International Journal of Biology and Life Sciences
ISSN: 2957-9511 | Vol. 15, No. 3, 2026

A Study on the Cognitive Bias of Zero-calorie and Zero-sugar Labels Misleading Fat Loss Behaviors

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Abstract: This paper focuses on the misleading effect of zero-calorie, zero-sugar labels promotion on consumers' fat loss behavior. With the rapid development of the health consumption market, zero-calorie, zero-sugar products are playing an increasingly important role in the field of fat, but such label promotions may cause cognitive biases among consumers, leading to problems such as compensatory eating and calorie underestimation. This study uses literature review, market research, questionnaire survey and quantitative analysis to systematically examine the misleading effect of label promotion on fat loss behavior. The study found that more than 80 percent of respondents believed the promotion was misleading, and nearly a quarter of them engaged in compensatory eating behavior. Promotional exposure had a significant positive effect on behavioral bias ($\beta=0.205$, $p<0.001$), but the mediating effect of cognitive bias was not established. This study provides empirical evidence for regulating food label promotion and guiding consumers to reduce fat rationally.

Keywords: Zero-calorie; zero-sugar Labels; Cognitive Bias; Fat Loss Behavior; Misleading Effect.

1. Introduction

With the significant improvement of the material living standards of Chinese residents, the problem of overweight and obesity has become increasingly prominent, and awareness of healthy eating has been constantly enhanced. Low-calorie, sugar-free and calorie-free foods are playing an increasingly important role in fat loss management. However, zero-calorie and zero-sugar products are not truly "zero calorie" or "fat-friendly", and their label promotion often takes advantage of consumers' naive perception of "health" and "fat loss" to create misleading consumption signals[1,2]. In recent years, market research and product testing have found that a large number of sugar-free and zero-calorie food products have labeling problems that do not live up to their names, technically compliant yet potentially misleading [3-5]. Consumers generally have cognitive biases about artificial sweeteners, calorie standards and fat loss effects, and even engage in trend-driven consumption and compensatory high-calorie eating[4,6,7].

At present, scholars at home and abroad have conducted extensive research on food label promotion and consumer behavior. The first type of research focuses on the positive impact of label promotion on consumers' purchase intention[2,5,12]; Some studies focused on the discourse construction of "zero-calorie, zero-sugar" advertisements and their health myth effects[10,13]. The second category of studies began to focus on the misleading effects of label promotion and consumer cognitive biases. The literature has pointed out that consumers generally have intuitive cognitive biases such as "sugar-free = healthy" and "zero-calorie = fat loss"[6,7,17]; There are problems with the labels of "sugar-free" and "zero-calorie" foods on the market, which are compliant but highly misleading[8,17,24]. Some studies have further found that artificial sweeteners may induce compensatory high-calorie eating, thereby undermining the actual fat loss effect[4,5,11]. However, existing research has mostly remained at the level of label compliance or discussions on the health risks of artificial sweeteners[12,13], and few studies have systematically explored the complete path of "zero-calorie, zero-sugar label promotion → cognitive bias → misleading fat loss behavior." Specifically, there is a lack of systematic empirical analysis on whether consumers have behavioral biases such as calorie underestimation and compensatory eating due to the "zero-calorie, zero-sugar" label, and how these biases affect actual fat loss results.

In response to the research gap, this paper uses a combination of market research, questionnaire survey and SPSS quantitative analysis to systematically examine the misleading effect of zero-calorie, zero-sugar label promotion on consumers' fat loss behavior, with a focus on analyzing the mediating role of cognitive bias to reveal the misleading path and degree, and to provide empirical evidence for regulating food label promotion and guiding consumers to lose fat rationally.

2. Research Methods

This study adopts a multi-method design combining literature review, market research, questionnaire survey, and SPSS analysis to explore how zero-calorie/zero-sugar labels mislead consumers' fat loss behavior and the underlying cognitive bias mechanism.

First, from March 9 to 15, 2026, literature review was conducted to sort out relevant theories on label marketing, cognitive bias, and fat loss behavior. From March 16 to 29, market research collected information on 50-80 zero-calorie/zero-sugar products using a 70%+30% sampling strategy: 70% of products were unique across different platforms, and 30% were shared to capture cross-platform consistency.

Based on the above, a 20-item structured questionnaire was developed, with items grouped into four dimensions: label cognition (Q4-Q8), promotion exposure (Q9-Q12), cognitive bias (Q13-Q17), and behavioral bias (Q18-Q20), plus 3 demographic questions (Q1-Q3). All items used a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The scales were adapted from validated instruments in the

literature, and Cronbach's alpha coefficients in the subsequent SPSS analysis confirmed the scale's good reliability.

