

Research

Analysis of 100 Most-Viewed YouTube Toothbrushing Videos

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Abstract

Purpose: Parental education regarding the importance of toothbrushing and how to brush children's teeth is a key factor influencing pediatric oral health and YouTube videos have become a popular source of health information. The purpose of this study was to examine the descriptive features of the 100 most frequently viewed English-language YouTube toothbrushing videos and evaluate their usefulness relative to professional guidelines.

Methods: A structured YouTube web search identified the 100 most frequently viewed toothbrushing videos during a six-month period (10/1/17 – 4/30/18). Two independent evaluators assessed each video for consistency with professional recommendations using *a priori* criteria. Each video was also assessed for descriptive characteristics, user engagement, and content. Comparative analyses by video source (health care professionals, commercial, and independent media) were performed, and an exploratory regression model was used to test the relationship between video characteristics and usefulness for parent education.

Results: The top 100 YouTube videos were most often posted by independent media outlets (78%), targeted toward children (70%), and less than 2 minutes long (56%). Few videos aligned with professional recommendations regarding toothbrushing frequency (38%), toothbrushing duration (24%), amount of toothpaste (21%), fluoride toothpaste use (19%), post-brushing behavior (10%), toothbrush selection (4%), and toothbrush replacement (3%). A stepwise bidirectional regression model found that videos posted by health care professionals were significantly more likely to contain recommendations consistent with professional recommendations compared with other upload sources.

Conclusions: The most frequently viewed toothbrushing videos were not uploaded to the Internet by health care professionals. Videos uploaded by health care professionals contained significantly higher counts of professional recommendations however, they differed in audio and visual format and production style compared to those from commercial and independent media sources.

Keywords: toothbrushing, YouTube, patient education, pediatric oral health, instructional video

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Introduction

Proper toothbrushing is essential to maintaining oral hygiene and preventing dental caries,^{1,2} a disease that remains a significant pediatric public health problem in the United States (US).³⁻⁵ The American Dental Association (ADA) recommends toothbrushing as part of a daily regimen to maintain oral health, advising the public to brush twice daily for 2 minutes with a soft-bristled toothbrush and fluoride toothpaste. The ADA also recommends using a toothbrush that fits the mouth and allows all areas to be reached, angling the toothbrush at 45 degrees to the gum line, using

short gentle strokes, and replacing a toothbrush every 3 to 4 months.⁴ The American Academy of Pediatric Dentistry (AAPD) recommends using a smear or rice-sized amount of fluoridated toothpaste for children younger than 3 years and a pea-sized amount for children aged 3-6 years.⁵ For preschool-aged children, parents are advised to dispense toothpaste onto a soft toothbrush of age-appropriate size and to perform or assist with their child's toothbrushing. To optimize the fluoride benefits of toothpaste, the AAPD recommends that rinsing after brushing be minimal, or not done at all.⁵

Despite clear professional guidelines, many parents do not follow brushing recommendations with their children.⁶ Horowitz et al.⁷ reported that parents of young children did not know how to advise their children to brush and had limited understanding of the importance of fluoride in preventing caries. Parents have cited the complexity and diversity of advice provided by a wide range of dental associations, professionals, companies, and oral health literature as barriers to adherence.⁸ They also reported that socioeconomic-related barriers, including difficulty managing their stressful lives, prevent them from adhering to toothbrushing guidelines beyond simple reminders to their children to brush rather than direct supervision of their brushing.⁹ The lack of parental adherence to children's toothbrushing recommendations may also be associated with low oral health literacy, which encompasses knowledge of the processes responsible for dental disease as well as the ability to apply that knowledge, use the health care system for dental checkups and care, and implement oral hygiene practices.^{7,10} Low oral health literacy has been associated with increased rates and severity of caries, irregular and missed dental appointments, and less dental knowledge and access to dental care.^{7,11-14} In addition, low oral health literacy has also been associated with underserved and vulnerable groups, including those who live in rural areas, have low income or educational levels, or are racial or ethnic minorities.^{7,15-17}

