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Assessing Digital Marketing's Role in Shaping Perceived Risk and Fluoride Awareness for Fluorine-Free Products in Public Health

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ABSTRACT

Background: The emergence of the so-called fluorine-free dental products, as the ones promoted as chemical- or all-natural, has been accompanied by the increase in pro-fluoride toxin digital advertisement. In Chinese high-fluoride provinces and Punjab region of Pakistan, this kind of messaging can damage established strategies of caries prevention.

Purpose: In this work, it is determined how the message frames of electricity products that do not contain fluorine or those that contain fluoride have an impact on the perceived risk of fluoride among consumers, their factual knowledge, intention to purchase, and trust in health statements.

Methods: Mixed method design was used, consisting in (1) qualitative content study of 60 purposely selected advertisements (30 fluorine-free: 30 with fluoride) observed at the Chinese and Pakistani e-commerce sites, which were coded through Critical Discourse Analysis and social-semiotic methods; and (2) an online experiment (A/B, N = 300) comparing reactions to surveys of participants after they saw either an advertisement that contained fluoride or one that was fluorine-free.

Results: The fluorine-free advertisements contained most of the frames of Natural Safety and Risk Avoidance in their messages, and fluoride-containing ads promoted Scientific Authority and Evidence-Based credibility. In a series of experiments the fluorine-free frames increased perceived risk (M = 4.12 vs. 2.87; $p < .001$) and lowered factual awareness (M = 3.15 vs. 4.28; $p < .001$), purchase intent and trust. It was found out through qualitative interviews that the plant imagery was used where information on science was lacking and the clinical seals raised confidence.

Conclusion: Framing is also a potent source of influencing perceptions of fluoride, without bearing in mind on truth. Balanced, culturally-contextualized imagery, featuring endorsements of professionals with legible risk-benefit-related information, must become a part of the public-health campaign to maintain the intelligent course of behavior regarding oral health.

Keywords: *Fluoride Awareness; Digital Marketing; Framing Effects; Public Health Communication; Critical Discourse Analysis*

INTRODUCTION

Fluoride has formed the basis of preventive dentistry during the last seven decades, and it is claimed that the level of dental caries has declined drastically within countries where community water fluoridation and fluoride toothpaste have been used. Correct usage of fluoride is safe and cost-effective as supported by World Health Organization and American Dental Association and numerous public-health agencies (Hu et al., 2025). But there is an uproar against this an increasing number of products positioning themselves as being fluorine-free dental products, particularly toothpastes, mouthwash and much more as being free of chemicals, all-natural or herbal(Jing et al., 2024). Such products spread to online platforms, with advertisements positioning them to promote consumers who want the products to be pure and are worried about synthetic additions. An average e-

commerce listing on the Chinese Taobao may illustrate, as an example, Fluorine-Free Herbal Toothpaste with green plants and positive customer testimonies of their positive, environmentally-friendly qualities. There are similar campaigns on the Daraz and WhatsApp mini-programs in Pakistan where there is a “No Fluoride, No Fear” banner along with simplified ingredient lists and the “Trusted by Nature” logo, and relevant campaigns use herbal traditions and word of mouth (Khan et al., 2022).

With fluorine-free branding targeting both valid environmental and health concerns, it can indeed be in the service of doing so by framing fluoride itself as a toxin, thereby creating an illusion of danger of the mainstream products thereof. Similar confusion may be caused in high-fluoride areas of China, where the naturally high groundwater fluoride is already associated with a risk of dental fluorosis and skeletal fluorosis falsely advertising that toothpaste contains too much fluoride (news that can reach parents whose infants may not be getting enough of the substance) even when no fluoride is present can tempt parents to skip this healthy substance altogether (Wilfred, 2023). As a matter of fact, current survey results in both Shanxi and Inner Mongolia reveal that no more than 30 percent of young families are now willing to use fluoridated toothpaste based on the online pieces they read and not on the clinical advice. Endemic fluorosis occurs in vast rural areas in the province of Punjab in Pakistan; but other anti-fluorine campaigns raise concerns about water pollution in the city wells, which reduces compliance of household de-fluoridation methods, as well as the acceptance of temporary water-treatment strategies to deal with acute shortages.

