

Content analysis of oral hygiene instruction posts on Instagram: a cross-sectional study

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ABSTRACT

Background: Social media platforms such as Instagram have emerged as alternative sources for oral hygiene instructions. This cross-sectional study evaluates the usefulness, understandability, and actionability of Instagram oral hygiene instruction posts. **Methods:** A systematic search of Instagram posts was conducted using the hashtags #dentalhygiene and #oralhygiene. The first 100 posts meeting the inclusion criteria for each hashtag were evaluated using 2 tools: the Oral Hygiene Content Usefulness Score (OHCUS), a newly developed scoring system, and the Patient Education Materials Assessment Tool (PEMAT). The OHCUS assessed the quality and clinical value of posts, while PEMAT evaluated their understandability and actionability. Statistical analysis included the Mann-Whitney U test, Kruskal-Wallis test, and Spearman's correlation. **Results:** Among the 200 posts, 110 were videos and 90 were photos. The average number of likes was 2,981.92 ($\pm 9,635.64$), and the average number of views for videos was 196,583 ($\pm 933,509$). Seventy-one percent of posts were educational. The mean usefulness score was 2.37 (± 1.94), the mean understandability score was 74.4% ($\pm 14.87\%$), and the actionability score averaged 35.6% ($\pm 24.37\%$). **Discussion:** Posts from oral health professionals, including dental hygienists, were more useful, understandable, and actionable than posts from other sources, with most posts shared by dental clinic accounts. **Conclusions:** Social media, particularly Instagram, has potential as a platform for disseminating oral health education. However, the quality and reliability of the information vary significantly. Posts from oral health professionals, especially dental hygienists, are more beneficial. Enhancing the quality and accuracy of social media content is crucial to maximizing its public health impact.

RÉSUMÉ

Contexte : Les plateformes de médias sociaux telles qu'Instagram sont apparues en tant que sources de rechange pour les instructions d'hygiène buccodentaire. Cette étude transversale évalue l'utilité, la compréhensibilité et la mise en pratique des publications d'instructions d'hygiène buccodentaire sur Instagram. **Méthodes :** Une recherche systématique des publications Instagram a été réalisée à l'aide des mots-clés #dentalhygiene et #oralhygiene. Les 100 premières publications répondant aux critères d'inclusion pour chaque mot-clé ont été évaluées à l'aide de 2 outils : le Oral Hygiene Content Usefulness Score – OHCUS (le score d'utilité du contenu d'hygiène buccodentaire), un système de notation nouvellement conçu, et le Patient Education Materials Assessment Tool – PEMAT (l'outil d'évaluation des documents d'éducation des patients). Le OHCUS évaluait la qualité et la valeur clinique des publications, tandis que le PEMAT évaluait leur compréhensibilité et leur mise en pratique. L'analyse statistique comprenait le test U de Mann-Whitney, le test de Kruskal-Wallis et la corrélation de Spearman. **Résultats :** Parmi les 200 publications, 110 étaient des vidéos et 90 étaient des photos. Le nombre moyen de mentions « j'aime » était de 2 981,92 ($\pm 9 635,64$), et le nombre moyen de vues des vidéos était de 196 583 ($\pm 933 509$). Soixante et onze pour cent des publications étaient éducatives. Le score moyen d'utilité était de 2,37 ($\pm 1,94$), le score moyen de compréhensibilité était de 74,4 % ($\pm 14,87$ %) et le score moyen de mise en pratique était de 35,6 % ($\pm 24,37$ %). **Discussion :** Les publications de professionnels de la santé buccodentaire, y compris les hygiénistes dentaires, étaient plus utiles, compréhensibles et applicables que les publications provenant d'autres sources, la plupart des publications étant partagées par des comptes de cliniques dentaires. **Conclusions :** Les médias sociaux, en particulier Instagram, ont un potentiel en tant que plateforme de diffusion d'informations sur la santé buccodentaire. Cependant, la qualité et la fiabilité de l'information varient considérablement. Les publications de professionnels de la santé buccodentaire, surtout celles des hygiénistes dentaires, étaient plus utiles. L'amélioration de la qualité et de l'exactitude du contenu des médias sociaux est cruciale pour maximiser son impact sur la santé publique.

