A digital study on predictive factors for Instagram users' engagement with amber necklace-related posts

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Abstract

Aim This study aimed to assess the engagement of Instagram users with Brazilian Portuguese posts related to amber necklaces for teething symptoms relief, identifying predictive factors that can increase users' engagement with information and misinformation.

Methods This digital study analysed Brazilian Portuguese amber necklace-related posts on Instagram. The posts were collected using specific search strategies on CrowdTangle™. Subsequently, two independent investigators were trained and calibrated to categorise the posts concerning the proposed outcomes. The posts were categorised according to their facticity (information or misinformation), type of media (album/photo or video/Instagram TV), sentiment (positive, neutral, or negative), author's occupation (dentist or non-dentist), and type of profile (commercial or personal). Additionally, investigators compiled information about the time of publication (days) and interaction metrics (total interaction and overperforming score). The statistical analysis assessed the inter-examiner reliability, group comparisons, and the factors associated with interaction and misinformation. P values <0.05 were considered significant.

Results The posts were primarily commercial, created by non-dentists, and published as albums/photos expressing a positive sentiment and containing misinformation. While a personal profile was a predictive factor for higher total interaction and overperforming scores, the identification of videos only predicted higher total interaction.

Conclusion Videos and personal profiles were predictive factors for higher user engagement with amber necklace posts on teething symptoms relief on Instagram, even with the warnings of health organisations and the lack of scientific evidence to confirm its efficacy.

KEYWORDS eHealth, Misinformation, Primary dentition, Tooth eruption.

Introduction

Personal lifestyle is profoundly influenced by popular knowledge [Putland et al., 2011], which is often based on opinions and publications found in the mass media [Ford and Kaphingst, 2009]. In this sense, social media has revolutionised the way people interact with each other, serving as a platform to read, watch, listen, and understand other people's health experiences. It acts as a bridge between groups and individuals who face real-life interaction difficulties and lack face-to-face support [Singleton et al., 2016]. Previous studies have indicated that online information can contribute to the individual's awareness of oral health [Albert et al., 2014], improve prognosis and treatment adherence, and facilitate professional-patient communication [Caglar et al., 2015; Rathert et al., 2017].

On the other hand, social media also contributes to spreading fake news—false or misleading information intentionally presented as credible information [Apuke and Omar, 2021]—often to generate more revenue through advertising [Chen et al., 2015]. In this context, Baltic amber has gained popularity as a "traditional healing resource" capable of alleviating the discomfort of teething in babies due to hypothetical succinic acid's analgesic and anti-inflammatory properties [Nissen et al., 2019]. A recent study demonstrated a global increase in Google users' interest in using amber necklaces, indicating that people are likely to believe in the effects of jewelry or talismans on physical and biological aspects [Strieder et al., 2019]. However, even if such information is not necessarily committed to facts and evidence, individuals usually accept them as truth, tending to replicate their contents, which contributes to the increase of the propagation of information and its persuasiveness [Arndt and Jones, 2018]. Hence, such inappropriate information finds fertile ground for widespread dissemination on social media, affecting negatively the decision-making process of the general public [Ellison and Boyd 2013].

Monitoring health behaviours through technology is crucial for understanding and reducing oral health disparities among different populations, making investigations in this area of fundamental importance [American Academy of Pediatric Dentistry 2022]. Nevertheless, there is a lack of digital studies evaluating

the popularity of posts about the use of amber necklaces by babies on social media platforms such as Instagram. This platform allows users to publicly upload and share photos and short videos. Users can also follow feeds of known individuals, celebrities, and businesses and engage with their posts by liking, commenting, and adding hashtags (a word or expression preceded by the hash sign #). Brazil has a staggering number of Instagram users, ranking third globally with around 113.5 million users [Kemp, 2022].

Therefore, this study aimed to assess the engagement of Instagram users with Brazilian Portuguese posts related to amber necklaces for teething symptoms relief, identifying predictive factors that can increase users' engagement with both information and misinformation.

Methods

Study design and ethics

This digital study analysed Brazilian Portuguese amber necklace-related posts on Instagram. Posts were collected using specific search strategies on CrowdTangle™, a tool from Meta Platforms, Inc. to analyse and report information on social media (version 2023, Menlo Park, USA). Two independent investigators (APS and PEAA) were trained and calibrated to categorise the posts according to their facticity (information or misinformation), type of media (album/photo or video/Instagram TV), sentiment (positive, neutral, or negative), author's occupation (dentist/non-dentist), and type of profile (commercial or personal). In addition, investigators compiled information about the time of publication (days) and interaction metrics (total interaction and overperforming score). The statistical analysis assessed the inter-examiner reliability, group comparisons, and the factors associated with interaction and misinformation.