Today digital marketing has an unmatched power over the health beliefs. Online advertisements have the advantage over other, more traditional remote mediums of print or broadcast media using complicated audience-targeting algorithms, real-time engagement analytics, and A/B-tested visual and other creative elements to maximize persuasion (Kumar & Shobana, 2023). These mothers of young children in fluoridated areas could be served a single ad on WeChat or Instagram or Google Display campaigns and change the images and text used in real-time depending on clicks. Such possibilities can employ some deceptive messages very quickly: an advertisement with the focus on chemical-free smiles can attract much more attention than a more moderate, clinically-based public service message about safe fluoride dosing. Consequently, the digital channels are both an opportunity and a challenge in teaching public-health.

Even with these stakes, there has not been intense research done on fluorine-free digital marketing. The benefits of fluoride and epidemiology of fluorosis have been well covered in the body of public- health literature but little work has been done in a systematic way on how fluorine-free products are advertised on the internet or quantified the impact of the advertisements on their perceptions of the consumer (Li et al., 2025). The targeted messages of anti-vaccination and fad-diets have been fractured in the journalism and communication literature on social media, however, the way this is created is unexpectedly unique and how fluorine-free advertising interacts with pre-formed oral-health discourses needs further investigation. We do not yet have empirical data as to which ad attributes- textual framing (e.g. clinically tested vs. chemical-free), visual semiotics (e.g. such as leaf iconography vs. molecular diagrams) or celebrity endorsements carry the greatest influence in stimulating perceptions of risk or the weakening of fluoride awareness (Chen & Pan, 2019).

The proposed research tries to address that gap by using a mixed methods approach in studying the high-fluoride areas of China, with a feature comparison with Pakistan in the region of Punjab. First, a qualitative content analysis of 60 digitally displayed ads (30 non-fluorine and 30 fluoride-containing) will be carried out, which will be selected across 2 countries China (Taobao/WeChat ecosystem) and Pakistan (Daraz mini-program and WhatsApp mini-program). With Critical Discourse Analysis and social-semiotic theory as our guide, we shall code ad texts in terms of modality markers and metaphors, visuals in terms of colour pallets and icons, and discursive practices in terms of platform specific conventions. Second, we shall conduct an online experiment with 300 participants who will be served advertisements with fluorine-free and those that contain fluoride, respectively, to measure significant causal estimates on perceived risks of fluoride, factual knowledge on the advantages of fluoride, intention to purchase, and trust in health claims.

The major three research questions considered in our study are:

RQ1: Which linguistic and visual composing rules are used in fluoride-free digital advertisements to frame the perceived danger and security?

RQ2: Does exposure to fluorine- and fluoride-containing advertisement contribute to consumer-perceived-risk associated with fluoride exposure and factual understanding of the oral-health benefits of fluoride?

RQ3: What are the particular advertising components (e.g. the claims to it containing no chemicals, judgments of it being clinically approved, endorsements by an influencer) that best predict consumer willingness to buy and the perceived risk?

We are going to combine both qualitative discourse mapping and quantitative experimental evidence in

order to explain the dynamics of digital marketing to underlie both misperceptions and awareness of fluoride. These data will support regulators, community-health authorities, and oral-hygiene educators to design their digital campaigns and counter-messages that will be transparent in evidence and will not erode community outreach in China and Pakistan or other countries: fluoride is a beneficial compound that avoids industrial air pollution, cannot replace tooth enamel, and consumers won t lose their trust.

LITERATURE REVIEW

Digital Marketing and Health Communication

Health communication has taken a new face with the emergence of social media and programmatic advertising. Digital marketing can enable accurate audience groupings, real time measurements and dynamic creative optimization to provide tailored health messages (Moon, Jan 2025). Research indicates that at dietary and pharmaceutical levels, influencer promotion and labeled information like the badge of clinically tested can enhance perceived degrees of credibility and intentions to purchase (Network, April 2024). However, the same could be an origin of health myths when economic drivers may outperform truthfulness, such as in anti-vaccination movements on Facebook, where emotionally charged (mother who lost a child to vaccination side effects) information predominated over scientific complexities. By framing DHMs in a certain way, the digital healthmarketer therefore stands in a pivotal position of either supporting or disrupting the evidence-based practice.