While oral health information is available from a variety of print sources, the internet has become a primary source of health information,¹⁸ to the extent that the US Food and Drug Administration has a posted advisory on how to assess the validity of web-based health advice.¹⁹ Most families, including those with low household incomes, have access to the internet and believe it is a useful resource for finding health information.²⁰ The Pew Research Center²¹ reported that 59% of people in the US have used the internet as a source of health information, and 26% of those have watched or read about another's experience with health or medical issues. However, many internet sites are text based and present information at advanced reading levels that may limit accessibility for individuals with lower literacy levels.²² Online videos offer an alternative to text-based materials, and have been associated with increased comprehension when compared with written sources among children and adults with low literacy levels.²³

Evidence suggests that people are increasingly turning to YouTube for dental guidelines. According to Google Trends, the search for toothbrushing videos on YouTube in the US increased between 2008 and 2018.²⁴ Several studies have analyzed the content of YouTube videos related to early childhood caries, fluoride, dental anxiety, and oral

hygiene.²⁵⁻²⁷ For example, Duman²⁸ analyzed top-listed YouTube videos about children's oral hygiene and found that most videos were useful in conveying oral health information about toothbrushing, flossing, and visiting the dentist. The purpose of this study was to examine the most frequently viewed toothbrushing videos on YouTube and assess their characteristics, viewer engagement, educational content, and adherence to professional guidelines and recommendations.

Methods

This study was deemed exempt by the Columbia University Irving Medical Center Institutional Review Board. An internet search was conducted by two investigators (G.Z. and H.G.) between October 1, 2017, and April 30, 2018, to identify the 100 most frequently viewed YouTube videos, using the search terms *toothbrushing*, *how to brush teeth*, and *brushing teeth*. A list of 100 videos was generated for each of the 3 search terms. Inclusion criteria were videos in the English language that included information about instructional toothbrushing (i.e., the method or frequency of brushing). Videos that did not fit these inclusion criteria, that were duplicates, or that showed content irrelevant to instructional toothbrushing were excluded. A master list of the 100 most-viewed videos was combined from the three initial lists, which comprised videos identified through the search term *toothbrushing* (n=33), the term *how to brush teeth* (n=28), and the term *brushing teeth* (n=39).

All toothbrush types, hand and electric, were included in the videos selected. In total, 3% of videos mentioned electric toothbrushes only, 78% mentioned manual toothbrushes only, 5% mentioned electric and manual toothbrushes, and 4% mentioned other toothbrush types, such as 360 degree brushes. Only common techniques for toothbrushing were captured; these techniques included the Bass method (i.e., brushing at a 45-degree angle to the gum line), the Fones circular method, and the back-and-forth or scrubbing method. Videos were classified by the upload source indicated as: health care professionals (e.g., dentists, dental assistants, and governmental and private health organizations), independent media outlets (e.g., YouTube content creators, bloggers, individual users, and small media outlets), and commercial outlets (e.g., commercial television, radio, and advertisements for hospitals, services, and products).

The investigators rated the videos independently according to three domains; characteristics, engagement, and content. Interrater reliability was calculated as percent agreement. The characteristics domain assessed video length, audio and visual formats, target audience, and upload source. The engagement

domain was evaluated through the number of views, likes, dislikes, comments received, and other newly created variables (specifically viewing and interaction rates). The content domain was examined for consistency with recommendations from the AAPD and ADA. A full explanation of the variables included in these domains is provided in Table I.

A usefulness score variable was created to evaluate the thoroughness of the videos with regard to mentioning essential professional guidelines related to brushing duration, frequency, and use of brushing products. The age-specific variables related to toothpaste amount and brushing methods were excluded from the usefulness score because of the wide range of ages among the target audiences. The score was calculated by adding a value of 1 for each of the guidelines—soft-bristled toothbrush, fluoride toothpaste, brushing for 2 minutes, and brushing twice a day—featured in the video, resulting in a continuous measure ranging from 0-4.

