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Public Expectations for E-Cigarette Regulation in China: A Quantitative Study Using the Kano Model

Yutong Meng[1], Yu Chen[2]

[1] School of Social Policy & Practice, University of Pennsylvania, Philadelphia, PA, United States

[2] School of Art and Media, Fujian Polytechnic Normal University, Fujian, China

Abstract

Objective To identify the evaluative reaction types and priorities of six e-cigarette regulatory policy attributes among adult respondents in a Chinese online sample using the Kano model, and to compare classification differences between users and non-users. Because all six attributes had already been enacted at the time of the survey, the Kano items measured counterfactual evaluative reactions to the presence versus absence of existing regulations, rather than expectations concerning future policy introduction.

Methods A cross-sectional online survey was conducted. Six policy attributes were measured using standardized Kano dual-item scales. The revised Kano classification matrix was applied, Better-Worse coefficients were calculated with four-quadrant analysis, chi-square tests compared classification distributions between users and non-users, and multinomial logistic regression was performed for the flavor restriction attribute.

Results Age verification and mandatory standards and review emerged as core anchors of policy expectations. Online sales restrictions and packaging warnings exhibited baseline guarantee characteristics; advertising restrictions and flavor restrictions showed significant group differentiation. Four-quadrant analysis grouped the six attributes into a core priority group and an optimization adjustment group, while Kano classification revealed a differentiation pattern of must-be dominant, one-dimensional dominant, and indifferent dominant attributes. Significant classification differences between users and non-users were observed for most attributes, with flavor restriction showing the strongest divergence; usage status was a key factor associated with

Corresponding author: Chen Yu, School of Art and Media, Fujian Polytechnic Normal University, Fujian, China Email: chenyu@alumni.pku.edu.cn © The Author(s), 2026. Published under the Creative Commons Attribution 4.0 International License (CC BY 4.0; https://creativecommons.org/licenses/by/4.0/), which permits use, distribution, adaptation, and reproduction in any medium, provided the original work is properly cited.

its classification.
Conclusions The public's expectations for e-cigarette regulatory policies exhibit a two-tier priority structure and multi-dimensional classification features. The two analytical perspectives complement each other, providing empirical reference for differentiated policy design.

Keywords: e-cigarette policy; Kano model; tobacco control; Better-Worse analysis; policy priority; China

Introduction

E-cigarettes, which emerged in the early twenty-first century, have rapidly become one of the central issues in global tobacco control (World Health Organization, 2021). As a novel alternative to conventional cigarettes, e-cigarettes have some potential to reduce exposure to harmful substances (McNeill et al., 2020). However, e-cigarette use has also created public health challenges, including the risk of addiction among adolescents, uncertain long-term health effects, and the disruption and reconfiguration of tobacco control norms (Glantz & Bareham, 2018). The central controversy surrounding e-cigarette regulation among governments and health authorities worldwide concerns how to balance harm reduction for adult smokers with the prevention of initiation among nonsmokers, particularly adolescents (Ashley et al., 2020).

As the world's largest producer and exporter of e-cigarettes, China has followed a distinctive and landmark trajectory in the evolution of its e-cigarette policies. In 2018, the State Administration for Market Regulation and the State Tobacco Monopoly Administration jointly issued a circular prohibiting the sale of e-cigarettes to minors (State Administration for Market Regulation & State Tobacco Monopoly Administration, 2018). In 2019, online sales channels for e-cigarettes were further closed (State Tobacco Monopoly Administration & State Administration for Market Regulation, 2019). In 2021, the State Council amended the Regulations for the Implementation of the Tobacco Monopoly Law of the People's Republic of China, bringing e-cigarettes under the tobacco monopoly regulatory framework (State Council of the People's Republic of China, 2021). In 2022, the Measures for the Administration of Electronic Cigarettes officially came into effect, establishing institutional arrangements for product review, licensing administration, and a unified national trading platform (State Tobacco Monopoly Administration, 2022). In the same year, the mandatory national standard GB 41700–2022, Electronic Cigarette, was officially issued, further specifying the technical requirements for e-cigarette products (State Administration for Market Regulation & Standardization Administration of China, 2022). This rapidly evolving policy framework reflects a governance model characterized by simultaneous implementation and adjustment in the absence of sufficient domestic empirical evidence in China (Jiang & Zheng, 2024; Yao et al., 2026).

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Existing research on e-cigarette policy in China has primarily focused on analyses of regulatory frameworks, evaluations of policy implementation effects, and industry responses (Jiang & Zheng, 2024; Lyu et al., 2024; Yao et al., 2026; Zheng et al., 2024). These studies have traced the evolution of China's e-cigarette regulatory system and discussed implementation issues related to policies concerning the protection of minors, online sales, product standards, and restrictions on flavored e-cigarettes. However, compared with research on regulatory institutions and policy effects, relatively few studies have directly examined how the public evaluates different e-cigarette regulatory policies.

Existing studies of public attitudes indicate that levels of public support vary across e-cigarette policy instruments. In a survey of young people in China, Pettigrew et al. (2023) found relatively high levels of support for restrictions on purchases by minors, health warnings on packaging, and advertising restrictions, but comparatively lower support for restrictions on flavored e-cigarettes. These findings suggest that the public does not simply support or oppose e-cigarette regulation in general; rather, individuals make different judgments depending on the specific content of a policy. Therefore, relying solely on overall levels of policy support may not fully capture the public's specific expectations regarding different policy attributes.

E-cigarette use status is an important factor influencing policy attitudes. Previous studies have shown that current e-cigarette users generally express lower levels of support than nonusers for sales restrictions, advertising restrictions, and restrictions on flavored products (Chung-Hall et al., 2020; Czaplicki et al., 2020b; Hairi et al., 2022; Posner et al., 2022). Group differences are particularly pronounced with respect to restrictions on flavored e-cigarettes. Research using a sample of young people in the United States found that e-cigarette users were substantially less supportive than nonusers of restrictions on the sale of flavored products (Posner et al., 2022). Multicountry surveys in Europe have likewise shown that e-cigarette users and dual users report relatively lower levels of support for restrictive policies (Chung-Hall et al., 2020). However, users do not oppose all regulatory measures. Some studies have found that users continue to express relatively high levels of support for policies such as minimum purchasing-age requirements and product safety standards (Hairi et al., 2022). In addition, research involving samples of parents suggests that family circumstances related to the protection of minors may increase support for restrictions on advertising and flavored products (Czaplicki et al., 2020a). Taken together, these findings indicate that public expectations regarding e-cigarette policies may be influenced by both policy attributes and e-cigarette use status.