Questionnaires were distributed from March 30 to April 12, 2026, targeting consumers of zero-calorie/zero-sugar products, with a target sample size of 200–300. From April 13 to 26, Excel and SPSS were used for data cleaning and quantitative analysis (including reliability, descriptive, and correlational analyses). Finally, the results were integrated into the thesis draft by May 3, 2026.

2.1. Literature Research Method

Centering on core themes such as "cognitive bias", "zero-sugar, zero-calorie", "fat loss", "sweeteners", this study searched for relevant literature in the past decade through foreign literature databases such as CNKI and Web of Science, and selected a total of 55 core and background literature. The technical definition of the zero-calorie, zero-sugar label (monosaccharides and bisaccharides ≤0.5g/100mL)[15], the theoretical basis of consumer cognitive bias (availability heuristic, anchoring effect, health halo effect, etc.)[18-20,22] and the physiological impact mechanism of artificial sweeteners were clarified through induction and analysis[4,5,11,13,21]. Literature analysis reveals that existing studies have mostly focused on the positive impact of label promotion on purchase intention[5,12,23], or have been limited to discussions on label compliance and the health risks of artificial sweeteners[8,17], while few studies have delved into how zero-calorie, zero-sugar label promotion misleads consumer fat loss behavior through cognitive bias mechanisms[1,14,17]. This approach provides a theoretical framework and logical starting point for the study.

2.2. Market Research Method

This study conducted a systematic investigation of zero-calorie and zero-sugar products on six major platforms: JD.com, Tmall, Meituan, Ele.me, Douyin, and Xiaohongshu, collecting 78 valid product samples covering four major categories: beverages, snacks, meal replacement, and condiments. The research covered product promotion slogans, types of scripts (core selling points, health halo, fat-loss related, vague concepts, etc.), types and contents of sugar substitutes, nutritional components (energy, fat, carbohydrates), and consumer reviews (332 valid reviews were collected, including rating stars, review content, follow-up reviews, etc.). By comparing the promotional rhetoric with the actual ingredients of the product, this paper identified typical misleading rhetoric types, providing a realistic basis for the design of the subsequent questionnaire survey.

2.3. Questionnaire Survey Method

Based on the results of literature research and market investigation, this paper has independently compiled the "Questionnaire on the Cognition of Zero-Calorie, Zero-Sugar Labels and Fat Loss Behaviors". The questionnaire covers five dimensions: Basic information (gender, age, fat loss experience), label recognition level (awareness of "zero-sugar" definition, identification of sugar substitutes, awareness of health risks), promotional exposure (channels of exposure, types of promotional slogans, misleading perception), cognitive bias (label trust, fat loss applicability evaluation), and behavioral bias (compensatory eating, fat loss effect perception, purchase intention). The questionnaire consists of multiple-choice questions, Likert five-point scale questions and multiple-choice questions. This article created an online questionnaire through Questionnaire Star website and distributed it through social media platforms in April 2026. A total of 244 valid questionnaires were retrieved. The sample covered consumers of different genders (93 men, 38.1%; 151 women, 61.9%), ages (mostly 18-25 years old, 51.6%), and experiences of fat loss (29.1% are currently losing fat, 34.0% have experienced fat loss), showing good representativeness.

The results of the reliability and validity test of the questionnaire showed that the Cronbach α coefficient in the cognitive bias dimension was 0.773 and the Cronbach α coefficient in the behavioral bias dimension was 0.664, both reaching acceptable levels (>0.6). The KMO test value was 0.775, and the Bartlett sphericity test reached a significant level (approximate chi-square =584.286, df=21, $p<0.001$), indicating that the questionnaire had good structural validity and the data were suitable for factor analysis.

2.4. Quantitative Analysis in SPSS

The data from 244 retrieved valid questionnaires were entered into SPSS software, and the following analyses were mainly conducted: (1) Descriptive statistical analysis, including frequency table, percentage of responses to multiple-choice questions, descriptive statistical table (mean, standard deviation), for presenting sample characteristics and distribution of each item; (2) Cross-table analysis and chi-square test to examine differences in purchase intention and perception of health risk among different fat loss experiences and genders; (3) Multiple response frequency analysis for dealing with the distribution of responses to multiple-choice questions (such as access channels, slogan types, sugar substitute cognition, etc.); (4) Reliability and validity tests, including Cronbach's coefficient and KMO test; (5) Mediating effect test, using Baron & Kenny's three-step method. The results showed that the overall effect of promotional exposure on behavioral bias was significant ($B=0.205$, $p<0.001$), but the effect of promotional contact on cognitive bias was not significant ($B=0.021$, $p=0.806$), so cognitive bias did not mediate between promotional contact and behavioral bias. Through the above quantitative analysis, this paper reveals the direct impact path of "zero-sugar, zero-calorie" label promotion on consumers' fat loss behavior.

