ORIGINAL ARTICLE

The use of digital dental calculator apps as an OHI-S calculation tool: a quasi-experimental

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Received: 01 Januari 2024
Revised: 31 March 2024
Accepted: 22 July 2024
Published: 31 July 2024
DOI: 10.24198/pjd.vol36no2.52851

p-ISSN 1979-0201
e-ISSN 2549-6212

Quote:
Moryka AN, Lestari C,Ningrum V, Batsukh N. The Use of Digital Dental Calculator App As an OHI-S Calculation Tool: A Cross Sectional Study. Padj J Dent, July. 2024; 36(2): 163-170.

ABSTRACT

Introduction: The utilization of applications as a tool for the calculation of dental and oral health indices has not yet been extensively explored. Consequently, researchers have proposed the development of the digital dental calculator application as a rapid and precise medium for the administration of oral health index surveys. Aim of this research is to analyze the use of digital dental calculator apps as an OHI-S calculation tool. **Methods:** The study design is quasi-experimental with a posttest-only group design. Convenient sampling was employed as the sampling technique, and the selected samples fulfilled the inclusion and exclusion criteria. The inclusion criteria were students of the dental profession at Baiturrahmah University, Indonesia, who were still enrolled in or had passed the periodontics module, while the exclusion criteria were students who did not participate in the full study (manual and digital). **Results:** The mean time taken to calculate OHI-S calculation results manually was 207.63 seconds, while the mean time taken to calculate the same results using the digital dental calculator application was 67.97 seconds. The results of the Mann-Whitney test indicate that there is a highly statistically significant difference between manual and digital calculations using the application, with a p-value of 0.000 (<0.05). **Conclusion:** There is a time difference between the use of digital and manual calculations for OHI-S calculations. The findings of this study indicated that the time required to perform OHI-S calculations using digital dental calculator applications was significantly shorter than that required for manual calculations.

KEYWORDS
oral hygiene index simplified (OHI-S), time duration, digital dental calculator

INTRODUCTION

The prevalence of dental and oral health issues continues to decline annually. One of the most prevalent challenges is dental caries, which is the most common dental and oral disease globally. According to the World Health Organization (WHO), approximately 60-90% of children worldwide experience dental caries, with 2.3 billion cases of caries in permanent teeth and 560 million cases of caries in primary teeth.[1] The results of the Basic Health Research (Riskesdas) in 2018 indicate that the prevalence of active dental caries in Indonesia reached 45.3%, with West Sumatra province exhibiting a prevalence of 43.9%. In accordance with this evidence, the proportion of the Indonesian population that has never consulted a medical or dental professional is 95.5% (Ministry of Health of the Republic of Indonesia, 2018). Long waiting times are a significant factor influencing individuals' reluctance to seek medical attention. The professional education process to become a dentist can influence the quality and ability to address patient-related issues.

Dental caries is a dental hard-tissue disease characterized by damages starting from the tooth surface, such as enamel and dentin, and spreading to the pulp.[2]

Dental caries is one of the most prevalent of tooth decay, which can impede the growth and development process. Dental caries can be caused by a number of factors, including: the primary factors that contribute to the development of dental caries are the host (teeth and saliva), substrate (food), caries-causing microorganisms, and time.[3] The interaction between these four factors is a prerequisite for the formation of dental caries. In addition, plaque accumulation, which is related to poor dental and oral hygiene, can also act as a trigger for dental caries. [4]

In order to maintain oral hygiene, it is recommended that individuals undergo routine dental examinations and oral hygiene assessments on a regular basis, with a frequency of every six months.[5] A dental examination conducted by a qualified dental practitioner is employed to ascertain the state of a patient's dental and oral hygiene. This is achieved by measuring the level of dental and oral hygiene using an index. One of the indices employed in the examination of dental and oral hygiene is the Oral Hygiene Index Simplified (OHI-S). The OHI-S is a composite index derived from the debris index and calculus index, which are calculated from examinations of six teeth. Once the index has been calculated, the data results are then processed manually.[6]

Dental and oral health surveys are routine activities carried out to measure the status of dental and oral health. Currently, dental and oral health surveys are still carried out conventionally by dentists, who then provide data on the results of the examination, which is processed manually and filled in using handwriting.[7] Manual data processing often results in records that are incomplete and inconsistent, compromising both the accuracy and comprehensiveness of the data. This process is time-consuming and arduous in its analysis.[8]