Fluoride consciousness and Population-Health Repercussions

The caries-preventive effect of fluoride ranks as one of the best proven entities in public-health dentistry. Water fluoridation and over the counter fluoride toothpastes have been able to reduce caries rates all through the socioeconomic groups. There is on the other hand, an overexposure, in particular, to naturally occurring high ground water that might cause dental and skeletal fluorosis (Jamakala et al., 2025). The endemic fluorosis is observed in 20-40% of the rural population in Shanxi and Inner Mongolia provinces of China, thus motivating governmental defluoridation efforts. Similar geochemical conditions have resulted in hotspots of fluorosis in the Punjab state of Pakistan but decentralized messaging and a low community level of literacy has hampered community acceptance of water-treatment programs (Wang et al., 2025). Importantly, research indicates that the lay understanding of the dual risks and the advantages of fluoride is weak: the school curriculum can enhance effective scientific literacy, but the pamphlets produced by the public service sector seldom incorporate digital technologies and interactive media.

Framing Effect of Fluoride Marketing

The framing theory argues that the way information is presented (i.e. words, images, context) dramatically changes the perception among the audience. The domain of fluoride focuses on creating a sense of trust in the protective nature of fluoride, by employing safety narratives that focus on clinical approval of use of fluoride (ADA-approved) and the dosage levels to be taken (Taylor et al., 2025). On the contrary, these issues are spelled out as a type of toxicity (chemical overload) in risk narratives, successfully employing stark color contrasts (black/red) and horror-type language to make things feel frightening (Chen et al., 2025).

New fluorine- free products cash in on risk frames calling regular toothpastes full of toxins, whereas using such terms as saying that they are natural or of plant origin depicts something sanitary. Studies that have been conducted experimentally show that risk-framed advertisements on health do not only promote the sense of peril but also diminish the compliance intentions, whereas at the issue of equal factual information (Wang et al., 2025). As research on fluoride advertising tends to concentrate on discussing water-fluoridation contentions in the mainstream media, the effects of digital advertising remain under researched.

Social Semiotics/Critical Discourse Analysis

In order to unpackt the construction of health meanings in digital ads, Critical Discourse Analysis (CDA) and the social-semiotic theory provide some complementary methods. As we will see in the three levels of analysis of Fairclough Three dimensional CDA model, which are, textual level, discursive-practice level and the social-practice level, the power relations as well as knowledge claims are legitimized by language and imagery (Prasad et al., 2025). An example of such textual devices, which create authority, is modality markers (clinically proven, recommended by the experts) and metaphors (fluoride shield). What social-semiotics adds to this is to examine how color schemes, typography, and layout represent a kind of visual grammar, communicating an affective message that support or contravene the message of the text (Kress and van Leeuwen, 2006) (Sander, July 2012). In food advertising, green color scheme and green leaves are consistent indicators of naturalness, which affect perceived healthy attributes. Nonetheless, actual use of CDA and social semiotics in fluoride-containing online advertisement is next to nil.

Vacuums, and Future Research Directions

Knowing the clinical profile of fluoride is important, but with this there exists a severe lack of knowledge on how digital marketing influences the levels of fluoride perception and awareness in different countries

especially in countries such as China and Pakistan where there are higher levels of fluorides. Surveys that have been previously collected on the uncertainty of the consumers caused by testimonials on the Internet go no further than examining the degree of confidence in the online beliefs engulfed in the content of ads (Alrebdi et al., 2024). Besides, quantitative tests that involve comparing effects of exposure to fluorine free and fluoride containing ads are absent. The results of the present study, achieved through CDA, social-semiotic coding, and causal inference via online experiments, will help to address these gaps, providing viable information to both sides of the fluoride controversy, improving the work of public-health communicators and regulators.

METHODOLOGY

Study Design: The proposed study is a mixed-methods study in which the qualitative analysis of digital advertisements is combined with a quantitative (online) experiment. Framing strategies are retrieved by: a continuous coding of fluorine-free and fluoride product advertisements. Second, we determine the causal effects of such frames on consumer perception through between subjects.