Existing studies of attitudes toward e-cigarette policies have generally used Likert scales or "support–oppose" items to measure policy support (Chung-Hall et al., 2020; Czaplicki et al., 2020a, 2020b; Hairi et al., 2022; Pettigrew et al., 2023; Posner et al., 2022). Although these approaches allow comparisons of support levels across different policies, they are less able to distinguish the different ways in which policy attributes may operate. For example, a high level

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of support may indicate that the public regards a policy as an indispensable regulatory baseline, or it may indicate that the public believes the policy should be implemented as fully as possible. At the same time, conventional support scales have difficulty assessing whether policy implementation and policy absence generate evaluative responses of different magnitudes, and they are also limited in identifying indifferent or reverse attitudes toward the same policy across different groups.

The Kano model was proposed in 1984 by the Japanese quality-management scholar Noriaki Kano (Kano et al., 1984) and is a widely used classification tool in consumer-preference research. The model classifies product or service attributes into five categories: attractive (A), one-dimensional (O), also referred to as performance attributes, must-be (M), indifferent (I), and reverse (R). Its central innovation lies in distinguishing the asymmetric effects of fulfillment and nonfulfillment. The absence of a must-be attribute produces strong dissatisfaction, whereas its presence is taken for granted; the fulfillment of a one-dimensional attribute is linearly associated with satisfaction; and the presence of an attractive attribute generates unexpected satisfaction, whereas its absence does not cause dissatisfaction (Matzler & Hinterhuber, 1998). In recent years, the Kano model has been applied to research on health-care service quality, patient needs, and health-service priorities (Barrios-Ipenza et al., 2021; Chen et al., 2019; Materla et al., 2019). Compared with conventional measures of policy support, the Kano model can not only identify the dominant classification of a policy attribute but also use Better-Worse coefficients to separately assess the positive gain associated with the presence of a policy and the negative effect associated with its absence. In this study, the Kano model is employed as an exploratory classification tool rather than as a direct measure of satisfaction. The paired responses are interpreted as capturing respondents' evaluative reactions to the hypothetical presence versus absence of a regulatory measure, which may reflect normative approval, perceived necessity, or policy support. These constructs are not treated as equivalent to consumer satisfaction, and the Better–Worse coefficients are accordingly interpreted as descriptive indicators of asymmetric evaluative patterns rather than as validated measures of policy priority. Because all six policy attributes had already been enacted at the time of the survey, the Kano items measured counterfactual evaluative reactions to the presence versus absence of existing regulations, rather than expectations concerning future policy introduction.

In summary, three limitations remain in the existing literature. First, research on e-cigarette policy in China has focused primarily on regulatory systems and policy effects, while systematic comparisons of adult public expectations regarding different policy attributes remain limited. Second, although previous studies have identified differences in policy attitudes between e-cigarette users and nonusers, few have examined whether these differences specifically take the form of must-be, one-dimensional, attractive, indifferent, or reverse classifications. Third,

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although conventional support scales can compare levels of policy support, they have difficulty revealing the asymmetric evaluations generated by policy implementation and policy absence.

Accordingly, this study focuses on six core attributes of China's e-cigarette regulatory policies and applies the Kano model to quantify the types and priorities of public expectations regarding each policy attribute. The specific objectives are to: (1) classify the six policy attributes using the Kano model and calculate their Better-Worse coefficients; (2) compare differences in policy-attribute classifications between e-cigarette users and nonusers; (3) use restrictions on flavored e-cigarettes as the dependent variable and conduct multinomial logistic regression to explore the sociodemographic correlates of classification differences; and (4) propose policy-priority recommendations based on four-quadrant analysis and the integration of multidimensional characteristics. This study aims to provide empirical evidence based on public preferences for the more refined design of e-cigarette regulatory policies.

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Method

Development of Policy Attributes

The selection of policy attributes followed a three-stage process: policy-text mapping, expert review, and pilot-survey refinement.

(1) Policy-Text Mapping

The U.S. e-cigarette policy classification framework developed by the Institute for Global Tobacco Control at Johns Hopkins University was used as a reference (Institute for Global Tobacco Control, n.d.). This framework categorizes e-cigarette regulatory policies into eight domains: minimum purchase age, sales restrictions, marketing restrictions, packaging and labeling, product regulation, reporting and notification, clean air, and taxation. The research team systematically compared these domains with China's current policy documents and mapped the eight domains onto operationalizable policy attributes, thereby generating an initial pool of 10 candidate attributes. The Chinese e-cigarette policy documents included in the coding are presented in Table 1.

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Table 1 Chinese E-Cigarette Policy Documents Included in the Coding

No.	Policy Document	Year of Issuance
P1	Circular on Prohibiting the Sale of Electronic Cigarettes to Minors	2018
P2	Circular on Further Protecting Minors from the Harms of Electronic Cigarettes	2019
P3	Measures for the Administration of Electronic Cigarettes	2022
P4	Provisions on Warning Labels for Electronic Cigarettes	2022
P5	GB 41700–2022 Mandatory National Standard for Electronic Cigarettes	2022
P6	Implementation Rules for the Technical Review of Electronic Cigarette Products (Revised)	2024
P7	Rules for the Administration of Electronic Cigarette Transactions (Revised)	2024
P8	Notice on Launching a Special Campaign to Protect Minors from the Harms of Electronic Cigarettes	2024
P9	Announcement on Levying Consumption Tax on Electronic Cigarettes	2022
P10	Announcement on Matters Concerning the Administration of Electronic Cigarette Consumption Tax Collection	2022

The initial pool of 10 candidate attributes included: (1) minimum age verification at point of sale; (2) prohibition of online sales; (3) restriction of advertising and promotion; (4) prohibition of flavored products; (5) mandatory product testing and technical review; (6) mandatory packaging warnings; (7) taxation on e-cigarette products; (8) reporting and notification requirements for manufacturers; (9) restrictions on use in indoor public places; and (10) restrictions on retail outlet density. Following expert review, attributes (7) and (8) were merged into attribute (5) because the experts judged that taxation and reporting requirements were perceived by the public as components of a broader product regulatory regime rather than as distinct policy instruments. Attributes (9) and (10) were excluded because the experts noted that clean-air restrictions and outlet-density restrictions are not yet comprehensively implemented in China, and their inclusion would have introduced substantial heterogeneity in respondents' reference points. The remaining six attributes were retained.