This study did not require institutional review board approval from the Council of Ethics in Human Research of the Bauru School of Dentistry because federal regulations do not apply to research using publicly available data that does not involve human subjects.

Search strategy

To gather the information for this research, we used CrowdTangle™ which is a web scraping tool owned by Meta Inc. that allows for the examination of several social media metrics, including posts, data, profile information, and performance scores associated with particular keywords in distinct periods and languages, permitting the ranking of posts by specific interaction metrics [Gomaa et al., 2022]. CrowdTangle™ access is restricted to authorised entities, such as qualified organizations such as universities and researchers. Our research team was given permission to access this platform solely for the investigation of misinformation in Dentistry. This study selected only posts on Instagram produced in Brazilian Portuguese by authors located in Brazil. They were retrieved using a search strategy developed by the combination of 10 terms, as follows: "colar de âmbar" OR "colar de ambar" OR "âmbar báltico" OR "colar de dentição" OR #ambarbaltico OR #colardeambarbaltico OR #colardeambar AND (dentição OR dente OR dentes). The keywords were determined through exploratory analysis of terms and hashtags to ensure the maximum recovery of data on Instagram.

Data collection

In order to include the most popular posts, they were ranked based on their total interaction. On September 28, 2021, raw data of interaction metrics and content of posts were retrieved from CrowdTangle™ and converted to .csv format. Before the qualitative analysis, a manual qualitative assessment of the raw dataset was conducted by a researcher (APS) who preprocessed data concerning the exclusion of duplicates, reposts, and non-amber necklace-related posts. These posts were then anonymised by blacking out names, profiles, and people's eyes in images, and were numbered and saved in sequence in Google Slides (Google, Mountain View, CA, USA), which was later converted to a .pdf file. This systematic process allowed for the ethical analysis of messages by different investigators at different times, ensuring standardization and preventing inconsistencies.

Qualitative data analysis

After training with the presentation of protocols and the discussion of the representative features of the posts, two investigators (APS and PEAA) confirmed their calibration by the intraclass correlation coefficient (ICC) for absolute agreement, considering the analysis of 20% of the sample of posts. The cases of divergence of opinion were posteriorly decided by reviewers' consensus. Then, the two trained and calibrated investigators determined, independently, the facticity (information or misinformation), type of media (album/photo or video/Instagram TV), sentiment (positive, neutral, or negative), author's occupation (dentist/non-dentist), and type of profile (commercial or personal).

Due to the difficulties in recognising the subjacent aims of Instagram users, we considered misinformation an umbrella concept that embraces false, incorrect, or misleading information published with or without the intention to deceive or cause harm [Wang et al., 2019]. The independent investigators analysed all content regarding the lack of scientific evidence to indicate that using an amber necklace is considered a superstitious health belief. In this sense, posts that contra-indicated the use of the amulet by presenting explicit counter-arguments against its possible benefits were categorised as information. Conversely, posts that indicated potential benefits related to its use were classified as misinformation.

The posts were manually categorised based on their sentiment, with positive, neutral, or negative categories. Overall, posts that reported promising results or recommended using the amber necklace were classified as positive, while posts expressing doubts or curiosity were considered neutral. On the other hand, negative posts contained warnings about the potential dangers of using the accessory on babies or mentioned the lack of scientific evidence supporting its supposed benefits.

Time of publication and interaction metrics

The time of publication (days) that a post was made available on the Web was calculated based on its publication date until September 28, 2021 (date of collection). Total interaction is the sum of all reactions, shares, and comments received by post. Additionally, the overperforming score measures the diffusion performance of a post relative to the interaction of the last 100 posts on the same account at the same time. The algorithm excludes the top and bottom 25% of posts and calculates the average number of interactions for the remaining middle 50% of posts during different time intervals, such as 15 minutes old, 60 minutes old, and 5 hours old, etc. When the account uploaded a new post, the platform