Keywords: dental hygienists; dentist; dentistry; education; oral hygiene; patient education; social media
CDHA Research Agenda category: risk assessment and management

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PRACTICAL IMPLICATIONS OF THIS RESEARCH

- Improving the quality and accuracy of health information on social media is essential to harnessing its potential in public health education.
- Health care professionals, particularly dental hygienists and dentists, should be more involved in creating and disseminating social media content to ensure its reliability.
- Social media platforms should implement stricter content validation processes to enhance the understandability and actionability of health information for diverse audiences.
- The newly developed Oral Hygiene Content Usefulness Score can be used to evaluate the usefulness of audiovisual content posted on social media.

INTRODUCTION

Periodontal disease and dental caries significantly contribute to years lost to disability, ranking 14th and 16th, respectively, in the 2017 Global Burden of Disease Study.¹ These conditions impose substantial economic burdens, with treatment costs estimated at \$356.8 billion in 2015, accounting for 4.6% of global health expenditure.² Primary prevention in dentistry is critical to mitigate these diseases’ functional, aesthetic, and financial impacts. Consequently, providing patients with comprehensive oral hygiene instructions (OHI) is essential. Effective OHI encompass primary and secondary factors influencing caries and periodontal disease progression, and guidance on chemical and mechanical oral hygiene aids, brushing techniques, and interdental cleaning.³⁻⁵

Traditionally, patients receive OHI during dental or dental hygiene visits. The role of dental hygienists is crucial in delivering these instructions, significantly improving patients’ oral health outcomes and adherence to recommended practices.⁶ Harnacke et al.⁷ demonstrated that individualized OHI significantly improve gingival bleeding index and oral hygiene skills compared to standardized instructions, indicating that while general instructions can be used, it is still crucial to spend time with the patient to provide tailored OHI, a task typically performed by dental hygienists or dentists in the office setting.

Social media platforms such as Instagram have become pivotal in disseminating health information. As of 2022, approximately 4.6 billion people used social media, with 74% of internet users in the United States seeking health information online.^{8,9} Social media’s visual and accessible nature makes it an attractive source of health information, often preferred over traditional health care appointments due to its convenience and cost-effectiveness.¹⁰ Platforms such as Instagram are utilized to raise awareness of a variety of health issues, including obesity,¹¹ skin cancer,¹² and oral health conditions such as early childhood caries,¹³ dental implants,¹⁴ bruxism,¹⁵ and oral cancer¹⁶.

However, the quality and reliability of health information on social media remain concerning; the content is often not professionally evaluated, leading to potential misinformation.^{17,18} Additionally, there is a broad recognition that patients face challenges in understanding health information and navigating the health care system.¹⁹ A large audience with diverse backgrounds and varying levels of health literacy must easily understand information materials.²⁰ In 2010, the US Department of Health and Human Services implemented the “National Action Plan” to improve health literacy and advocate for developing and publicizing accurate, accessible, and actionable health information.²¹