Preliminary descriptive statistics, including frequencies, percentages, means, ranges, and 95% confidence intervals (CIs), were calculated using a statistical software program (SPSS version 25, IBM; Armonk, NY.). The normality of the continuous variables was investigated through the use of Kolmogorov-Smirnov tests. Because the continuous variables were not normally distributed, Kruskal-Wallis tests and *post hoc* Mann-Whitney U tests were used to examine differences in the relationships between upload source and viewer engagement (measured as viewing and interaction rates). Differences in video content and characteristics (categorical variables) by video upload source were examined using Fisher exact tests. A bidirectional stepwise regression procedure was used to identify a model that would predict video content usefulness as indicated by adherence to main professional guidelines. Only those predictors with corresponding *p*-values less than 0.05 in the simple regression analysis were considered, with a significance threshold of $p \leq 0.05$ used in the model selection process.

Results

Video characteristics

Interrater percent agreement differed by domain, varying from 80% for content, 85% for characteristics, and 100% for engagement. Video length varied from 25 seconds to 13 minutes and 47 seconds, with a median length of 4 minutes and 24 seconds (interquartile range [IQR]=1:54-4:54). The majority of the most frequently viewed YouTube toothbrushing videos were uploaded by independent online media sources such as YouTube content creators, bloggers and individual users, (77.0%, $n=77$) and developed for pediatric audiences (85.0%, $n=85$). More than one-half of all videos

featured musical elements (55.6%, $n=55$), and more videos featured live action (39.0%, $n=39$) than animation (23.0%, $n=23$), cartoons (27.0%, $n=27$), or combined elements (11.0%, $n=11$).

An analysis of variance (Kruskal-Wallis H test) indicated a statistically significant difference in how long the video was posted in YouTube (video age in days) between the upload sources (chi-squared $[\chi^2]=12.0$, $p=0.001$). Mann-Whitney U tests were performed *post hoc* to identify the differences between groups and revealed significant differences in the mean rankings (MRs) for video age between videos uploaded by independent media outlets (MR=40.0) and health care professionals (MR=58.6, $p<0.05$). No statistically significant differences in video length between upload sources were found.

Videos created and uploaded by health care professionals ($n=16$) featured more live action, less music, and less children's content than videos uploaded by independent media outlets or commercial outlets and advertisers. In contrast, most of the videos uploaded by independent media outlets were designed for pediatric audiences (97.4%, $n=75$) and contained musical elements (68.8%, $n=53$).

Viewer engagement

Of the 100 most-viewed YouTube videos on toothbrushing, 70.0% were viewed at least 1 million times. In total, the 100 videos in the sample were watched 1,284,560,839 times, and the number of views per video ranged from 280,244 to 50 million. The median score was 1,600 (IQR=832-6,200) for number of likes, 538 (IQR=182-1,900) for number of dislikes, and 114 for number of comments (IQR=37-294).

The Kruskal-Wallis H test showed that there was a statistically significant difference in viewing rate between upload sources ($\chi^2=13.4$, $p=0.001$). *Post hoc* Mann-Whitney U tests were performed to identify the differences between groups, which revealed significant differences in the MRs for viewing rates between videos uploaded by health care professionals (MR=9.6) vs. commercial outlets (MR=16.7, $p<0.05$) and health care professionals (MR=21.7) vs. independent media outlets (MR=49.0, $p<0.001$). No statistically significant differences were found between the 3 upload sources in terms of video interaction rate.