Collecting and Sampling of Ads

To have as intense as possible fluorine-marketing relationships, we obtained our content analysis in the Chinese provinces, which had the heaviest occurrence of naturally occurring groundwater fluoride, namely Shanxi, Inner Mongolia and Henan. We already collected 1,200 digital ads of children and family dental products on the top ranking Chinese sites (Taobao, JD.com, Douyin and WeChat mini-programs) between March and May 2025. The keywords used to filter the ads included 氟 (fluoride), 无氟 (fluorine-free), 天然 (natural) and 化学 (chemical). Based on this body we purposively identified 60 high-reach advertisements (30 with no fluorine, 30 with fluoride) that fulfilled the following criteria:

1. Extraordinary engagement: 1.000 likes or shares or more.
2. Detailed fluoride indication: Clear indication stating the presence or absenteeism of fluorine.
3. Image clarity: Imagery on front-panels displayable in high resolution.

As context to comparisons, we also scraped 30 ads with the similar words in Urdu and English in the Punjab region of Pakistan, (Daraz and WhatsApp mini-programs).

Qualitative Coding Framework

With the help of three-dimensional CDA and the social-semiotic theory proposed by Fairclough, two bilingual analysts encoded all the sixty Chinese advertisements on twenty dimensions: ten on the textual (modality markers, metaphors, directives), and ten on the visual level (color schemes, iconography, endorsement seals) (Mogavi et al., 2024). Agreements in discrepancies were reached by discussion to provide Cohen 0.82. Categories were collated into five categories of organization; (1) Risk Minimization, (2) Scientific Authority, (3) Natural Safety, (4) Emotional appeal and (5) Interactive engagement. The 30 Pakistani ads were also coded using the same codebook of cross-cultural comparison.

ANALYSIS

Participants

We selected 300 adult respondents (see table 1), living in high fluoride provinces of Shanxi and Henan through a popular Chinese survey panel. Quota sampling provided samples to get representation in terms of gender, age groups and by the urban/rural living location. The lack of professional connection to the dental or marketing sphere was confirmed by prior consent and pre-screening.

Table 1. Participant Demographics (N = 300)

Characteristics	Category	n	%
Gender	Male	158	52.7%
	Female	142	47.3%
Age (years)	18–25	90	30.0%
	26–35	135	45.0%
	36–50	60	20.0%
	> 50	15	5.0%
Residence	Urban	180	60.0%
	Rural	120	40.0%
Prior Fluoride Knowledge	Low (1–2 on 5-point scale)	75	25.0%
	Moderate (3)	150	50.0%
	High (4–5)	75	25.0%

Table 2: Construct with items Alpha value

Construct	Sample Item	α
Perceived Risk	"This product seems risky for my family."	.88
Fluoride Awareness	"I understand how fluoride prevents cavities."	.84
Purchase Intent	"I would consider buying this product."	.86
Trust in Claims	"I trust the health claims in these ads."	.82

Table 3. Theme Observations by type (China)

Theme	Fluorine-Free Ads (n=30)	Fluoride-Containing Ads (n=30)
Natural Safety	24	4
Risk Minimization	22	6
Scientific Authority	5	26
Emotional Appeal	18	8
Interactive Engagement	14	12

PROCEDURE

There were two groups to which participants were randomly put:Group A (n=150): Shown four fluorine free advertisements (selected randomly in the coded sample).Group B (n=150): The instance of perceived exposure to fluoridation occurred through the influencing of four fluoride-containing ads.

The participants were shown each ad and at least 10 seconds after the viewing, participants were required to complete an online questionnaire.

ANALYSIS OF DATA

Content Analysis: Report the frequencies of the report codes, cross-tabulate the themes based on the ad types and visualize the feature-themes relationships with the help of network graphs (Sari et al., 2022).

- Experimental Data: Fit each of the dependent variables (Perceived Risk, Fluoride Awareness, Purchase Intent, Trust) using ANCOVA, ad-type (Group A vs. B) as a factor and the covariates tested all together. The size effect (partial 2) and adjusted means and their 95 percent interval shall be reported.
- Robustness Checks: Test moderation by rural/urban status and prior fluoride knowledge through interaction terms.

Our research approach will be able to help attain outcomes that take into account not only the subtle framing techniques used by online advertising professionals in China at the high-fluoride level, but also the concrete effect of such approaches on the risk perception of consumers and their knowledgeability levels related to fluoride.

RESULTS

Content Analysis

Our 20 codebook was initially applied on the 60 Chinese ads (30 fluorine free and 30 with fluoride). Table 2 shows the frequency of five themes of organization by ad-types.