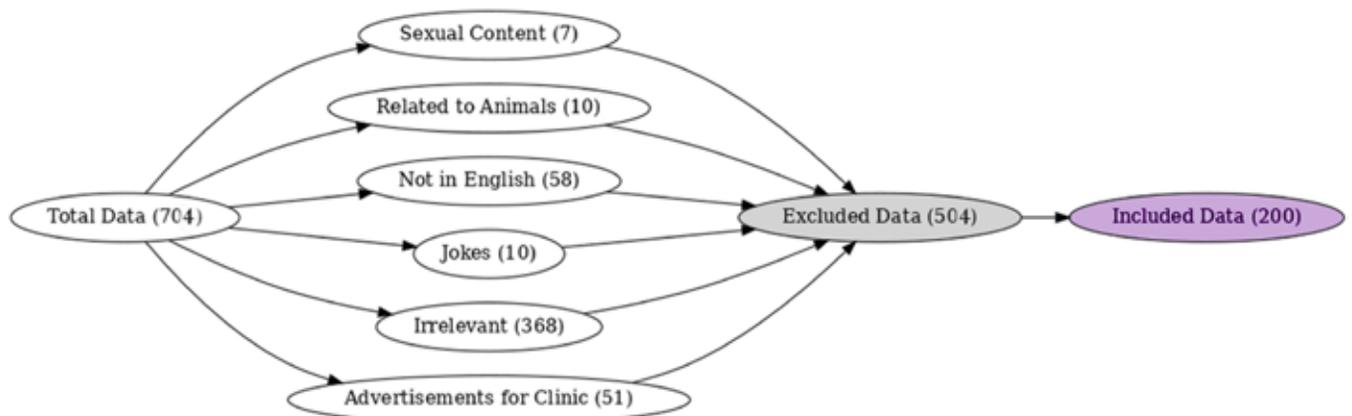
In this context, tools such as DISCERN and the Suitability Assessment of Materials (SAM) have been developed to evaluate the quality of written health education materials. Yet, their application to social media content is limited.^{22,23} The Patient Education Materials Assessment Tool (PEMAT) provides a framework for assessing the understandability and actionability of both print and audiovisual materials, which are essential for ensuring that online health information is reliable and actionable.²⁴

This study aims to evaluate the usefulness, understandability, and actionability of oral hygiene instruction posts on Instagram. By analyzing posts with the hashtags #dentalhygiene and #oralhygiene, this study provides insights into the quality of OHI available on this popular social media platform.

MATERIALS AND METHODS

The Faculty of Dentistry Research and Ethics Committee of the University of Jordan deemed the study exempted. This decision was based on the non-intrusive nature of the research, which solely involved analyzing publicly accessible data from a social media platform.

Figure 1. Number of posts and reasons for exclusion



Sample size and data collection

This is a cross-sectional study aimed at assessing the usefulness, understandability, and actionability of oral hygiene instruction posts on Instagram. The literature indicates that performing sample size calculations for studies assessing Instagram posts and other social media platforms is challenging due to the dynamic nature of posts, which are frequently added and deleted, leading to an inconsistent number of posts.²⁵ Therefore, the sample size for this study was determined based on methodologies described in previously published research of a similar design.¹⁶

An Instagram search was conducted on April 15, 2024, to investigate user-generated content related to oral hygiene. All posts retrieved from Instagram up to the date April 14, 2024, were included (Figure 1).

To minimize algorithmic bias and ensure a representative sample, 2 new Instagram accounts were created specifically for this research. These accounts had no prior activity, followers or search history, which might influence the Instagram algorithm's content recommendations. To ensure comprehensiveness, 2 distinct search terms, #dentalhygiene and #oralhygiene, were employed on the same date, reflecting commonly used phrases on the platform as identified through Google Trends.²⁶

Posts were included if they were in English, had original content (no duplicates), and were relevant to oral hygiene practices (e.g., excluding jokes, oral hygiene for pets, and clinic advertisements). Two independent researchers (SJZ and DRT) evaluated the included posts and their captions. Data collected for each post included:

- Upload date
- Source of upload (creator category): categorized as health care professionals (dentists, dental hygienists, dental clinics, health care pages), media outlets (TV/news), health information pages, individual users, and commercial accounts
- Country of origin (if available)
- Engagement metrics: number of views and likes
- Type of post based on content (educational, promotional, testimonial) or format (video, image) and its characteristics
- Presence of a demonstrative image as a guide to visually explain OHI

Each post was then evaluated using the Oral Hygiene Content Usefulness Score (OHCUS), a newly developed tool, and PEMAT.