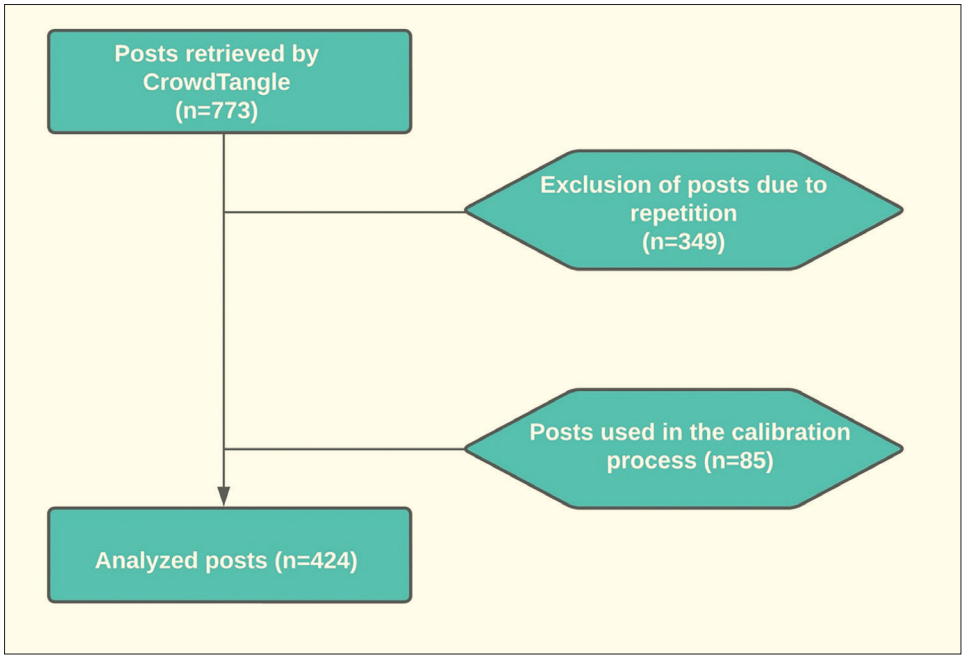

FIG. 1 Flowchart on the selection of posts for analysis.

compares its metrics with the calculated average and applied the corresponding weights from each dashboard to the obtained difference.

Variables

For statistical analysis, total interaction and overperforming scores were normalised by the time of publication of posts (days). Then, categorical variables were dichotomised as follows: total interaction (< 0.36 or ≥ 0.36), overperforming score (< 1.36 or ≥ 1.36), facticity (information or misinformation), type of media (album/photo or video/Instagram TV), sentiment (positive or neutral/negative), author's occupation (dentist or non-dentist), and types of profiles (commercial or personal). The continuous variables were dichotomised according to their median values. Since previous studies have suggested a correlation between positive emotions and increased engagement rates among social media users [Klassen et al., 2018], the positive sentiment was considered as a separate category in our analysis.

Statistical analysis

Data were analysed with the SPSS (version 25.0; IBM Inc., Armonk, USA), as follows:

1. The ICC was applied to assess the absolute inter-examiner agreement for the analysis of human-based sentiment and identification of misinformation;
2. Mann-Whitney U test was applied for the comparison of variable groups about interaction metrics, regarding the non-normal distribution of data previously detected by the Kolmogorov-Smirnov test;
3. Chi-square test was performed to evaluate differences in the distribution of dichotomised total interaction, overperforming score, facticity, type of media, human-based sentiment, and author's occupation about the type of profile;
4. Multiple binary logistic regression models were conducted to determine the association of dichotomised variables with total interaction and overperforming scores, regarding confounding factors. Only factors with Wald statistics with $P < 0.20$ in prior simple analyses were included in the models.

For all analyses, P values < 0.05 were considered significant.

Results

Overall, 773 posts were collected using the search strategy. After removing duplicates and reposts, 424 posts were considered for the analysis. In general, the posts were predominantly commercial (247, 58.3%), created by non-dentists (416, 98.1%), and published as album/photo (414, 97.6%), expressing a positive sentiment (339, 80.0%), and containing misinformation (338, 79.7%).

Table 1 presents the comparison of central tendency measures of dichotomised variable groups regarding total interaction and overperforming scores (per number of days from publication). A significantly higher total interaction was noted with posts on video/Instagram TV ($P = 0.015$) and posts shared by dentists ($P = 0.009$). In addition, significantly higher overperforming scores were observed in posts on album/photo ($P = 0.003$) and from personal profiles ($P < 0.001$).

Table 2 summarises the distribution of total interaction, overperforming score, facticity, type of media, human-based sentiment, and author's occupation. Posts from personal profiles were more frequently related to higher total interaction ($P < 0.001$) and overperforming scores ($P = 0.047$). Also, posts from commercial profiles were more frequently published by non-dentists and related to misinformation and positive sentiment ($P < 0.001$).

Table 3 displays the multiple logistic regression models for total interaction and overperforming scores. Total interaction was positively associated with the personal profile (odds ratio [OR] = 19.78; $P < 0.001$) and posts created as video/Instagram TV (OR = 14.20; $P = 0.017$). Also, the overperforming score was positively associated with the personal profile (OR = 1.48; $P = 0.047$).