The waiting time for dental and oral health services is a crucial aspect that must be addressed.[9] Dentists are one of the main components of health service providers who are directly involved in providing services[10]. This means that a dentist must be able to function as a leader and driving force for the creation of effective and efficient dental health team work.[11] Students of the dental profession also provide services directly to patients. The direct involvement of students in providing services and examinations requires efforts from students to consider the duration of service and the time required to pursue professional education.[12]

A variety of tasks can be completed in a shorter time than usual, including surveying. The transition from manual to digital methods of data calculation has been widely implemented in line with technological developments, including in the field of dentistry. A study conducted by Nagarajappa et al. (2021) developed an Android-based oral health data recording application, namely "Mobile Assisted Recording System" (MARS), which collects data using various indices to measure oral health conditions. One of the indices measured is OHI-S. This application is able to produce a total debris and calculus score and provide an overview of oral hygiene automatically. Another application, "Smart Odontogram", has been proposed as a potential replacement for conventional data surveys. Based on the results of interviews with research respondents, the majority of respondents indicated that this application was very useful because it could save time in filling out odontograms. However, despite the importance of filling out a complete odontogram, respondents often overlooked this activity due to its perceived length. [7]

In the digital era, a plethora of applications have been developed for everyday use. These applications can be broadly classified into three main categories: desktop applications, mobile applications (commonly known as "apps"), and web-based applications.[13] Currently, web-based applications are the most widely used due to their ease of use and practicality, as they do not require installation on a computer.[14] In contrast to desktop applications, which require installation prior to use and are therefore less efficient, web-based applications only require a web browser to run,

allowing them to be used on any computer platform (multiplatform).[15] A review of several studies indicates that the use of smartphone technology-based tools for data collection offers a number of advantages, including the provision of a wider range of choices.

The data obtained can be transferred and stored shortly after it is collected, thus reducing the time needed for analysis. This also becomes more efficient, as data collection, data entry, and analysis can be combined into one step. Collecting data using smartphones is easier and more convenient, as there is no need to collect a lot of paper. Electronic devices are more economical and environmentally friendly, and they can analyze results more quickly and with better accuracy.[16] The use of electronic devices as a data collection tool for examining dental and oral health indices has not been widely studied.

The utilization of applications as a tool for the calculation of dental and oral health indices has not yet been extensively developed. Consequently, researchers have proposed the development of the "digital dental calculator" application as a rapid and precise oral health index survey instrument. The objective of this study was to ascertain the differences in OHI-S calculation times between the digital dental calculator application and manual calculation.

METHODS

The research methodology employed in this study is a quasi-experimental design with a posttest-only group. In this study, the experimental group constituted the sole group, with no control group (Nugraha, 2020). The population of this study consisted of 231 active dental profession students at Baiturrahmah University's Dentistry department. The sample for this study comprised dental profession students at Baiturrahmah University who were currently or had previously completed the Periodontics module. The sample size was determined in this study using the Slovin formula. The minimum sample size, as determined by the Slovin formula, was 59 active dental profession students.

In this sampling technique, the sample was determined based on chance. Consequently, any professional student who encountered the researcher by chance was eligible to be included in the sample, provided that the person satisfied the research criteria. The instruments and materials employed in this research included a smartphone, stationery, a stopwatch, and the SPSS application. In addition, the materials employed included informed consent, an OHI-S examination sheet, a scenario sheet, and a research subject identification number.

Data analysis was conducted to compare the time required to perform calculations and the OHI-S calculations between manual methods and the use of digital dental calculators. The measurement procedure carried out both digitally and manually uses a scenario form that contains a description of 6 index teeth that have been assigned calculus and debris scores. Respondents performed both manual and digital calculations by calculating the ohi-s score based on the images on the scenario form. For manual measurements, it is calculated on paper by manually summing up the ohi-s score. Meanwhile, digital measurement is done by entering the score on the scenario form into a digital dental calculator and the application will calculate the ohi-s score automatically.

In this research, the data analysis was divided into two methods: univariate analysis and bivariate analysis. The objective of univariate analysis was to describe the characteristics of each research variable in terms of frequency distribution and percentages, with the aim of identifying any differences in the time required to use the digital dental calculator application by dental profession students at Baiturrahmah University for OHI-S calculations. Bivariate analysis is a statistical technique to examine the relationship between two variables, where one variable is considered the independent variable (calculation method) and the other is the dependent variable (duration time). The Kolmogorov-Smirnov test was employed to ascertain the normality of the data, with the Mann-Whitney test subsequently

applied due to the non-normality of the data. The objective of this data analysis test is to assess the differences in average time and other parameters between the two data sets. The objective of this analysis is to assess the differences in the duration of digital dental calculator application use in the OHI-S calculation process in comparison to manual methods.