Oral Hygiene Content Usefulness Score

To assess the information quality and clinical value of Instagram posts containing oral hygiene content, the authors developed a new scoring system tailored to this study. Previously, a usefulness score was applied to evaluate the content of YouTube videos on oral cancer.¹⁶ However, no similar scoring system exists to assess OHI, whether delivered orally, in writing or through social media posts.

Consequently, the research team established a new Oral Hygiene Content Usefulness Score (OHCUS).

The criteria for each item of OHCUS (Table 1) were meticulously chosen and validated by a panel of 4 board-certified periodontists (OAA, NSK, AAH, DAA). These items address critical elements that should be present in comprehensive OHI, including mentioning the importance of oral hygiene, covering toothbrushing techniques, frequency, and duration, discussing the use of other oral hygiene aids such as floss or mouthwash, diet advice, and highlighting common mistakes in oral hygiene practices. The panel reviewed these criteria for appropriateness in assessing the value of oral hygiene content on Instagram by applying them in a random sample before using OHCUS to score the posts included in this study.

Scoring calculation and interpretation

Each post was evaluated based on the criteria listed in Table 1, using the following scoring system:

- Each of the 10 criteria was assigned a score of 1 if present; otherwise, 0 was awarded.
- The final OHCUS score for each post was calculated by summing the awarded points for all criteria met, ranging from 0 to 10. Scores were interpreted as follows:
 - 0 points: Not Useful (no information on oral hygiene practices)
 - 1–3 points: Slightly Useful (limited information)
 - 4–6 points: Moderately Useful (some key aspects covered)
 - 7–9 points: Very Useful (comprehensive and informative)
 - 10 points: Exceptional (exceptionally informative and comprehensive)

Higher scores indicate more comprehensive and accurate content.

Table 1. Oral Hygiene Content Usefulness Score (OHCUS)

Criteria	Points
Mentioned the importance of oral hygiene	1
Explained toothbrushing technique	1
Addressed duration of brushing	1
Addressed frequency of brushing	1
Discussed interdental cleaning aids	1
Mentioned tongue scraping	1
Mentioned chemical oral hygiene aids (e.g., toothpaste)	1
Mentioned adjunctive oral hygiene aids (e.g., mouthwash)	1
Provided relevant dietary advice	1
Addressed common mistakes or false practices	1
TOTAL	10

PEMAT Score

PEMAT is a validated tool designed to assess the understandability and actionability of patient education materials.²⁴ Understandability measures how patients with diverse backgrounds and literacy levels comprehend the information. Actionability measures the ease with which patients identify the necessary steps based on the information presented.

PEMAT utilizes worksheets to assess these criteria for print and audiovisual materials. Each worksheet includes items with scoring options (e.g., agree, disagree, not applicable). Scores for each domain (understandability and actionability) are calculated by summing the points assigned to each item and dividing them by the total possible points (excluding “not applicable” items). The result is then multiplied by 100 to obtain a percentage score. According to Shoemaker et al.,²¹ the research team that developed this toolset, a threshold of 70% was set for what should be considered understandable or actionable.

Pilot study

A pilot study was conducted with a random sample of 20 videos (10 from each hashtag) to assess the feasibility and identify any challenges using OHCUS and PEMAT. Conflicts raised during the posts’ assessment were resolved to reach a joint decision. The pilot study results were excluded from the final analysis. The inter-rater agreement exceeded 0.80 for OHCUS and PEMAT scores in both the pilot and original study.

Statistical analysis

All statistical analyses were conducted using SPSS Statistics software (version 28, IBM Corp., Armonk, NY, USA). The normality of the data was checked using the Kolmogorov-Smirnov test. Variables that did not follow normal distribution were presented as median and interquartile range (IQR). Categorical variables are reported as frequency and percentages. The Mann-Whitney U and Kruskal-Wallis tests were used to examine the relationships between categorical variables. Inter-rater agreement analysis was done using Cohen’s kappa test. Spearman’s correlation was conducted to assess the relationship between continuous variables. A *p* value of less than 0.05 was considered statistically significant.

