous research aimed at optimizing these tools is essential for further embedding them into clinical workflows, ultimately fostering an innovative environment that enhances patient care outcomes across the board.

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