3. Results and Analysis

3.1. Sample Characteristics

A total of 244 valid questionnaires were retrieved in this study. Among them, 61.9% were female and 51.6% were 18-25 years old; A total of 63.1% of respondents were on or had a history of fat loss.

3.2. Consumers' Perception of the "Zero-Sugar, Zero-Calories" Label

3.2.1. Awareness of the "Zero-Sugar" Standard and Label Viewing Habits

Regarding the "zero-sugar" national standard (≤0.5g/100ml) [1], only 11.5% of respondents were "very clear", while more than half were confused. Only 25.0% check the ingredient list "every time" when purchasing, and consumers generally have the naive perception that "zero sugar = no sweetness" and "zero calories = no calories".

3.2.2. Perception of the Types of Artificial Sweeteners

Xylitol had the highest recognition rate (30.7%), with 14.4% of respondents saying "none of them knew" (see Table 1).

Table 1. Understanding of Sugar Substitutes

Types of artificial sweeteners	Response frequency	Response percentage
Xylitol	143	30.70%
Erythritol	91	19.50%
Unclear	67	14.40%
Trichlorosucrose (Sucralose)	58	12.40%
Aspartame	57	12.20%
Maltitol	50	10.70%
In total	466	100.00%

Note: The data is sorted from the highest response percentage to the lowest; the data is derived from 244 valid questionnaires.

3.2.3. Channels of Exposure to Promotion and Common Slogans

The main channels of contact are short-video platforms (27.8%), and social media is the main battlefield for information dissemination (see Table 2).

Table 2. Channels for Contacting the Campaign

Channel	Response frequency	Response Percentage
Short-video platforms such as Douyin and Kuaishou	166	27.80%
Craigslist-like review platforms such as Xiaohongshu	110	18.40%
JD.com/ Tmall and other e-commerce platforms	99	16.60%
Offline supermarkets and shopping centers	96	16.10%
Othe	46	7.70%
Food delivery platforms (Meituan/ Ele.me)	41	6.90%
Live streaming room	39	6.50%
In total	597	100.00%

Note: The data is derived from 244 valid questionnaires.

Common slogans suggest fat loss and health attributes such as "Drink without gaining weight" (22.1%), "Drink with peace of mind during fat loss" (19.1%), and "Zero burden, say goodbye to guilt" (19.1%) (see Table 3).

Table 3. Common Types of Promotional Phrases

Promotional slogan	Response frequency	Response Percentage
“zero-sugar, zero-fat, zero-calories. You won't gain weight by drinking it.”	170	22.10%
“Feel free to drink during the fat loss period.”	147	19.10%
“No burden, saying goodbye to guilt.”	147	19.10%
“Sugar-free is healthier.”	128	16.60%
“Suitable for diabetes patients / people controlling blood sugar levels.”	108	14.00%
“zero-sugar=sugar-free.”	70	9.10%
In total	770	100.00%

Note: The data is derived from a market research conducted on 78 product samples from six platforms: JD, Tmall, Meituan, Ele.me, Douyin, and Xiaohongshu.

3.2.4. Awareness of Health Risks and First Reactions

Regarding the impact of long-term consumption of "sugar-free" foods containing artificial sweeteners on health, 51.6% of the respondents believe that "there is a certain risk". When seeing the promotion of "zero-sugar, zero-calorie", 38.5% 's first reaction was "Look at the ingredient list", but 36.1%' s first reaction was "healthy" and "won't make you gain weight" (see Table 4).

Table 4. Descriptive Statistics of Attitude Questions (N= 244)

	N	Minimum value	Maximum value	Mean value	Standard deviation
The influence of labels on the effectiveness of fat loss	244	1	5	2.9	1.300
Suitable for consumption during the weight loss period	244	1	5	2.49	1.020
Drinking it won't cause weight gain	244	1	5	2.93	1.096
Can be used as a substitute for sugar	244	1	5	2.64	1.134
Reduce psychological burden	244	1	5	3.41	1.117
Purchase intention	244	1	4	2.23	0.913

Note: In this scale, the higher the score, the greater the degree of agreement with the statement (1 = strongly disagree, 5= strongly agree). The data are derived from 244 valid questionnaires.