RESULTS

A total of 64 research subjects met the inclusion and exclusion criteria and were included in the study. Descriptive statistics were generated for the subjects in terms of age and gender.

Table 1. Distribution of Gender Respondents

Gender	f	%
Female	41	64.06
Male	23	35.94
Total	**64**	100

Table 1 above illustrates that most respondents were female, with a percentage of 64.06%, while male respondents were 35.94%.

Table 2. Distribution of Age Respondents

	min	max	mean	SD
Age (Years)	22	25	23.28	0.90

Table 2 illustrates that the average age of respondents is 23 years, with the youngest respondent being 22 years old and the oldest being 25 years old. This sample consists of various classes of dental profession students at RSGM Baiturrahmah. The results of the univariate analysis demonstrate the time frequency distribution of OHI-S calculations using paper and pen and using a digital dental calculator application among dental profession students at Baiturrahmah University.

Table 3. Time Duration Distribution of OHI-S Calculation Using Manual and Digital

	Time Duration (seconds)			
	Min	**Max**	**Mean**	**SD**
Manual Calculation	135	319	207.63	39.88
Digital Calculation	31	109	67.97	19.38

Table 3 above demonstrates that digital calculation requires a significantly shorter average time, namely 67.97 seconds, in comparison to manual survey methods, which require an average time of 207.63 seconds. The results of the bivariate analysis were used to determine the difference in time required to perform OHI-S calculations using a digital dental calculator application versus traditional methods, such as paper and pen, among dental profession students at Baiturrahmah University. A normality test, specifically the Kolmogorov-Smirnov test, was employed to ascertain whether the data was normally distributed.

Table 4. Normality Test Results (Kolmogorov Smirnov)

	Kolmogorov-Smirnov
	p value
Manual Calculation	0.016
Digital Calculation	0.2

The results of the normality test in Table 4 above indicate that the data is not normally distributed, as evidenced by the p-value of the manual survey, which is less than 0.05. The analysis proceeded with the use of non-parametric tests, specifically the Mann-Whitney test.

Table 5. Mann Whitney Test

Research variable	p value
OHI-S Calculation Time Using Manual Calculation and Digital Dental Calculation	0,001

The Mann-Whitney test in Table 5 above indicates a p-value of 0.000, which is less than 0.05. This result rejects the null hypothesis (Ho) and accepts the alternative hypothesis (Ha), indicating that there is a significant difference in the time required for manual and digital calculations. From the aforementioned hypothesis, it can be concluded that there is a difference in the timing of OHI-S calculations when digital calculation is employed.

DISCUSSION

Digital health literacy is increasingly important in today's healthcare landscape. Various tools have been developed to assess and improve individuals' competencies in engaging with digital health services. For example, the Digital Health Literacy Instrument (DHLI) Haikal et al. (2023) and the Digital Health Technology Literacy Assessment Questionnaire (DHTL-AQ) Yoon et al. (2022) are reliable tools for measuring digital health literacy competencies. These instruments are crucial for evaluating operational skills and technology literacy among different population segments, including students in health science faculties (Haikal et al., 2023), adolescents (Park & Kwon, 2021), and older adults (Daniolou et al., 2021).[17,18]

Additionally, tools like the mobile-centered digital health readiness scale (mDiHERS) Kim (2024) and the Digital Health Indicator (DHI) Woods et al. (2022) have been developed to assess patients' readiness and healthcare organizations' digital health capabilities. These tools offer insights into factors influencing individuals' engagement with digital health services and help organizations evaluate their digital health maturity to enhance patient care and outcomes.[19,20] Research has demonstrated the significant impact of digital health literacy on various health aspects, such as physical health, mental health, life satisfaction, and health behaviors. Improving digital health literacy, especially among community-dwelling older adults, has been linked to efficient and cost-effective medical treatment. Furthermore, the association between digital health literacy and physical activity levels highlights the importance of targeted interventions to enhance health outcomes.[21,22,23]

The development and validation of tools for assessing digital health literacy, along with research on its impact on health outcomes, emphasize the importance of promoting digital health literacy across diverse population groups. By enhancing individuals' competencies in navigating digital health services, healthcare organizations can enhance patient care, population health, and overall healthcare delivery. Healthcare providers often rely on calculations to make informed decisions in various medical scenarios. The use of digital tools for calculations in healthcare has been a subject of interest due to its potential benefits in terms of efficiency, accuracy, and consistency compared to manual calculations.[26] For instance, automated calculation of Venous Thromboembolism (VTE) risk using electronic health record data has shown similar predictive abilities to manual calculation methods.[27] This indicates that digital tools can be as effective as manual methods in certain medical calculations.