(2) Attribute Screening and Pilot Survey

Five experts in tobacco control, with expertise spanning public health, health policy, law, and epidemiology, were invited to assess content validity. Using a 4-point scale, the experts evaluated the content relevance of each candidate attribute, and the item-level content validity index (I-CVI) was calculated. The inclusion criterion was an I-CVI of 0.80 or higher. Following

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the review, 8 of the 10 candidate attributes met the criterion, with all eight achieving an I-CVI of 1.00; the remaining two attributes were merged or excluded because of excessive overlap.

A pilot survey was subsequently conducted with a convenience sample of 150 participants to assess the comprehensibility of the paired functional and dysfunctional Kano items and the questionnaire completion rate. After the wording was revised based on participant feedback, six policy attributes were retained. Their policy sources, corresponding domains, and the wording of the functional and dysfunctional items are presented in Table 2.

Table 2 Mapping from Policy Documents to Kano Attributes and Item Wording

Attribute	Policy Source	Legal Status	Effective Date	Mapped Domain	Functional Item	Dysfunctional Item
K1	P1, P2, P8	Enacted	2018/2019/2024	Protection of minors	Age verification is required when purchasing e-cigarettes.	Age verification is not required when purchasing e-cigarettes.
K2	P3 (Article 23)	Enacted	2022	Sales channels	The online sale of e-cigarettes is prohibited.	The online sale of e-cigarettes is permitted.
K3	P3 (Article 22)	Enacted	2022	Advertising and promotion	E-cigarette advertising and marketing activities are strictly restricted.	E-cigarette advertising and marketing activities are permitted.
K4	P5 (GB 41700)	Enacted	2022	Ingredient/flavor restrictions	The sale of flavored e-cigarettes is prohibited, with only tobacco-flavored products permitted.	The sale of e-cigarettes in a variety of flavors is permitted.
K5	P5, P6	Enacted	2022/2024	Product standards	E-cigarettes must pass testing and review under mandatory national standards.	E-cigarettes are not required to pass testing and review under mandatory national standards.
K6	P4	Enacted	2022	Packaging and labeling	Health warnings must be printed on e-cigarette packaging.	Health warnings are not required on e-cigarette packaging.

Study Design and Participants

This study employed a cross-sectional online survey design. From June to July 2026, convenience sampling was conducted among adults aged 18 years or older across China through the Wenjuanxing platform. The questionnaire was distributed through social media platforms, including WeChat and QQ, as well as through a professional research panel. Respondents participated voluntarily and completed an anonymous, self-administered questionnaire.

The sample size estimation was informed by a previous study using the Kano model (Zhang et al., 2024). To detect between-group differences in the distribution of Kano classifications between users and nonusers, with an effect size of $w = 0.20$, $\alpha = 0.05$, and statistical power of 0.80, the minimum sample size required for the chi-square test was approximately 200. To ensure adequate statistical power for stratified analyses and multivariable regression, while allowing for an anticipated exclusion rate of approximately 10% for invalid questionnaires, the target sample size was set at more than 700 participants.

The inclusion criteria were as follows: being 18 years of age or older and being able to complete the Chinese-language questionnaire independently. The exclusion criterion was a questionnaire completion time of less than one-third of the median completion time observed in the pilot survey, which was considered indicative of an invalid response. The study was approved by the institutional ethics committee, and all respondents provided electronic informed consent before completing the questionnaire.

Measurement Instruments

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The questionnaire consisted of three modules: (1) sociodemographic characteristics and e-cigarette use behaviors; (2) Kano evaluations of the six policy attributes; and (3) questionnaire quality-control items. The Kano evaluation used the standard paired functional and dysfunctional question format (Kano et al., 1984). Because all six policy attributes had already been enacted at the time of the survey, the Kano items measured counterfactual evaluative reactions to the presence versus absence of existing regulations, rather than expectations concerning future policy introduction. These responses may reflect policy awareness, normative endorsement, perceived necessity, or satisfaction with implementation; these constructs were not separately measured and are not distinguished in the present analysis. Each pair of items included five standard response options: "I like it that way," "It must be that way," "I am neutral," "I can live with it that way," and "I dislike it that way." Respondents separately evaluated the implementation of a given policy using the functional item and the nonimplementation of that policy using the dysfunctional item. The combination of responses to the functional and dysfunctional items was mapped onto the five Kano categories: must-be (M), attractive (A), one-dimensional (O), indifferent (I), and reverse (R).

Kano Classification and Better–Worse Coefficients

Policy attributes were classified using the modified Kano evaluation matrix (Matzler & Hinterhuber, 1998). This matrix reassigns response combinations classified as questionable or conflicting (Q) in the standard matrix to the nearest Kano category based on the principle of minimal reclassification. This approach was adopted because the Q category typically represents contradictory or random responses, and reassignment permits the use of all available data. However, we acknowledge that this approach removes a potential indicator of item misunderstanding. Consequently, the frequency of the Q category is always zero in the modified matrix. The modified evaluation matrix is presented in Table 3. To assess the robustness of the results, a sensitivity analysis was also conducted using the standard matrix, with Q frequencies and coefficient changes reported in Section 3.2.

Table 3 Modified Kano Evaluation Matrix

Functional Item \ Dysfunctional Item	I like it that way	It must be that way	I am neutral	I can live with it that wat	I dislike it that way
I like it that way	A	A	O	O	O
It must be that way	M	I	I	I	M
I am neutral	M	I	I	I	M
I can live with it that way	M	I	I	I	M
I dislike it that way	A	R	R	R	M

Note. A = attractive; O = one-dimensional; M = must-be; I = indifferent; R = reverse.Better-Worse The Better–Worse coefficients were calculated as follows:

Better = (A + O) / (M + A + O + I)

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$$\text{Worse} = -1 \times (M + O) / (M + A + O + I)$$

The Better coefficient ranges from 0 to 1, with higher values indicating a greater increase in satisfaction when the attribute is present. The Worse coefficient ranges from −1 to 0, with a larger absolute value, |Worse|, indicating a greater decrease in satisfaction when the attribute is absent. The standard errors of the coefficients were calculated using a binomial approximation, and the 95% confidence intervals were constructed as Better ± 1.96 × SE.

Statistical Analysis

Statistical analyses were conducted using R version 4.3.0. Kano classifications were calculated using frequency cross-tabulations, and the Better–Worse coefficients and their confidence intervals were calculated using custom-written scripts. Between-group comparisons were performed using chi-square tests. For attributes with zero frequencies in some categories, sensitivity analyses were conducted by combining the R category or using Fisher's exact test. Effect sizes were measured using Cramér's V (Chen et al., 2019).