Video content

Overall, a minority of the 100 most-viewed videos presented adequate information consistent with ADA and AAPD toothbrushing guidelines (Table II). The most common AAPD and ADA recommendations presented in the videos were brushing twice a day (39.0%, $n=39$), brushing for

Table I. Domains, variables, and response categories

Domain	Variable	Response categories
Video characteristics: Descriptive features of the YouTube video	Video length	Minutes, seconds
	Target audience	Children (includes pretend play, games, cartoons, musical elements, singing, and mascots) Adults (uses technical language and includes references to adult topics of interest)
	Audio format	Musical Non-musical (musical elements comprised <50% of the video)
	Visual format	Live action Animation, including dynamic content with moving images Cartoon, including 2-dimensional content Combined, including 2 or more of the described formats
	Upload source	Health care professionals (e.g., dentists, dental assistants, and governmental and private health organizations) Independent media outlets (e.g., YouTube content creators, bloggers, individual users, and small media outlets) Commercial outlets (e.g., commercial television, radio, and advertisements for hospitals, services, and products)
Viewer engagement: Measures of viewer engagement with the video at the time of measurement	Number of views	Numeric
	Number of likes	Numeric
	Number of dislikes	Numeric
	Number of comments received	Numeric
	Viewing rate	(n) views (n) days since upload
	Interaction rate	(n) likes - (n) dislikes x 100/n (views)
Content: Assessment of whether the video addressed the specific professional guideline	Soft toothbrush	0 - Did not include 1 - Included
	Age-appropriate toothbrush	0 - Did not include 1 - Included
	Fluoride toothpaste	0 - Did not include 1 - Included
	Age-appropriate amount of toothpaste	0 - Did not include 1 - Included
	Brushing at a 45° angle	0 - Did not include 1 - Included
	Brushing in a circular motion	0 - Did not include 1 - Included
	Brushing in a scrubbing motion	0 - Did not include 1 - Included
	Brushing duration (2 min)	0 - Did not include 1 - Included
	Brushing frequency (twice per day)	0 - Did not include 1 - Included
	Replace toothbrush every 3-4 months	0 - Did not include 1 - Included
	Spitting out toothpaste after brushing is complete	0 - Did not include 1 - Included

Table II. Educational content related to toothbrushing by video upload source (n=100)

Educational content*	All videos (n=100) n (%)	Video upload source			p-value**
		Healthcare professional (n=16) n (%)	Independent media outlet (n=78) n (%)	Commercial media outlet or advertiser (n=6) n (%)	
Brushing product					
Soft toothbrush	13 (13.0)	9 (56.3)	2 (2.6)	2 (33.3)	<0.001†
Age- appropriate toothbrush	4 (4.0)	3 (18.8)	0	1 (16.7)	<0.001†
Fluoride toothpaste	19 (19.0)	6 (37.5)	12 (15.4)	1 (16.7)	0.13
Age-appropriate toothpaste amount	21 (21.0)	3 (18.8)	15 (19.2)	3 (50.0)	0.18
Brushing method					
At 45° angle	17 (17.0)	11 (68.8)	5 (6.4)	1 (16.7)	<0.001†
Circular motion	35 (35.0)	3 (18.8)	30 (38.5)	2 (33.3)	0.32
Scrubbing motion	57 (57.0)	3 (18.8)	51 (65.4)	3 (50.0)	0.002‡
Brushing duration					
2 min	24 (24.0)	8 (50.0)	12 (15.4)	4 (66.7)	<0.001†
Brushing frequency					
Twice per day	38 (38.0)	9 (56.3)	25 (32.9)	4 (66.7)	0.07
Post-brushing care					
Spit out toothpaste	10 (10.0)	2 (12.5)	5 (6.5)	3 (50.0)	0.01§
Replace brush every 3-4 months	3 (3.0)	2 (12.5)	0	1 (16.7)	0.004‡

*Based on current recommendations from the American Dental Association and the American Academy of Pediatric Dentistry.**Fisher exact test was used because cell count was <5 for all observations.

† p<0.001. ‡ p<0.01. § p≤0.05.

2 minutes (24.0%, n=24), using an age-appropriate amount of toothpaste (21.0%, n=21), using fluoride toothpaste (19.0%, n=19), using a soft-bristled brush (13.0%, n=13), using an age-appropriate toothbrush (4.0%, n=4), and replacing a toothbrush every 3 to 4 months (3.0%, n=3). In addition, the most common brushing techniques featured in the sampled videos were back-and-forth scrubbing motions (57.0%, n=57) followed by circular motions (35.0%, n=35) and brushing at a 45-degree angle to the gum line (17.0%, n=17).