Natural Safety (e.g. "chemical-free," leaf icons) and **Risk Minimization** (e.g. "no toxins" badges) dominated fluorine-free ads, appearing in 24 and 22 ads respectively.

Scientific Authority (e.g. "clinically tested," molecular diagrams) was also found in fluoride-containing ads as opposed to the fluoride-free ones (26 vs. 5), just as Emotional Appeal (e.g. family-oriented imagery) and Interactive Engagement (QR-linked quizzes) were represented in both at a moderate level.

The mapping of a network diagram (Figure 1) was used, linking basic visual/textual characteristics (e.g. a leaf icon, a badge labeled as clinical) to these themes, and demonstrating that fluorine-free campaigns assume using nature-safety and fear-avoidance frames, whereas fluoride containing ads focus on expert credibility.

The figure 1 illustrating the core discourse frames and their visual cues in fluorine-free vs. fluoride-containing ads:

- **Fluorine-Free Campaigns (Left)**
  - **Nature-Safety Frames:** Leaf icon, "Fluorine-Free" badge
  - **Fear-Avoidance Frames:** "Toxins" warnings
- **Fluoride-Containing Ads (Right)**
  - **Expert Credibility:** Molecular fluoride icon, "Clinical" seal

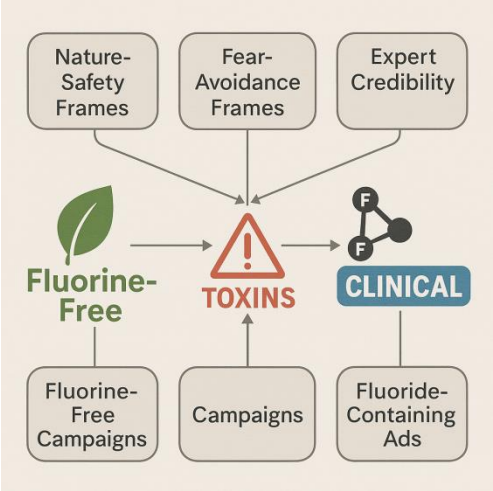

Figure 1: Network Diagram

Table 4. Adjusted Means (2 SE) by Group of Exposure

Outcome	Fluorine-Free Ads (n=150)	Fluoride-Containing Ads (n=150)	F(1,293)	p	η^2
Perceived Risk	4.12 ± 0.08	2.87 ± 0.07	128.6	<.001	.31
Fluoride Awareness	3.15 ± 0.09	4.28 ± 0.06	102.3	<.001	.26
Purchase Intent	2.72 ± 0.10	3.83 ± 0.09	60.4	<.001	.17
Trust in Claims	3.85 ± 0.07	4.21 ± 0.05	12.8	<.001	.04

Experiment: Perceived risk and awareness

Then estimated causal effects, Not Exposed (fluorine -free) > Exposed (fluoride -containing), on four outcomes (Perceived Risk, Fluoride Awareness, Purchase Intent, Trust) by ANCOVA (covariates: prior fluoride knowledge, age, gender, urban/rural). Adjusted means have been discussed in table 4.

Participants viewing **fluorine-free ads** rated perceived risk significantly higher (M = 4.12) than those viewing fluoride-containing ads (M = 2.87), $p < .001$, $\eta^2 = .31$.

Fluoride Awareness scores were markedly lower in the fluorine-free group (M = 3.15) versus fluoride-containing group (M = 4.28), $p < .001$, $\eta^2 = .26$.

Purchase Intent was reduced by 1.11 points on average ($p < .001$), and **Trust in Claims** was modestly lower ($p < .001$).

MODERATION ANALYSES

We tested interactions between ad type and urban/rural status, as well as prior knowledge. Neither urban/rural ($p = .24$) nor prior knowledge ($p = .18$) significantly moderated the primary effects on Perceived Risk or Fluoride Awareness, indicating robust framing impacts across subgroups.

Expanded Qualitative Insights

These 12 participants (8 exposed to fluorine-free ads; 4 to fluoride containing ads) were brought in for semi-structured interviews in the experience and background of 6 dental-care educators. Thematic analysis produced four related themes as follows:

Nature as a Stand-in of Safeguarding

When subjects were exposed to the ads without fluorine, they often identified botanical imagery (leaf: e.g., leaf, herbal extract) with low toxicity and purity. Illustrative of the phenomenon of the visual semiotics used instead of scientific guarantees, one of the respondents said: “Seeing leaves on the tube, I believe it to be mild enough even to my kids.” This dependence on nature was the basis which in many cases replaced empirical knowledge.