RESULTS

Descriptive results

The study’s findings revealed a significant digital presence of oral hygiene posts. A total of 849,000 posts were found with the hashtag #oralhygiene, and for #dentalhygiene, there were a staggering 2 million posts. Next, 278 posts using the hashtag #oralhygiene were screened, and 426 posts using the hashtag #dentalhygiene were screened. The first 100 posts from each hashtag that met the inclusion criteria were selected. Of the 704 posts, 504 were excluded (from #oralhygiene #dentalhygiene screening, respectively) for the reasons described in Figure 1.

Characteristics of Instagram posts

Of the 200 posts, 110 were videos and 90 were photos. Posts were uploaded to the Instagram platform between February 19, 2019, and April 6, 2024. More than half (56.5%) of the posts were uploaded in 2024. Thirty-four percent (34%) of the posts were of no known origin, 27% were from the United States, and 12% were from India. The average number of likes per post was 2981.92 ±9635.64 (median = 533, IQR = 1394 likes), and the average number of views for video posts was 196,583 ±933,509 (median = 12,969, IQR= 47,022 views).

Almost all of the posts had captions, 21.5% had demonstrative images, and 4% contained misleading information. The posts targeted the general public, and only 2 were aimed at professional audiences. Only 1 post cited the source of the included information. Over half of the posts were contributed by health care professionals (37 were by dentists, 23 by dental hygienists, 13 by health care pages, and 41 by dental clinics). The remaining posts were uploaded by individuals, commercial pages, and others (dietitians, beauty care pages, nursery pages).

Posts were categorized into educational posts containing instructions or information, promotional posts describing a product, and testimonial posts including opinions. Seventy-one percent (71%) of the posts were educational, and dental clinic accounts uploaded most of these posts; 20.5% of the posts were testimonials, uploaded chiefly by individuals; and only 8.5% were promotional and posted primarily by individuals.

Social media audience and engagement

The analysis of social engagement revealed significant trends in the types of content and sources on social media. Promotional content received a higher number of likes (755 likes) compared to testimonials or educational videos (*p* < 0.001). Posts uploaded by individuals and dental hygienists received a significantly higher number of likes (546 likes) compared to other sources (*p* < 0.001). Additionally, video posts had substantially higher likes than photos (*p* < 0.001).

OHCUS results

The mean OHCUS of the included posts was 2.37 ±1.94 (median = 2, IQR = 3). Just over ten percent (10.5%) of the posts were deemed not useful, 64% were slightly useful, 21% were moderately useful, and 4.5% were very useful. None of the posts achieved an “exceptionally useful” score of 10 (Figure 2). Video posts were significantly more useful than photos (*p* = 0.003). Table 2 shows a significant difference in the distribution of usefulness observed with information sources (*p* = 0.018) and post-content type (*p* < 0.001). Dental hygienists and dentists posted more helpful information than other sources. The most useful posts were the educational ones, with a mean of 2.6, while the mean was 1.0 for promotional and 2.0 for testimonial posts.

Table 2. Distribution of usefulness, actionability, and understandability scores by information source, post content, post type, and presence of demonstrative images