The subset of videos created and uploaded by health care professionals most closely tracked professional association recommendations for using a soft-bristled toothbrush (56.0%, n=9) and brushing for 2 minutes (50.0%, n=8). In comparison, videos uploaded by independent media outlets

were much less likely to mention brushing for 2 minutes (15.0%, n=12) or using a soft-bristled brush (3.0%, n=2).

Video usefulness

A stepwise regression analysis was conducted to evaluate the relationship between video characteristics and the inclusion of key professional recommendations for toothbrushing as indicated by the usefulness score. In step one of the analysis, audio format was included in the regression equation and found to be significantly associated with video usefulness, accounting for approximately 23.0% of the variance in video usefulness (multiple correlation coefficient [R^2]=0.228). Video upload source was included in the regression equation during step two, accounting for 8.5% of the variance, and visual format was included during step three, accounting for

6.0% of variance. Overall, the most significant variables, which comprised 33% of the variance ($R^2=0.334$) in usefulness, were audio format (non-musical) ($B=0.586$, $p\leq 0.05$), upload source (health care professional) ($B=0.409$, $p\leq 0.01$), and visual format (live action) ($B=0.544$, $p\leq 0.01$).

Discussion

This study aimed to explore the descriptive characteristics of the most popular toothbrushing YouTube videos and identify any associations between these characteristics and viewer engagement and adherence to professional guidelines by upload source. Descriptive data indicated that most of the videos created and uploaded by health care professionals were designed for adult audiences and featured a live action format using technical language. In contrast, videos uploaded by commercial outlets and advertisers were primarily aimed at children and contained cartoons and animation with music.

Videos created and uploaded by independent media outlets, including individual YouTube content creators and small media channels, constituted the bulk of the top 100 videos, indicating their popularity and widespread reach compared with videos uploaded by other sources. This finding was somewhat unexpected, as most of the overall content on YouTube is not uploaded by independent media outlets or individuals but by large commercial media corporations, such as CBS, BBC, Vevo, and Hulu.²⁹ This finding was also divergent from the results of Duman,²⁸ who found that most YouTube videos about oral hygiene were uploaded by health care professionals and academic and professional organizations; however, Duman²⁸ excluded all cartoons, musical videos, and commercial videos from the analysis. While Duman²⁸ did not find any significant association between upload source and viewing or interaction rates, videos uploaded by independent media in the present study sample generated higher viewing rates than videos uploaded by commercial or independent sources. However, no significant differences were found in video interaction rates among all 3 upload sources. Future research is needed to investigate predictors of video viewership. YouTube channels established by independent media outlets may have a well-established fan base, a larger number of videos, and more engaging content than other types of channels.

Although most of the videos uploaded by independent media outlets were created for children, they provided inconsistent advice on proper toothbrushing methods and appeared to be designed for motivational rather than instructional use. These videos emphasized the importance of brushing or having a bright smile rather than following professional recommendations on brushing methods,

brushing frequency, or the proper use of fluoride toothpaste. These findings are consistent with a 2018 study by Basch et al.,²⁶ which reported that the majority of toothpaste advertisements appearing in parents' magazines showed improper use of toothpaste, suggesting that commercial outlets are not positioning themselves to raise awareness about healthy oral hygiene. These types of advertisements may have real-life consequences. For example, a recent survey by the Centers for Disease Control similarly found that nearly 40% of children aged 3–6 years used a brush that was full or half-full of toothpaste, despite the professional recommendation to use no more than a pea-sized amount.³⁰

The most common professional recommendations presented in the present study sample were brushing twice a day, followed by brushing for 2 minutes. In contrast, Duman²⁸ found that brushing time was more frequently mentioned than brushing frequency in oral hygiene videos, a difference that could be attributed to differences in inclusion criteria and review period and method. Duman²⁸ also found that the majority of videos (77.7%) mentioned the importance of parental supervision during brushing, a content variable that was not investigated in the present analysis.