Discussion

To the best of our knowledge, this is the first evidence of the interaction of Instagram users with Brazilian Portuguese

	Total interaction			Overperforming score		
	Mean (± SD)	Median (IQR)	P	Mean (± SD)	Median (IQR)	P
Facticity			0.090			0.105
Information	3.00 (± 9.73)	0.71 (1.81)		-0.31 (± 5.45)	1.04 (5.00)	
Misinformation	4.76 (± 44.99)	0.32 (1.15)		1.16 (± 6.36)	1.40 (5.00)	
Type of media			0.015*			0.003*
Album/Photo	4.40 (± 40.88)	0.35 (1.18)		1.00 (± 6.11)	1.40 (5.00)	
Video/Instagram TV	4.25 (± 3.72)	4.24 (7.95)		-4.76 (± 8.17)	-2.17 (10.00)	
Sentiment			0.090			0.093
Neutral/Negative	3.27 (± 10.00)	0.70 (1.84)		-0.31 (± 5.48)	1.05 (5.00)	
Positive	4.68 (± 44.91)	0.32 (1.13)		1.16 (± 6.36)	1.40 (5.00)	
Author's occupation			0.009*			0.553
Dentist	9.05 (± 20.16)	1.36 (0)		0.19 (± 2.93)	0.02 (5.00)	
Non-dentist	4.31 (± 40.69)	0.35 (1.18)		0.88 (± 6.26)	1.36 (5.00)	
Type of profile			0.061			<0.001*
Personal	9.79 (± 62.20)	1.25 (2.88)		0.82 (± 6.11)	1.48 (4.00)	
Commercial	0.54 (± 1.52)	0.12 (0.35)		0.90 (± 6.30)	1.11 (5.00)	
**indicate significant differences SD = Standart Deviation IQR = Interquartile Range*						

TABLE 1 Comparison of the mean (± SD) and medians (IQR) of total interaction and overperforming score (per number of days from publication) regarding dichotomised variable groups (Mann-Whitney U test, $P < 0.05$).

		Type of Profile		P
		Personal	Commercial	
Total interaction	<0.36	25 (14.1%)	186 (75.3%)	<0.001*
	≥0.36	152 (85.9%)	61 (24.7%)	
Overperforming score	<1.36	78 (44.1%)	133 (53.8%)	0.047*
	≥1.36	99 (55.9%)	114 (46.2%)	
Facticity	Information	54 (30.5%)	32 (13.0%)	<0.001*
	Misinformation	123 (69.5%)	215 (87.0%)	
Type of media	Album/Photo	172 (97.2%)	242 (98.0%)	0.592
	Video/Instagram TV	5 (2.8%)	5 (2.0%)	
Sentiment	Neutral/Negative	53 (29.9%)	32 (13.0%)	<0.001*
	Positive	124 (70.1%)	215 (87.0%)	
Author's occupation	Dentist	8 (4.5%)	0 (0%)	<0.001*
	Non-dentist	169 (95.5%)	247 (100%)	
**indicate significant differences*				

TABLE 2 Distribution of dichotomised variable groups according to type of profile (Pearson Chi-square test, P<0.05).

amber necklace-related posts to prevent teething symptoms. Most posts were commercial, created by non-dentists, and published as album/photo, expressing a positive sentiment and containing misinformation. While the personal profile was a predictive factor for higher total interaction and overperforming score, the identification of videos was a predictive factor only for higher total interaction. Additionally, higher overperforming scores were observed among posts on album/photo. Besides that, posts from commercial profiles were more frequently created by non-dentists and related to misinformation and positive sentiment. This result can be explained by the fact that commercial profiles tend to publish merchandise posts, inducing the consumption of the amulet by positive sentiment, avoiding the mention of the risks involved with its use. In this sense, it was observed that total interaction was positively associated with personal profiles and posts created as video/Instagram TV. Also, the overperforming score was positively associated with the personal profile.