3.3. Attitudes and Behaviors of Consumers

3.3.1. Attitude Questions Describe Statistics

The descriptive statistics of the attitude questions (see Table 4) showed that the mean of "reduced psychological burden" was the highest (3.41±1.117), indicating that the main psychological benefit for consumers when purchasing "zero-sugar, zero-calorie" food was the relief of eating anxiety. The lowest mean was (2.49±1.020) for "suitable for consumption during fat loss period", indicating that consumers did not fully agree with its fat loss effect on a rational level.

3.3.2. Experiences Related to "Zero-Sugar, Zero-Calorie" Foods

Table 5. The "Zero-sugar, Zero-calories" Experiences of the Respondents

Type of Experience	Response frequency	Response Percentage
Having never had these experiences	106	28.40%
Because of consuming "zero-sugar" foods, one eats more of other things.	90	24.10%
Because of drinking "zero-sugar" beverages, one becomes more inclined to eat sweet foods/starchy foods.	73	19.60%
Long term consumption of "zero-sugar" beverages but no significant fat loss effect.	68	18.20%
After drinking "zero-sugar beverages, one feels an increase in weight.	36	9.70%
In total	373	100.00%

Note: The data is derived from 244 valid questionnaires.

Only 28.4 percent of respondents said they had no experience of compensatory eating, 24.1 percent admitted to

eating more than anything else because of "zero-sugar" foods, and 19.6 percent wanted more sweets or staple foods because of drinking "zero-sugar" beverages (see Table 5).

3.3.3. Misleading Perception of Promotion

Combined, more than 80 percent of respondents believed that the propaganda rhetoric was misleading (30.3 percent thought it was "widespread", and 51.2 percent thought it was "partially".

3.4. Analysis of Differences Among Different Groups

3.4.1. Differences in Purchase Intention Among Different Fat Loss Experiences

Chi-square test showed extremely significant differences in purchase intention among people with different fat loss experiences (χ^2=32.633, $p < 0.001$), with the highest proportion of "more willing to buy" among those on fat loss (43.7%) (see Table 6).

Table 6. Analysis of Differences in Purchase Intentions Due to Different Fat Loss Experiences

Fat Loss Experience	n	More likely to purchase(%)	No significant change(%)	Be cautious in selection(%)	Even more skeptical(%)	Chi-square	P
Currently, I'm on a fat loss program.	71	43.7	9.9	45.1	1.4	32.633	<0.001
Has experience of losing weight.	83	32.5	25.3	41.0	1.2		
No experience of losing weight before.	54	9.3	35.2	46.3	9.3		
Interested but not yet started	36	19.4	33.3	38.9	8.3		
In total	244	28.7	24.2	43.0	4.1		

Note: The data is derived from 244 valid questionnaires.

Regression analysis showed that fat loss experience had a significant negative predictive effect (β=-0.224, $p < 0.001$) on the perception of label fat loss effect, that is, respondents with more fat loss experience were less likely to think that "zero-sugar, zero-calorie" foods were helpful for fat loss (see Table 7).

3.4.2. Differences in Gender and Perception of Health Risks

There were significant differences in perception of health risks between different genders (χ^2=13.051, p=0.011). Women were more likely to think "there is a certain risk" (55.6%), and men were more likely to think "the risk is greater" (10.8%).

3.5. Analysis of the Factors Influencing the Perception of The Effect of Labeled Fat Loss

The regression model for factors influencing perceived fat loss effect was significant ($F(4,239)=24.847$, $p < 0.001$), with an adjusted R^2 of 0.277, indicating the model explained 27.7% of the variance in consumers' perceived fat loss effect of zero-calorie/zero-sugar labeled products. Significant predictors all showed negative coefficients ($p < 0.01$): fat loss experience (β=-0.224), standard awareness (β=-0.252), perception of health risk (β=-0.169), and first response (β=-0.279). Among these, the first response had the largest absolute coefficient (β=-0.279), meaning consumers' initial reaction to the promotion was the strongest negative predictor of perceived fat loss effect. The negative coefficient for fat loss experience indicates that consumers with more fat loss experience are less likely to believe such labels help with fat loss. Standard awareness refers to consumers' understanding of food labeling standards and nutritional requirements; its negative coefficient (β=-0.252) suggests that consumers with higher awareness of relevant standards are more skeptical of the exaggerated fat-loss claims in these labels, thus perceiving their fat loss effect as weaker. Similarly, consumers who perceive higher health risks related to such products also have lower confidence in their fat loss claims. All variables had variance inflation factor (VIF) values below 2, indicating no serious multicollinearity in the model (see Table 7).