For the restriction on flavored e-cigarettes (K4), multinomial logistic regression was conducted with Kano classification as the dependent variable, using the indifferent category (I) as the reference group, and sociodemographic variables as the independent variables. Adjusted odds ratios (aORs) and 95% confidence intervals were calculated. Model fit was evaluated using the likelihood-ratio test and Nagelkerke's R^2. Fisher's exact test results were reported when sparse cells were present. All tests were two-sided, and $P < 0.05$ was considered statistically significant.

Results

Zhao said that the effectiveness of tobacco control communication is determined not only by the construction of message content but also by the appropriateness of its delivery strategies. In intervention practice, message content strategy and message execution strategy function as an integrated system. The former aims to define the thematic focus and normative orientation of the campaign, while the latter concerns the selection of media channels and expressive formats to optimize how the target audience receives, interprets, and engages with the message.

Sample Characteristics

A total of 768 questionnaires were collected. After 47 invalid questionnaires with excessively short completion times or logically inconsistent responses were excluded, 721 valid questionnaires remained, yielding a valid response rate of 93.9%. Based on e-cigarette use status, 200 respondents were current users (27.7%), 59 were former users (8.2%), and 462 were never users (64.1%). Statistically significant differences were observed among the three groups in sex, age, income, city tier, and co-residence with minors (all $P < 0.01$), whereas the difference in educational attainment was not statistically significant ($P = 0.362$). The distribution of sample characteristics by e-cigarette use status is presented in Table 4.

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Table 4 Sample Characteristics by E-Cigarette Use Status (N = 721)

Characteristic	Current Users (n=200)	Former Users (n=59)	Never Users (n=462)	χ^2	P
Sex				35.88	<0.001
Male	125 (62.5)	31 (52.5)	174 (37.7)		
Female	75 (37.5)	28 (47.5)	288 (62.3)		
Age group (years)				55.02	<0.001
18-25	57 (28.5)	22 (37.3)	257 (55.6)		
26-35	83 (41.5)	18 (30.5)	114 (24.7)		
36-45	51 (25.5)	13 (22.0)	67 (14.5)		
46-55	9 (4.5)	3 (5.1)	16 (3.5)		
⩾56	0 (0.0)	3 (5.1)	8 (1.7)		
Educational attainment				8.77	0.362
Middle school or below	0 (0.0)	0 (0.0)	1 (0.2)		
High school/secondary vocational school/technical school	2 (1.0)	0 (0.0)	15 (3.2)		
Junior college	17 (8.5)	9 (15.3)	45 (9.7)		
Bachelor's degree	156 (78.0)	44 (74.6)	334 (72.3)		
Master's degree or above	25 (12.5)	6 (10.2)	67 (14.5)		
Monthly income (RMB)				42.76	<0.001
⩽ 3000	9 (4.5)	3 (5.1)	58 (12.6)		
3001-5000	23 (11.5)	19 (32.2)	131 (28.4)		
5001-8000	79 (39.5)	17 (28.8)	133 (28.8)		
8001-12000	53 (26.5)	13 (22.0)	82 (17.7)		
12001-20000	25 (12.5)	5 (8.5)	41 (8.9)		
⩾20001	11 (5.5)	2 (3.4)	17 (3.7)		
City tier				21.93	0.005
Rural area	2 (1.0)	2 (3.4)	12 (2.6)		
Township	4 (2.0)	2 (3.4)	25 (5.4)		
County seat/county-level city	27 (13.5)	9 (15.3)	72 (15.6)		
Prefecture-level city	52 (26.0)	24 (40.7)	168 (36.4)		
Municipality/provincial capital	115 (57.5)	22 (37.3)	185 (40.0)		
Living with minors				31.92	<0.001
Yes	123 (61.5)	24 (40.7)	175 (37.9)		
No	77 (38.5)	35 (59.3)	287 (62.1)		

Note. Data are presented as n (%). The χ^2 and P values represent comparisons among the three groups.

Kano Classifications and Better–Worse Coefficients in the Full Sample

The Kano classification results and Better–Worse coefficients for the six policy attributes are presented in Table 5. Age verification (K1) was classified as a must-be attribute (M) by 47.7% of respondents, making M its dominant classification. Mandatory standards and review (K5) was classified as a one-dimensional attribute (O) by 46.7% of respondents, making O its dominant classification; it was the only attribute dominated by the one-dimensional category. Online sales restrictions (K2) and packaging warnings (K6) were both dominated by the M category, at 41.7% and 45.4%, respectively. Advertising and marketing restrictions (K3) and restrictions on flavored e-cigarettes (K4) were both dominated by the indifferent category (I), at 35.0% and 39.4%, respectively.

K5 had the highest Better coefficient (0.477) and |Worse| coefficient (0.922), followed by K1 (0.456 and 0.918, respectively). K4 had the lowest Better coefficient (0.301) and |Worse| coefficient (0.524). For all attributes, the |Worse| coefficients were markedly higher than the Better coefficients, indicating that, descriptively, respondents assigned greater evaluative weight to policy absence than to policy presence. Because loss aversion was not experimentally tested,

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this pattern is reported as a descriptive asymmetry rather than as evidence of loss aversion. Under the standard matrix, the Q frequencies for the six attributes were as follows: K1: 0 (0.0%), K2: 1 (0.1%), K3: 3 (0.4%), K4: 6 (0.8%), K5: 0 (0.0%), K6: 1 (0.1%). The low Q frequencies indicate that contradictory responses were rare. Reclassification of Q responses under the modified matrix produced minimal changes in category distributions. For K4, the largest differences were an increase of 0.4 percentage points in the indifferent category and a decrease of 0.3 percentage points in the reverse category; these changes did not alter the dominant classification. The Better–Worse coefficients changed by less than 0.01 for all attributes under the modified matrix, and all coefficient rankings remained identical. Complete classification distributions under both matrices are presented in Supplementary Table S1.The distributions of Kano classifications for the six attributes are shown in Figure 1.