Commercial profiles and individuals without dental expertise shared most posts analysed in this study. This highlights the impact that digital influencers can have on people's perceptions of health products [Pechmann and Catlin, 2016]. Companies often leverage social media to advertise their

	B	S.E.	Wald	P	OR (95% CI)
Total interaction					
Type of profile (Personal)	2.98	0.27	119.93	<0.001*	19.78 (11.60-33-73)
Sentiment (Positive)	0.16	0.33	0.25	0.614	0.85 (0.45-1.60)
Type of media (Video/Instagram TV)	2.65	1.11	5.68	0.017*	14.20 (1.60-125.74)
Overperforming Score					
Type of profile (Personal)	0.39	0.2	3.93	0.047*	1.48 (0.46-1.00)
B = Unstandardized coefficient					
S.E. = Standard error					
OR = Odds ratio					
*indicates significant differences					

TABLE 3. Multiple logistic regression models show the association of total interaction and overperforming score with different factors.

products through personal profiles [Zarei et al., 2020]. In recent years, social media has become a hub for communication, decision-making, and shopping, which makes it easier for users to connect with influencers who share similar interests and ideas [Ecker et al., 2022]. This phenomenon has given rise to influencer marketing, a strategy that involves collaboration between companies and social media influencers who hold sway over potential customers [Haenlein et al., 2020]. Digital influencers provide personal opinions and information that can make their followers feel more connected to them and the products they promote [Ki et al., 2020].

Despite scientific evidence that suggests no release of succinic acid from amber beads on human skin [Nissen et al., 2019], some people and influencers on the Instagram claim to have positive experiences using the amber necklace and insist that it works. However, studies have not yet provided evidence for the anti-inflammatory properties of succinic acid [Nissen et al., 2019].

The publications created via video/Instagram TV received a higher number of interactions, which is likely due to the fast acquisition of new content since videos can provide a large amount of information in a short period. Additionally, videos engage multiple senses, including sight and sound, which makes learning more effective and increases information retention [Mayer, 2022]. In contrast, photos with captions or simple text articles require reading and, thus, more time and concentration. Videos can be watched anywhere without requiring the viewer's full attention to the screen, allowing for the transmission of information with less effort. Image-sharing platforms such as Instagram are being widely used to exchange health information. The identification of characteristics of amber necklace-related misinformation on social media has the potential to inform targeted interventions and help the increment of correct information. These findings suggest the need for professionals to discuss health information online with patients and highlight an opportunity to disseminate safe alternatives for managing teething symptoms.

In a comprehensive analysis, most of the posts analysed in this study contain misinformation, which can harm people consuming this content or even influence their health decision-making process [Basch and MacLean, 2019; Kim, 2022]. However, the findings also demonstrated that posts created by dentists received a higher total interaction score, indicating a positive influence of those professionals on the audience. Hence, dental professionals could use social media platforms to offer health education to the public and create posts highlighting the risks and ineffectiveness of amber necklaces. Science communication through social media is currently being neglected, but it could be a high-return, low-risk outreach tool that healthcare professionals can utilize to raise awareness gradually, without attacking patients' existing beliefs.

More than 40% of contemporary patients report that social media affects their health decisions [Agarwala et al., 2019]. Information and scientific literacy are associated with lower vulnerability to misinformation but have a lower probability of being shared by the general public [Keselman et al., 2021]. A recent study showed that people who were reported to be the most likely to share misinformation are those who believed the shared content to be correct [Buchanan, 2020].

The amber necklace is marketed as a quick solution to a temporary problem, promising to alleviate the symptoms associated with tooth eruption that usually subside on their own within a few days [Nemezio et al., 2017]. Nevertheless, this creates an illusion of causality where parents attribute the improvement of symptoms to the succinic acid present in Baltic amber [Torres et al., 2020]. It is important to note that using this accessory carries risks, such as choking and strangulation, as previously reported in children [Soudek and McLaughlin, 2018].

Currently, there are virtually no limits to obtaining medical information; however, healthcare professionals may not be using communication channels to their full potential in providing crucial information to patients. Therefore, it is the responsibility of the scientific community to ensure that high-quality information is disseminated and made accessible to the public. Paediatric dentists have a crucial role to play in educating and empowering families and children to access evidence-based materials and address misconceptions [Colombo et al., 2019]. Professionals can contribute to the dissemination of high-quality information by publishing evidence-based materials that are easily understandable and accessible to the general public. Efforts should be made to improve search engine and social media experiences.

This study has some limitations that must be considered when interpreting the results. For instance, the identities and demographic characteristics of Instagram users were undefined, and it is impossible to confirm whether all interactions with posts were made by parents, caregivers, or relatives directly interested in preventing teething in their babies or children.

Conclusion

Despite health organizations' warnings and the lack of scientific evidence to support its effectiveness, amber necklace-related Instagram posts for teething symptoms relief are popular in Brazil. This suggests that parents are concerned about their children's discomfort during tooth eruption and are interested in alternative and natural remedies for its symptoms. However, the abundance of information on social media raises many questions among the population. Dentists should inform people about the potential dangers of using this accessory and promote safer alternatives for managing teething, which typically resolves on its own without the need for treatment.

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