Table 7. Multiple Linear Regression Analysis of Influencing Factors on the Cognitive Impact of Labelled Fat Loss Effects

Independent variable	B	Beta	Significance	VIF
(Constant)	6.406		0	
Fat loss experience	-0.283	-0.224	0	1.104
Standard awareness level	-0.39	-0.252	0	1.1
Health risk perception	-0.22	-0.169	0.003	1.052
The first reaction	-0.297	-0.279	0	1.032

Note: The dependent variable is the impact of the "zero-sugar, zero-calorie" label on the fat loss effect; the adjusted $R^2 = 0.277$; $F(4239) = 24.847$, $p < 0.001$. The VIF values of all independent variables are all less than 2, indicating that there is no serious multicollinearity problem in the model.

4. Discussion

4.1. Theoretical Integration and Mechanism Interpretation

The study found that the promotion of zero-calorie, zero-sugar labels is often associated with a health halo and fat loss implications, leading to cognitive biases among consumers that "sugar-free = healthy" and "zero-calorie = not fat". More than 80 percent of respondents believed the promotion was misleading, and nearly a quarter of them engaged in compensatory eating behavior. The regression model accounted for 27.7 percent of the variation, with the first response being the strongest factor influencing perception of fat loss effect (β=-0.279).

The results are in line with existing theories. From the perspective of cognitive bias mechanisms, businesses use

consumers' availability heuristics, anchoring effects, health halos and other cognitive biases to construct marketing traps[3,18-20,22]. Specifically, the "zero-calorie, zero-sugar" label activates consumers' emotional heuristic[19,20,22], as shown by the highest mean of "reducing psychological burden" in this study (3.41), causing consumers to overestimate the health attributes of the product, creating a "health halo effect"[4,20], which in turn leads to "moral permission", reduces self-restraint, and ultimately triggers compensatory eating behavior[4,5,10,11].

Artificial sweeteners may physiologically stimulate appetite and interfere with metabolic regulation[13,21]. Psychologically, they offer consumers "indulgence permission", lowering their vigilance against calorie intake [4, 10, 25].

4.2. Conversations with Existing Research

Previous studies have mostly focused on the positive impact[2,5,12] of label promotion on purchase intention, or have been confined to discussions[16,17,23] about the health risks of artificial sweeteners. Few studies have examined fat loss as an outcome variable and attempted to test the mediating role of cognitive bias. This study attempted to examine the transmission pathway of "label promotion → cognitive bias → misleading fat loss behavior", but found no significant mediating effect of cognitive bias between promotional exposure and behavioral bias. Nevertheless, the proposition and test of this pathway still provide an exploratory reference for the application of behavioral economics and consumer psychology theories in the field of health food.

In addition, the study found that fat loss experience, standard awareness, health risk perception, and first response were all significant predictors for labeling fat loss effect perception, and all coefficients were negative in direction. This means that consumers with richer fat loss experiences, higher awareness of standards, greater perception of health risks, and more cautious first reactions rated "zero-calorie, zero-sugar helps with fat loss" lower. This finding provides empirical evidence for targeted interventions.

4.3. Research Limitations and Future Directions

This study has the following limitations: the sample is mainly composed of young people (51.6%) and there are more females (61.9%). The data relied on self-reporting questionnaires; No rigorous mediating effect test using methods such as Bootstrap; The adjusted R^2 of the regression model was only 0.277, with a large number of unincluded influencing factors.

Future studies could expand the sample coverage (such as including middle-aged and elderly populations and male populations), use experimental methods (such as eye-tracking and situational experiments) to further verify the causal direction, and introduce mediating effect models to test the specific pathways of cognitive bias.

5. Conclusion

The study found that more than 80 percent of respondents believed that the "zero-calorie, zero-sugar" promotion was misleading, and nearly a quarter showed compensatory eating behavior. The promotion exposure had a significant positive impact on behavioral bias, but the mediating effect of cognitive bias did not hold. It is recommended that consumers develop the habit of checking the ingredient list, enterprises avoid using suggestive promotions such as "drink with confidence during the fat loss period", and regulators include "fat loss cues" in the regulatory scope of misleading promotions.

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