Table 5 Kano Classifications and Better–Worse Coefficients in the Full Sample (N = 721)

Attribute	Dominant Category	M%	A%	O%	I%	R%	Better (95%CI)	Worse (95%CI)
K1 Age verification	M	47.7	1.5	44.1	6.7	0.0	0.456 (0.422,0.492)	−0.918 (−0.939,−0.899)
K2 Online sales restrictions	M	41.7	2.9	28.6	26.0	0.8	0.317 (0.282,0.352)	−0.709 (−0.739,−0.675)
K3 Advertising and marketing restrictions	I	33.7	2.6	25.9	35.0	2.8	0.294 (0.262,0.328)	−0.613 (−0.651,−0.576)
K4 Restrictions on flavored e-cigarettes	I	26.5	5.5	22.9	39.4	5.7	0.301 (0.268,0.337)	−0.524 (−0.559,−0.486)
K5 Mandatory standards and review	O	45.5	1.0	46.7	6.8	0.0	0.477 (0.441,0.513)	−0.922 (−0.942,−0.902)
K6 Packaging warnings	M	45.4	2.5	35.4	16.6	0.1	0.379 (0.345,0.415)	−0.808 (−0.835,−0.781

Note. M = must-be; A = attractive; O = one-dimensional; I = indifferent; R = reverse. The Better coefficient ranges from 0 to 1, and the Worse coefficient ranges from −1 to 0. Percentages may not sum to 100.0% because of rounding.

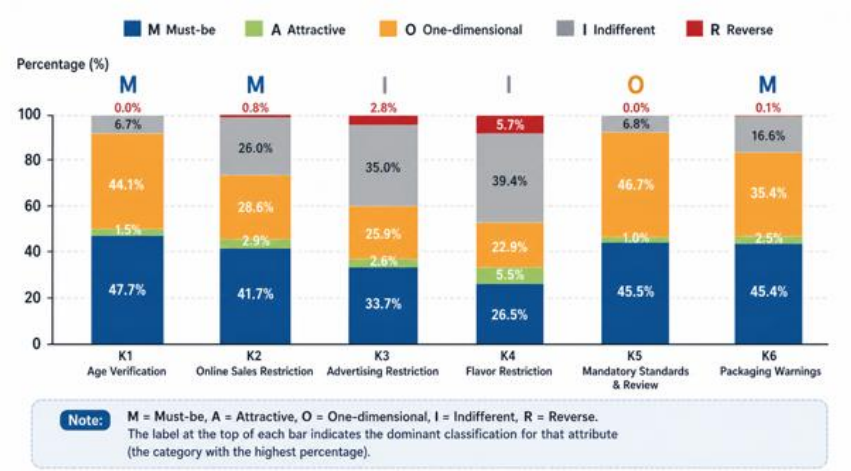

Figure 1 Kano Classification Distribution of Six Policy Attributes (N=721)

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Between-Group Comparison of Kano Classifications Between Users and Nonusers

Table 6 presents the distributions of Kano classifications for the six policy attributes and the corresponding between-group comparisons between current users (n = 200) and never users (n = 462). Former users (n = 59) were not included in this analysis. Among the six attributes, statistically significant differences in classification distributions were observed for all attributes except K5 (all P < 0.001). K4 showed the largest between-group difference (Cramér's V = 0.38). The proportions classified as attractive (13.0%) and reverse (15.5%) were substantially higher among users than among nonusers (2.7% and 1.9%, respectively). For K2, the indifferent category was dominant among users (38.0%), whereas the must-be category was dominant among nonusers (44.5%). For K1, the must-be category was dominant among users (52.0%), whereas the one-dimensional category was dominant among nonusers (47.8%). A comparison of the classification distributions between the two groups is shown in Figure 2.

Table 6 Between-Group Comparison of Kano Classifications Between Current Users and Never Users

Attribute	Current Users						Never Users						χ^2	P	Cramér's V
	Dominant Category	M%	A%	O%	I%	R%	Dominant Category	M%	A%	O%	I%	R%			
K1	M	52.0	0.5	34.5	13.0	0.0	O	46.1	1.9	47.8	4.2	0.0	25.49	<0.001	0.19
K2	I	34.5	4.0	21.0	38.0	2.5	M	44.5	2.5	31.5	21.3	0.2	34.94	<0.001	0.22
K3	I	28.5	3.5	13.0	49.5	5.5	M	35.7	2.3	30.9	29.4	1.7	45.04	<0.001	0.25
K4	I	18.5	13.0	10.0	43.0	15.5	I	29.6	2.7	27.8	38.0	1.9	102.24	<0.001	0.38
K5	O	43.5	0.5	45.5	10.5	0.0	O	46.3	1.2	47.2	5.4	0.2	6.55	0.088	0.10
K6	M	41.5	3.0	26.0	29.5	0.0	M	46.8	2.3	39.0	11.7	0.2	35.93	<0.001	0.22

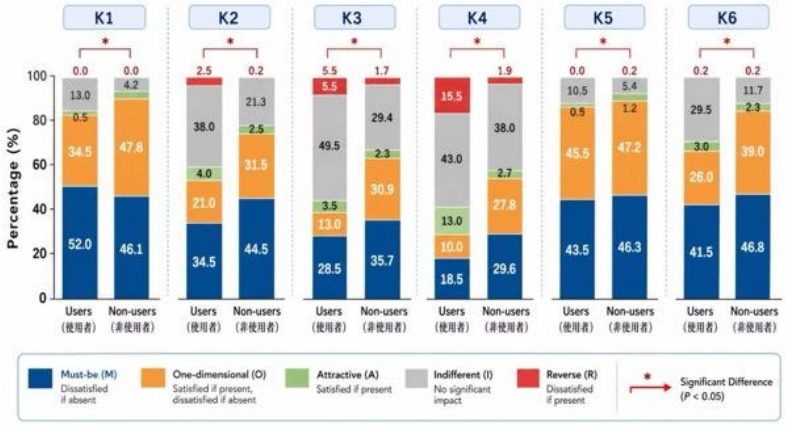

Figure 2 Kano Classification Distribution by User Group (Users vs. Non-users)

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Multinomial Logistic Regression Analysis of Restrictions on Flavored E-Cigarettes

The multinomial logistic regression model using the Kano classification of K4 as the dependent variable, with the indifferent category (I) as the reference category, demonstrated an overall good fit (LR χ^2 = 144.44, df = 28, P < 0.001, Nagelkerke's R^2 = 0.194). The results are presented in Table 7. Compared with nonusers, current users were more likely to be classified in the attractive category (A; aOR = 4.488) and the reverse category (R; aOR = 8.448), and less likely to be classified in the must-be category (M; aOR = 0.462) and the one-dimensional category (O; aOR = 0.302). Living with minors was associated with a greater likelihood of classification in the M category (aOR = 1.688) and a lower likelihood of classification in the R category (aOR = 0.403). The effect estimates and confidence intervals for each variable across the different category comparisons are shown in Figure 3.