In the context of radiology reporting, the use of web-based calculators, and structured report generators has been shown to improve efficiency, accuracy, and consistency in reporting. Similarly, digital cephalometric landmark identification has been found to be preferred by dental students over manual methods, indicating a preference for digital tools in learning and practice.[28] Moreover, the performance of a glucose meter with a built-in automated bolus calculator has been compared to manual bolus calculation, highlighting the potential risks associated with difficulties in manual calculations leading to incorrect dosages.[29]

The development of applications for automatically calculating the mean amplitude of glycemic excursions has shown a high rate of agreement between manual and digital calculations.[30] The time efficiency of digital calculations has also been highlighted in various studies. For instance, a study comparing software-based versus manual workflows for toric intraocular lens calculation and implantation demonstrated a significant reduction in total diagnostic and surgical time with digital tools.[31] Similarly, a study on wound assessment found that digital tools were more likely to achieve acceptable wound images on the first attempt compared to manual methods.[32] The evidence suggests that digital calculation tools in healthcare offer advantages in terms of efficiency, accuracy, and consistency compared to manual calculations in various medical contexts. These tools have the potential to streamline processes, improve decision-making, and enhance overall healthcare delivery. In conducting this research, there are limitations that may affect the results of the study, including the limitations of time, energy and the ability of researchers. At the time of collecting respondents, it was difficult to collect respondents at the same time and in the same room due to the respondents' different activity schedules. There is a lack of ability of respondents to understand the questions on the ohi-s scenario form so there is a possibility that the results are less accurate and affect the time needed to calculate the ohi-s score.

CONCLUSION

The results of the data analysis conducted in this study indicate that there is a discrepancy in the time required to measure the Oral Hygiene Index Simplified (OHI-S) manually and digitally. This research demonstrates that there is a discrepancy in the utilization of digital dental calculators with regard to the time required for the calculation of the Oral Hygiene Index Simplified (OHI-S). Choosing the right method for taking measurements can affect the speed and accuracy of the measurement results. In taking ohi-s measurements, there is a difference in the speed of ohi-s measurement time using digital methods compared to manual. Faster measurement results are certainly beneficial for users because they can reduce work time for digital application users. It is hoped that users can take advantage of this application, especially when taking ohi-s measurements on a large scale such as dental and oral health research activities which will certainly be very helpful in making calculations. The results of this study are used as a consideration to pay more attention to the use of digital applications in taking ohi-s measurements for learning media for preclinical students and use in clinics and fields by dental medical workers.

Acknowledgement: I would like to emphasize that this research was self-funded and did not receive any financial support from any external sources.

Author Contributions: This research article is the result of collaborative work by several authors. M.A.N and N.V, conceptualized the study and developed the methodology. L.C, M.A.N, and N.V, contributed to the validation and formal analysis of the data. M.A.N, curated the data and wrote the original draft of the paper while N.V, L.C, and M.A.N reviewed and edited it. M.A.N also contributed to the visualization of the data. N.V and L.C, supervised the research project, while M.A.N, was responsible for the project administration and funding acquisition. All authors have read and approved the final version of the manuscript.

Funding: This research is self-funded.

Institutional Review Board Statement: The research was conducted in accordance with ethical principles and was approved by the Institutional Review Board of the Faculty of Medicine, University of Baiturrahmah, with the approval number 225/ETIK/FKUNBRAH/03/11/2023.

Informed Consent Statement: Written informed consent was obtained from all study participants prior to their inclusion in the research. The purpose and procedures of the study were explained in detail to the participants, and they were given the opportunity to ask questions and clarify any doubts they may have had. Participants were informed that their participation was voluntary and that they could withdraw from the study at any time without any consequences.

Data Availability Statement: The data that support the findings of this study are available upon request from the corresponding author. Restrictions apply to the availability of these data, which were used under license for this study and are not publicly available. However, data are available from the authors upon reasonable request and with the permission of the data provider.

Conflicts of Interest: The authors declare no conflicts of interest related to this study.

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