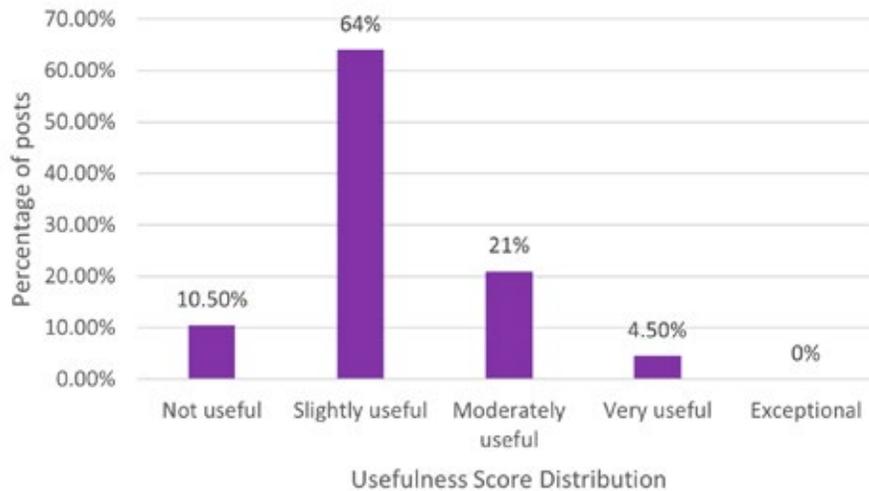
		Usefulness	<i>P</i> value	Actionability	<i>P</i> value	Understandability	<i>P</i> value
Information source	N (%)	Median (IQR)		Median (IQR)		Median (IQR)	
Individuals	72 (36)	2 (1)		0.37 (0.2)		0.67 (0.2)	
Dental clinic	41 (20.5)	2 (2)		0.40 (0.4)		0.89 (0.1)	
Commercial page	6 (3)	1 (3)		0.30 (0.4)		0.77 (0.4)	
Dental hygienist	23 (11.5)	4 (4)	0.018 ^a	0.60 (0.5)	0.048 ^a	0.83 (0.2)	0.001^b
Dentist	37 (18.5)	3 (3)		0.40 (0.4)		0.77 (0.2)	
Health care page	13 (6.5)	2 (4)		0.33 (0.3)		0.73 (0.1)	
Other	8 (4)	1 (1)		0.40 (0.6)		0.69 (0.3)	
Post content							
Educational	142 (71)	2 (3)		0.40 (0.4)		0.80 (0.2)	
Testimonial	41 (20.5)	2 (3)	0.001 ^a	0.20 (0.4)	0.001 ^a	0.60 (0.2)	0.001^b
Promotional	17 (8.5)	2 (0)		0.40 (0.2)		0.67 (0.1)	
Post type							
Video	110 (55)	2 (3)	0.003 ^a	0.40 (0.4)	0.076	0.74 (0.2)	0.87 ^a
Picture	90 (45)	1 (1)		0.40 (0.2)		0.75 (0.2)	
Demonstrative image							
Yes	43 (21.5)	2 (3)	0.083	0.40 (0.6)	0.028 ^a	0.89 (0.2)	0.001^a
No	157 (78.5)	2 (2)		0.40 (0.3)		0.72 (0.2)	

^aMann-Whitney U test

^bKruskal-Wallis test

IQR = interquartile range, N = number of participants, SD = standard deviation. Bold numbers are statistically significant *p* values.

Figure 2. Distribution of OHCUS



OHCUS item fulfillment analysis

Figure 3 shows that none of the OHCUS criteria received a zero mention rate. The highest items were “discussing tooth brushing technique” (39.5%) and “interdental cleaning aids” (31.5%). The lowest items were “toothbrushing duration” (14.5%) and “mentioned tongue scraping” (16.5%).