Table 7 Multinomial Logistic Regression Analysis of K4 Restrictions on Flavored E-Cigarettes (Reference Category = I; N = 721)

Variable	M vs I		A vs I		O vs I		R vs I	
	aOR (95%CI)	P	aOR (95%CI)	P	aOR (95%CI)	P	aOR (95%CI)	P
Current e-cigarette user	0.462 (0.288-0.743)	0.001	4.488 (2.080-9.683)	<0.001	0.302 (0.172-0.531)	<0.001	8.448 (3.732-19.127)	<0.001
Male	0.790 (0.537-1.163)	0.233	1.143 (0.564-2.318)	0.710	0.578 (0.382-0.877)	0.010	1.002 (0.495-2.030)	0.995
Age (ordinal)	1.204 (0.961-1.509)	0.106	0.779 (0.483-1.257)	0.306	1.391 (1.106-1.750)	0.005	0.983 (0.610-1.584)	0.944
Junior college education or higher	0.350 (0.086-1.426)	0.143	0.271 (0.025-2.876)	0.278	0.300 (0.072-1.248)	0.098	20.836 (0.000-183790996.686)	0.710
Income (ordinal)	0.980 (0.834-1.151)	0.804	0.925 (0.685-1.248)	0.608	1.018 (0.859-1.207)	0.834	1.038 (0.754-1.428)	0.820
City tier	0.945 (0.775-1.154)	0.580	0.757 (0.502-1.143)	0.185	0.946 (0.768-1.165)	0.600	0.795 (0.518-1.220)	0.293
Living with minors	1.688 (1.102-2.585)	0.016	1.050 (0.476-2.316)	0.903	1.016 (0.648-1.594)	0.945	0.403 (0.175-0.926)	0.032

Note. aOR = adjusted odds ratio; estimates were adjusted for all other variables included in the table. The indifferent category (I) served as the reference category. For junior college education or higher in the R versus I comparison, the confidence interval was extremely wide, indicating an unstable estimate due to sparse data. Overall model fit: LR χ^2 = 144.44, df = 28, P < 0.001, Nagelkerke's R^2 = 0.194.

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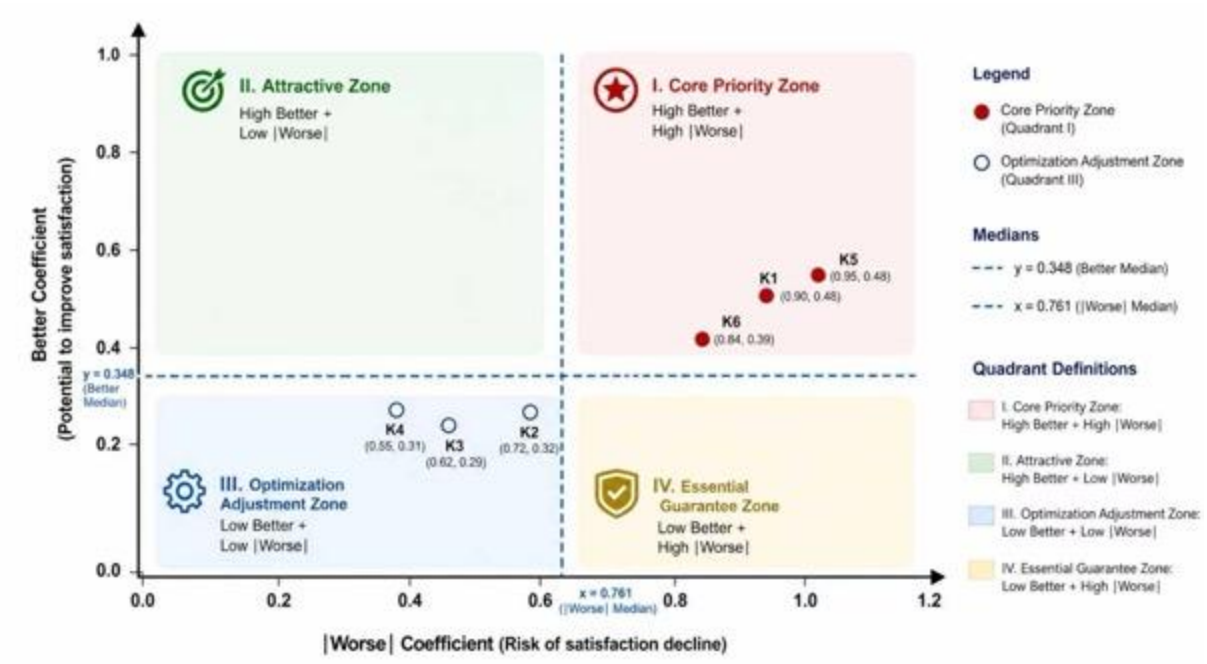

Figure 3 Better-Worse Four-Quadrant Policy Priority Analysis

Identification of Policy Levers Using Four-Quadrant Analysis

Using the median Better coefficient (0.348) and the median |Worse| coefficient (0.761) as the cutoff points, the six policy attributes were mapped onto four quadrants (Figure 4). Quadrant I, the core priority area, included K1, K5, and K6; Quadrant III, the optimization and adjustment area, included K2, K3, and K4. No attributes fell into Quadrants II or IV, resulting in a clear two-tier structure.

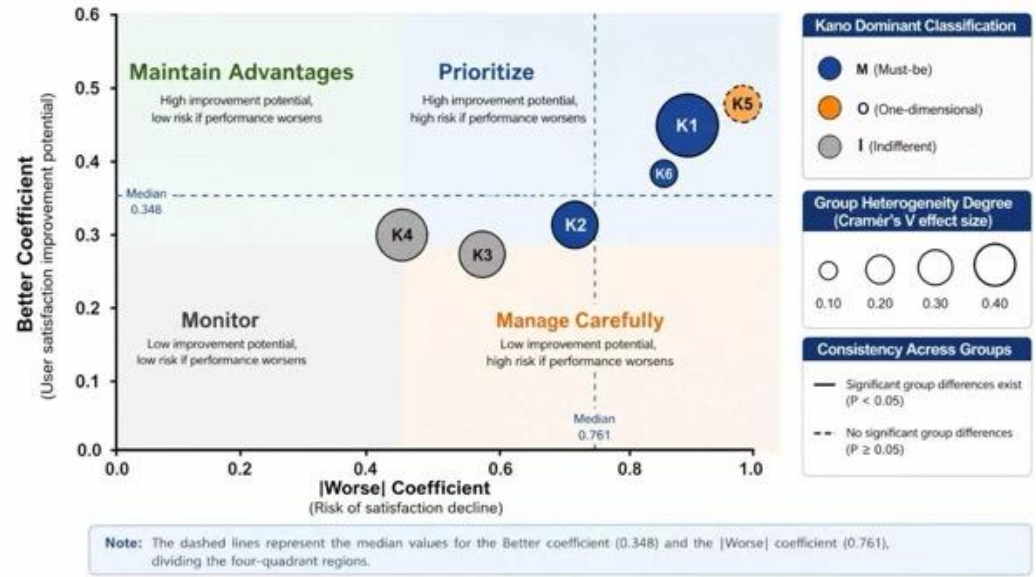

Figure 4 Better-Worse Bubble Chart with Group Heterogeneity Analysis

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Integration of the Multidimensional Characteristics of Policy Attributes