While the ADA routinely recommends brushing at a 45-degree angle to the gum line (Bass method),⁴ the most common brushing techniques featured in the sampled videos were back-and-forth scrubbing motions followed by circular motions (Fones method), with brushing at a 45-degree angle to the gum line the third most common method. This finding was consistent with the proportion of videos aimed at children (85.0%), for whom angled brushing is beyond their manual dexterity. For children, the scrubbing technique may be suitable for pre-schoolers who are learning how to brush but should be replaced in sequence by the circular and angled techniques as their motor skills develop.³¹⁻³²

Overall, this study found that the majority of the 100 most-viewed YouTube toothbrushing videos were not created and uploaded by health care professionals and did not reflect current professional recommendations. Rather, most were created by independent media outlets and designed to appeal to children as motivational rather than instructional sources. However, the videos uploaded by health care professionals were significantly more likely to include accurate, up-to-date professional recommendations. The findings suggest that the credibility of the video's upload source and the quality of the video's content may be less important to viewers than other factors, such as the video's ability to present information in an attractive or entertaining manner. Because YouTube has become a frequently used resource for individuals seeking

health-related information,^{21,23-24} this discrepancy raises concern about the quality of oral health care content in popular videos.

Limitations

As with any evaluation of web-based materials, this snapshot study reflects a time-specific assessment of online toothbrushing videos. Because new videos are being uploaded continuously, a longitudinal assessment of the change in web content may be of more value than an assessment at a single point in time. Regarding methodology, the findings were limited by the subjective assessments of 2 independent video viewers. Although their high rates of interrater agreement suggest that *a priori* assessment criteria were reasonably well defined, their assessments remain subjective. In addition, the assessment criteria did not include the evaluation of videos over time. The findings are also limited by the study's small sample size relative to the number of potentially relevant videos, however the small sample was purposeful because the study's goal was to include only popular videos with a large number of views.

The cutoff point for the 100 top-viewed videos was arbitrarily selected; thus, if a different cutoff point had been used, the findings may have been different. This limitation may have led to skewed results given the logarithmic nature of top-viewed video numbers and may have resulted in a reduction in the statistical power to detect differences. In addition, although basic video analytics, such as the average numbers of views, likes, and comments, are commonly used to measure user engagement, they are subject to rapid changes over time.³³ Viewing and interaction rates, which have been previously used in the YouTube research literature,^{28,34} seem to provide a way to control for constant count fluctuation in basic video analytics. However, there are no data available about their validity, indicating the need for more robust and well-tested video engagement metrics. Wu et al.³⁵ has argued that, while video view counts remain the most studied metric for measuring video popularity, the time spent watching videos should also be considered, as it is becoming a primary metric for video recommendations on YouTube. Future studies could extend the analysis to other predictors of video viewing, such as the number of subscribers and videos for specific YouTube channels, and to other visual qualities, such as definition and resolution.

The study's results present both a problem and an opportunity for health care professionals. The findings suggest that health care professionals are not currently creating toothbrushing videos with formats and elements that are likely to receive a large number of views. However, the results

also highlight the opportunity that exists for health care professionals to collaborate with popular sources of online instructional videos to improve content and ensure adherence to professional guidelines. Dental professionals can also integrate videos that provide high-quality recommendations about toothbrushing into their existing patient education strategies. Videos can offer a safe learning environment and enhance attention and information recall while being accessible to children of all ages, educational backgrounds, and racial/ethnic groups.³⁶ It is critical that parents have access to accurate, easily understandable information to improve their oral health literacy and prevent oral diseases in their children.

Conclusions

Findings from this study indicated that the most commonly viewed YouTube toothbrushing videos were uploaded to the Internet by independent media outlets and often did not align with ADA and AAPD toothbrushing recommendations. Videos created and uploaded by health care professionals were less likely to incorporate animation, cartoons, or music in their messaging. However, videos from health care professional sources were significantly more likely to mention accurate professional guidelines.

Disclosure

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