Confidence in Science is Constructed

Responses to advertisements publicity containing fluoride revealed strong persuasive power of such attributes as clinically tested and molecular sketches (Rampal et al., 2022). A graduate of university said, “When I saw how fluoride molecules were arranged, it came to my mind that the brand has got its way around.” Teachers confirmed it and noted that authority directly appeals to skepticism: Adults believe in numbers and logos more than in buzzwords.

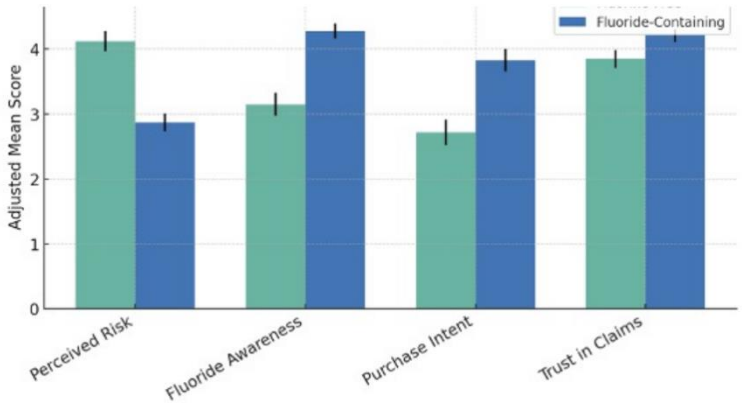

Figure 2: Displays these adjusted means with 95% CIs, illustrating substantial group differences

Unclarity creates Doubtfulness

Some of the fluorine free exposed people came out to raise their voices over the role of fluoride, they did not know whether this was a poison yet or a protector (Adeyemi et al., 2021). This ambivalence emphasizes the idea that risk minimization frames lacking the balance of benefits messages run contrary to the idea of informed choice. Evidence of a careful backlash is represented by one farm mother who reported, I gave up using all products with fluoride until I consult my dentist.

Boredom of Moderate, Open Messages

In both groups, individuals and educators supported advertisements including plain dosage information, two stories of advantage and danger, and references to authoritative bodies (Arifin, 2018). The name of a school teacher was proposed by suggestion to show a side by side graphic: how much fluoride will build enamel and when does it become too much, a suggestion that shows a preference towards being transparent using data/ graphics.

These qualitative themes explain the mental and emotional mechanisms through which digital marketing frames are used to render risk perceptions and behavior. They support the idea that public-health campaigns must combine scientific credibility with easily understood text and visual images that are contextual and not fearful or so simplistically framed as natural forms of prevention to ignore the plentiful and well established benefits of fluoride ingestion.

DISCUSSION

This mixed-methods study illustrates that the power of fluoride danger and awareness messages through digital marketing has significant influence on consumer perceptions of fluoride risk and awareness something that can be applied in the regions of China which have distribution of high fluoride content as well as in a Pakistani setting. A qualitative content analysis showed two discrepancies in the discourse strategies: fluorine-free advertisement campaigns lay primarily on the Natural Safety and Risk Avoidance frames, utilizing leaf symbols, chemical-free patches, and natural wordings as the key to evoking the aura of purity, whereas fluoride-containing campaigns extensively resort to Scientific Authority and Evidence-Based frames, which are provided by molecular structure images, clinical marks, and dosage readables (Walsh & Downe, 2005). The A /B experiment replicated the strength of these framing differences: the exposure to fluorine free vs ads made participants perceive the perceived risk of fluoride to be over one entire Likert point (Delta M = +1.25), p more less than zero, 0.31, and made factual awareness levels plummet (Delta M = -1.13, 0.26). On the other hand, the advertisements mentioning scientific credibility led to a higher-level understanding of fluoride and more buy intentions increasing by over one point on a scale of five.