To further reveal the relationships among policy priority, Kano classification, and the degree of between-group differentiation, the Better–Worse coefficients, dominant classifications, and effect sizes of between-group differences (Cramér's V) for the six attributes were integrated into a single bubble matrix plot (Figure 5). The position of each bubble indicates its quadrant assignment, the color denotes its dominant Kano classification, and the bubble size represents the degree of between-group differentiation. A dashed border indicates consistency across groups (K5). The figure visually demonstrates the distinctive status of K5 as a "high-priority, high-consensus" attribute and the salient characteristics of K4 as a "low-priority, highly differentiated" attribute. It therefore provides direct visual evidence for the two-tier structure discussed below and for the complementarity of the two analytical perspectives.

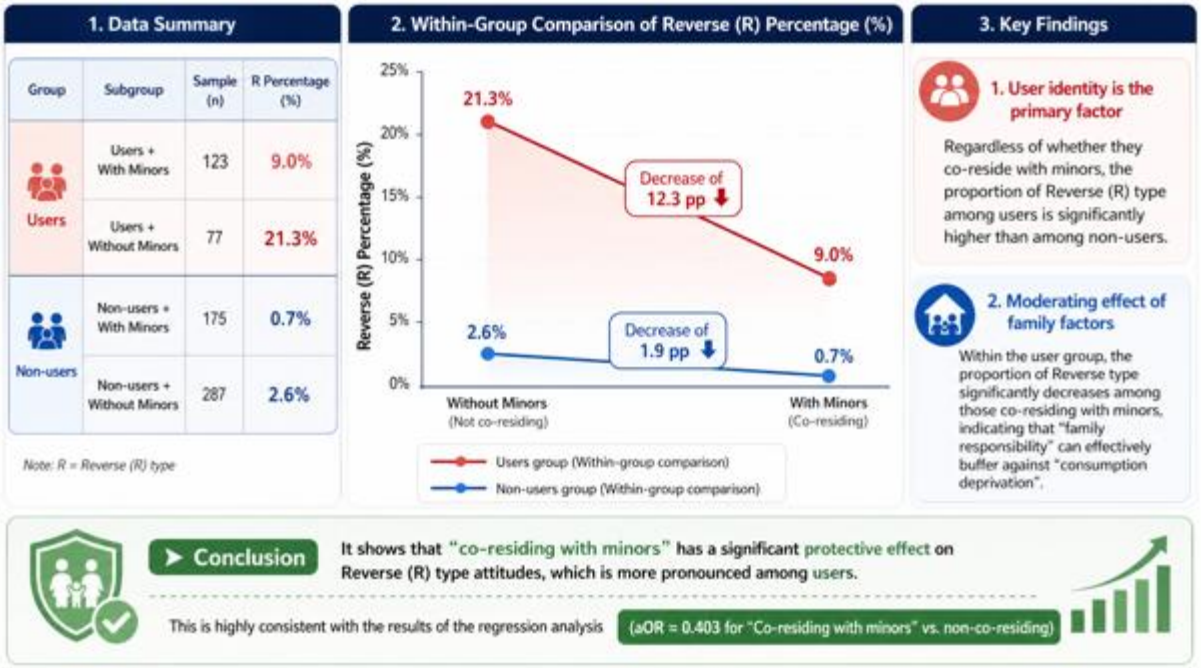

Figure 5 Interaction Effect of "User Identity" and "Co-residing with Minors" on Reverse (R) Classification

The message content strategy addresses the fundamental question of what to communicate. In the context of tobacco control, commonly adopted content approaches include: (1) emphasizing the health risks associated with smoking (Hammond et al., 2007); (2) highlighting its social and economic costs (Hiilamo et al., 2014); and (3) employing moral framing to construct normative opposition (Yang & Yang, 2023). For instance, health risk–centered messages often rely on epidemiological statistics and graphic imagery to heighten individual risk perception (Hammond et al., 2007). Messages emphasizing social costs underscore the burdens of smoking on family well-being and public resources, aiming to evoke a sense of collective responsibility (Hiilamo et al., 2014). Moral framing approaches frequently focus on issues such as secondhand smoke exposure and tobacco industry manipulation, encouraging audiences to question the legitimacy of smoking behaviours through ethical reflection (Yang & Yang, 2023). For instance, health risk–centered messages often rely on epidemiological statistics and graphic imagery to heighten individual risk perception (Hammond et al., 2007).

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The persuasiveness of a message depends not only on the internal coherence of its argumentative logic but also on its resonance with the lived experiences of the intended audience. For instance, research indicates that adolescents are generally less responsive to warnings about long-term health risks (Latimer et al., 2012). Instead, messages that emphasize the immediate consequences of smoking—such as its effects on appearance, breath, athletic performance, or social image—are more likely to elicit emotional reactions and shape behavioural intentions (Hallfors et al., 2005). Furthermore, studies have found that integrating moral value frameworks, such as the ethics of care or the ethics of purity, can strengthen adolescents' identification with tobacco control norms, fostering internal reflection and promoting greater self-regulation of smoking behaviours (Yang & Yang, 2023).

By contrast, the message execution strategy focuses on how to communicate. This involves selecting appropriate information channels, scheduling dissemination effectively, and making stylistic decisions regarding both visual and linguistic presentation. Execution is not merely a technical extension of content design; rather, it plays a pivotal role in determining whether messages enter the audience's perceptual field, are cognitively processed, and ultimately retained (Noar et al., 2016). Even well-crafted content may lose its persuasive power if the mode of delivery fails to align with the audience's expectations and media consumption habits. Zhao cited the U.S. "Truth" campaign as an exemplary case of synergy between message content and execution strategy. Rather than relying on fear appeals, the campaign strategically exposed how tobacco companies manipulated youth consumer psychology, thereby provoking scepticism and resistance among adolescents (Farrelly et al., 2005). On the execution side, it employed live-action storytelling, rapid editing, and visually arresting imagery, while deliberately avoiding didactic or patronizing language (Farrelly et al., 2009). This approach created a communication style that appeared youth-driven, reinforcing both authenticity and emotional identification. The convergence of content intent and execution design enabled the campaign to build a foundation of trust and affective resonance among young audiences, ultimately contributing to a significant decline in youth smoking rates over a decade (Farrelly et al., 2005). It is widely regarded as a benchmark case in integrated tobacco control communication.