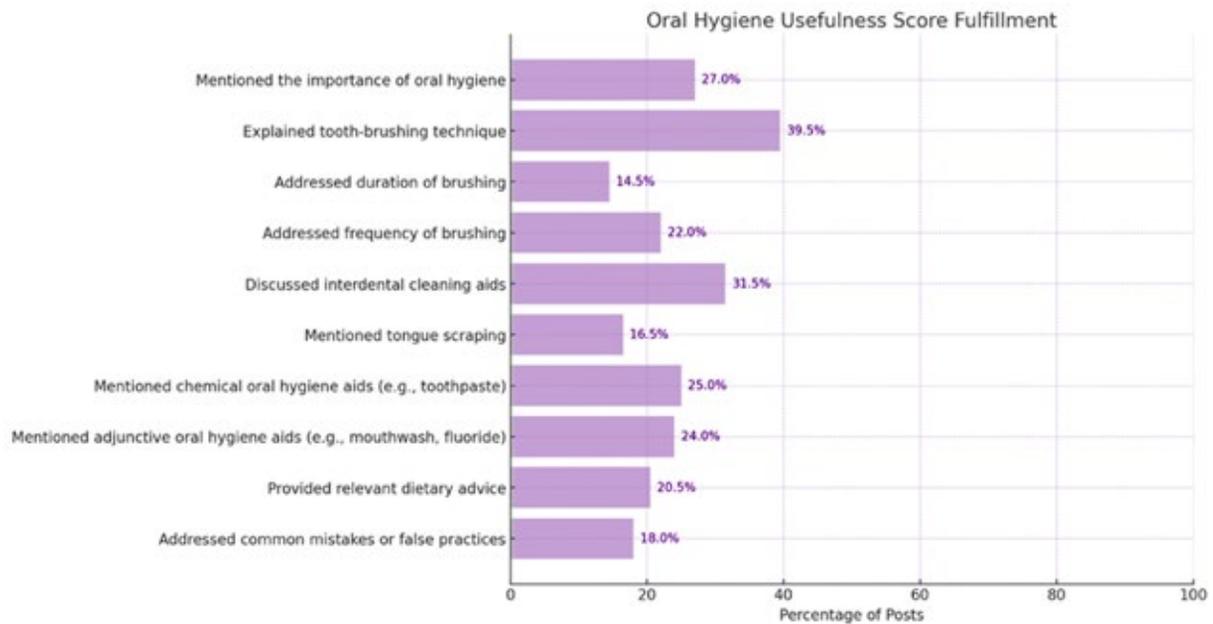
PEMAT (understandability and actionability)

As seen in Figure 4, the mean understandability score for the posts was 74.4% ±14.87% (median = 75%, IQR = 22%).

Sixty-one percent (61%) of the posts were considered understandable (scored higher than 70%). A significant difference in the distribution of understandability was observed with information sources (*p* < 0.001) and post-content type (*p* < 0.001). Dental hygienists and dental clinics had the most understandable posts. Educational posts scored higher in understandability.

The actionability score averaged 35.6% ±24.37% (median = 40%, IQR =40%), and 92.5% of the posts

Figure 3. OHCUS fulfillment



were poorly actionable. A significant difference in the distribution of actionability was observed with information sources ($p = 0.048$) and post-content type ($p < 0.001$). Dental hygienists and dentists posted the most actionable posts, while educational posts were more actionable than testimonials and promotional posts.

Usefulness and PEMAT

Positive correlations were observed among usefulness, understandability, and actionability. The correlation between usefulness and understandability was ($r = 0.251$, $p < 0.001$), and between usefulness and actionability was ($r = 0.370$, $p < 0.001$).

DISCUSSION

Social media has become ubiquitous,⁸ offering constant information across various platforms such as YouTube, Facebook, Instagram, and Telegram. This includes a growing trend of health care content shared by individuals, health care professionals, and institutions. Several studies have acknowledged the potential of social media for oral health education, highlighting its ability to share knowledge among users.²⁷⁻²⁹ However, many studies have raised concerns regarding the accuracy and reliability of this information.^{14,16,17} This study addressed one of the gaps by analyzing the quality and effectiveness of OHI, specifically on Instagram. Implementing the novel OHCUS scoring system in conjunction with PEMAT has provided valuable insights into the usefulness, understandability, and actionability of patient education materials posted on Instagram. The present analysis has identified positive aspects and areas for improvement on the platform's potential for patient education.

The prevalence of oral hygiene content on Instagram underscores its potential as a platform for oral health education. Most posts originated within the last 5 years, reflecting a bias towards recent content. This aligns with findings from other studies highlighting a trend favouring recent content on social media platforms.¹⁵ The dominance of video posts in the present research suggests that videos effectively demonstrate proper techniques such as brushing and flossing, enhancing user understanding.³⁰ Demonstrative images further improve comprehension, as highlighted by studies on dental hygiene education.³¹