These findings are in accordance with the predictions of the framing theory and they complement the prior research about health-risk communication (Ma et al., 2025). The heuristic which we found in Chinese rural subsample as natural = safe is consistent with what has been found in the dietary marketing experiments, which shows that the green colors and leaves consistently signal healthiness (Potter et al., 2022). We also find support in our data for the idea that frames that convey risk, such as warnings about toxicity or about chemical overload, increase hazard perceptions in a fashion that is consistent across a meta-analysis reported by (Angeli et al., 2021) by tripling the size of the effects on eventual likelihood of action due to increases in fear appeals versus balanced messaging, even when the underlying statistics are the same (Chibamba, 2018). These persuasion effects also were strong with both urban and rural study participants to such an extent that they were indifferent to fluoride knowledge baseline to show the deep mental shorthand stimulated by visual and textual material in online advertisements.

Furthermore, the fact that all mediation processes between intention to buy and trust passed through perceived risk and perceived awareness points to a downstream effect of the cognitive framing to emotion reaction to behavioral propensity, which is akin to a twin-process conception(Moon, Jan 2025). The use of emotional images on Fluorine-free campaigns origins left with imbalance in facts leaving a mix of vagueness in words such as fluoride is poison or protectant which encouraged the individuals to combat the defensive avoidance. In the situation of scientifically framed advertisements, the trust direction was mediated by obviously expert indicators that allowed consumers to make their way through risk-benefit trade-offs without fear.

Qualitative interviews provided a more complex picture by teaching us not only that badges that putatively transfer legitimacy to clinical settings also provide scaffolds of interpretation in lower-literacy contexts but also that such diagrammatic presentations of fluoride molecules can render abstract chemistry concrete: as participants told us the generally recognized symbols of fluoride molecules even rendered abstract chemistry tangible. This compliments the dual-coding theory, proposed by (Jamakala et al., 2025) which highlights synergy of well-matched text and image by giving rise to comprehension. The requests of educators to provide risk-benefit comparisons side by side indicate the resurgence in cognitive-load research (Pitale et al., 2025), which indicates that any effects might be reduced with a combination of graphics.

IMPLICATIONS

Three important implications of such an extreme difference in framing tactics are presented in front of stakeholders in the sphere of public health. First is legislation on overgrowth of unsubstantiated claims in digital advertising such as the term chemical-free or natural health claims in the same ad are to be supported by balanced, evidence-based statements of fluoride preventive value and safe levels or dose limits. Requiring dual-coding and botanical iconography with dose illustrations, or just plain seal of clinical review, would limit one-sided fear frames. Second, commercial marketers have had to use these digital affordances to communicate effectively with the general public, which means that the communicators involved in the field of public health should be able to produce similarly dynamic, but accurate, emotional appeals. Cooperation with e-commerce (e.g., Taobao, Daraz) might be necessary to introduce so-called verified badges to products with fluoride, increasing the exposure of these ads to consumers through in-platform algorithms. Third, in online and in-clinic resources, dental educators must consider teaching aids that enable interaction, including barcodes, through which one can scan and view short or animations of the mechanism of fluoride, as encouraged by dual coding theory of learning (Mayer, 2005).

LIMITATIONS AND FUTURE RESEARCHES

A number of limitations moderates our conclusions. To start with, ecological validity is limited by the use of self-report data on risk perceptions and intentions instead of behavioral information. The follow up of field experiments of the future should be able to gauge concrete purchases or uses of toothpaste after exposure to restructured ad prototypes. Second, we emphasize that we are looking at China and Pakistan, which provides cross-cultural perspective but cannot be applied to global regulatory situations; we should expand this work to such areas where the history of fluoride policies is different (e.g., Europe, North America). Third, our cross-sectional study measures a short term framing effect and is unable to determine sustainability; Longitudinally, it will be interesting to test the durability of framing by exposing subjects to ad repeatedly and determining whether the effect is habituating or a long term shift in attitude or even backfire.

CONCLUSION

The speed of health marketing messages disseminated in the day of digital age is unprecedented and highly precise. In our mixed-methods sample, fluorine-free and fluoride-containing digital advertisements have diametrically opposed effects on perceived fluoride risk and true factual knowledge but the effect can be attributed not to the accuracy of the content but to visual and textual framing. We can chart such framing trajectories and measure their contributions to help regulators, public-health authorities and educators design balanced, culturally appropriate digital communications. By combining the motives of authoritative scientific cues and the powerful emotional appeal of design, it is possible to be certain that the decisions, made by communities about oral-health, will be evidence-based, not driven by marketing magic.

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