The present study reveals that over half of the posts originated from health care professionals, with dentists, dental hygienists, and dental clinics being the primary contributors. The majority of their posts were educational, which suggests a growing awareness among these professionals of social media's potential for patient education.²⁷ However, social engagement metrics, such as likes and views, were significantly higher for promotional content posted by individuals, indicating that social metrics do not necessarily correlate with the scientific content's quality,³² as many factors influence social engagement, such as the owner's popularity, sponsorship, and quality of the post.^{31,33}

Despite the high quantity of OHI on Instagram, information quality is a significant concern. The low average OHCUS and the high proportion of posts categorized as "not useful" or "slightly useful" suggest a need for improvement in content accuracy and comprehensiveness. Previous studies have highlighted similar concerns about the quality of health information on social media, including Instagram and YouTube.^{18,34}

Figure 4. PEMAT results of Instagram posts



PEMAT analysis revealed that, while two-thirds of the posts were understandable, the actionability scores were low, indicating that the information was not easily translatable into actionable steps for users. Similarly, a study analyzing vasectomy information on YouTube³⁵ and another evaluating non-vitamin K oral anticoagulants content on Google, Yahoo!, and Bing³⁶ found content with high understandability but low actionability. A recent study on clubfoot information on websites reported similar results, with none of the websites meeting the actionability threshold of 70%.³⁷ These findings suggest that social media platforms require stricter content validation for accuracy, literacy, and information delivery despite their potential for patient education.

Interestingly, a recent study on Instagram's effectiveness in improving oral hygiene in young orthodontic patients showed that patients had significant knowledge improvement but needed to put their knowledge into actionable steps.³⁸ This aligns with the findings of the present study and highlights the importance of creating content beyond basic understanding and translating information into actionable user steps.

Content from oral health professionals, particularly dental hygienists and dentists, was more informative, understandable, and actionable, considering their expertise in oral hygiene education.^{6,39,40} Educational posts were also found to be more informative and actionable compared to promotional or testimonial content. This finding highlights the importance of seeking information from credible sources and being aware of potential biases in promotional content.

The findings of the present study suggest that Instagram has the potential to be a valuable platform for disseminating oral health education. However, the variability in content quality and reliability remains a significant challenge, consistent with prior studies on other platforms such as YouTube and TikTok.^{18,34,41} Posts from oral health professionals achieved higher usefulness, understandability, and actionability scores, reinforcing their role in addressing the impact of media hype and

guiding audiences towards credible health education. This highlights the need for standardized guidelines to improve the quality of social media content for public health.⁴²

Future research should explore innovative approaches, including the use of smartphone applications and artificial intelligence (AI), to enhance oral health education. Smartphone apps have shown potential in improving patient engagement and adherence to oral hygiene practices,⁴³ while AI applications such as convolutional neural networks offer promising tools for diagnostics and education in dentistry.⁴⁴ Examining these technologies could provide valuable insights into their scalability and effectiveness in promoting oral health.

This study has limitations. First, the data were limited to posts in English, although Instagram provides a translation function for its posts. OHCUS and PEMAT assessments depend highly on the accuracy of word usage, which most translation functions may not provide. Second, the dynamic nature of social media content and the limitations of search algorithms were identified as challenges in this study. Social media search results are cross-sectional, representing a specific time and not necessarily reflecting the quality of all Instagram content. Additionally, the lack of clinical trials to validate the real-world impact of Instagram-based oral hygiene education limits the generalizability of the findings. While the present analysis provides insights into the quality and engagement metrics of social media posts, randomized controlled trials are needed to evaluate their effectiveness in improving oral health outcomes.

CONCLUSION

Despite the significant presence of OHI on Instagram, the findings of this study highlight limitations in information quality and content's ability to translate information into actionable steps. While content from oral health professionals tends to be more informative, understandable, and actionable, there is a clear need for improvement. Social media platforms such as Instagram offer immense potential for delivering oral health education.

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CONFLICTS OF INTEREST

The authors have disclosed no conflicts of interest.

DISCLOSURE OF AI-GENERATED CONTENT

While preparing this work, the authors used Grammarly to improve the readability and language of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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