In applied contexts, the effectiveness of communication strategies often hinges on the degree of alignment between message content and its mode of execution. For instance, among older rural populations, channels such as radio broadcasts, village bulletin boards, and in-person health talks tend to be more effective due to their immediacy and accessibility. In contrast, for urban youth, short-form video platforms, popular culture references, and interactive formats are more likely to attract attention and encourage engagement. Moreover, highly educated audiences typically place greater value on logical coherence and data transparency, whereas general audiences may respond more strongly to vivid, concrete, and emotionally resonant messages. Ultimately, the impact of communication on behavioural decision-making depends not only on message validity, but—more critically—on whether the delivery format aligns with the audience's cognitive schemas and media consumption habits.

Discussion

A Two-Tier Policy Structure of Core Priorities and Optimization and Adjustment

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The four-quadrant analysis and the multidimensional feature integration plot jointly revealed a two-tier structure in public policy expectations. Age verification (K1), mandatory standards and review (K5), and packaging warnings (K6) constituted the core priority tier. All three attributes were characterized by both high gains in satisfaction and high risks of dissatisfaction. K1 was dominated by the must-be category, reflecting its role as a fundamental safeguard against minors' access to e-cigarettes. K5 was dominated by the one-dimensional category, indicating that the public expected product standards to be "the stricter, the better." Although K6 was classified as a must-be attribute under the Kano framework, its Better–Worse coefficients placed it in the core priority area, indicating that packaging warnings have an important influence on overall satisfaction.

Online sales restrictions (K2), advertising and marketing restrictions (K3), and restrictions on flavored e-cigarettes (K4) fell within the optimization and adjustment area. K2 may have had a relatively limited marginal effect because of perceived constraints on its implementation feasibility. K3 may have had limited public salience because its effects are indirect, whereas K4 was associated with pronounced between-group differentiation. This structure suggests that, from the perspective of public evaluative reactions, policy implementation might first consolidate the core priority tier and then progressively optimize and adjust the second tier according to the level of social acceptance. Although the three attributes in the core priority tier differed in their Kano classifications, they shared a common Better–Worse pattern of "high Better and high |Worse|." Although the three attributes in the core priority tier differed in their Kano classifications, they shared a common Better–Worse pattern of "high Better and high |Worse|."

Mechanisms Underlying Group Differentiation in Policies Restricting Flavored E-Cigarettes

Restrictions on flavored e-cigarettes exhibited the largest between-group difference (Cramér's V = 0.38). Most nonusers regarded this attribute as indifferent, whereas users showed substantial internal differentiation: a considerable proportion strongly opposed the restriction and were classified in the reverse category, while others regarded it as an unexpected benefit and were classified in the attractive category. The multinomial logistic regression results further confirmed that current-user status increased the likelihood of classification in both the A and R categories, whereas living with minors was associated with a greater likelihood of classification in the must-be category and a lower likelihood of classification in the reverse category. These findings indicate that resistance to a flavored e-cigarette ban primarily originates from specific subgroups rather than from uniform opposition among users. A one-size-fits-all ban may provoke strong resistance, and differentiated communication and transitional arrangements may therefore represent more appropriate strategies. This study did not measure conventional cigarette use, dual use, or nicotine dependence. These factors may represent important dimensions for explaining heterogeneity among users and warrant further investigation.

Differences in Perceptions of Institutional Safeguard Policies

K5 was the only attribute dominated by the one-dimensional category and showing no statistically significant between-group difference. This finding indicates consistent recognition of product standards and review across groups, with the public tending to regard them as a linear determinant of satisfaction for which "the stricter, the better." Its highest Better and |Worse| coefficients suggest that improving product standards can effectively increase satisfaction, while inadequate standards may also generate dissatisfaction, thereby producing a "double-edged sword" effect. K3 fell within both the indifferent category and the optimization and adjustment

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area. This result may be related to the public's indirect perception of advertising and marketing restrictions, whose importance has not yet been fully recognized.

Research Contributions and Limitations

This study is the first to apply the Kano model to research on public expectations regarding e-cigarette policies. By adopting the perspective of asymmetric satisfaction, it revealed a tiered structure that extends beyond conventional policy-support scores. The complementary use of four-quadrant analysis and Kano classification, together with the design of the multidimensional feature integration plot, provides a new tool for prioritizing policies. This study nevertheless has several limitations. First, the Kano model was originally developed within the context of product and service quality; its application to public-policy evaluation remains exploratory. Although the present study interprets the Kano responses as evaluative reactions to hypothetical policy presence and absence rather than as consumer satisfaction, formal psychometric validation of the Kano items against established measures of policy support and normative approval was not conducted. Future research should examine the convergent and discriminant validity of Kano-based classifications in policy contexts. Second, the six policy attributes do not exhaustively cover all domains of e-cigarette regulation in China. Taxation, reporting and notification, and clean-air restrictions were not included because they are either less comprehensively implemented or judged to be less salient to the public. Future research should examine these domains separately. Third, online convenience sampling may have affected sample representativeness, particularly because older adults, individuals with lower levels of education, and rural residents were underrepresented. Fourth, the cross-sectional design precludes causal inference. Fifth, potential influencing factors such as conventional cigarette use and nicotine dependence were not measured. Sixth, the frequencies of the R category were sparse for some attributes. Future studies could address these limitations by incorporating longitudinal designs, probability sampling, and more refined measures of use behavior.

Policy Implications

Based on the findings above, three recommendations are proposed. First, age verification, product standards and review, and packaging warnings should be prioritized and continuously strengthened because these three core policies constitute the foundation of public trust. Second, online sales restrictions, advertising restrictions, and restrictions on flavored e-cigarettes should be progressively optimized and accompanied by differentiated communication based on group feedback, after the core policies have been firmly established. Third, given the pronounced group differentiation surrounding restrictions on flavored e-cigarettes, reasonable transition periods and alternatives could be considered for adult users to reduce policy resistance, while protection against the appeal of flavored e-cigarettes among adolescents should be strengthened.

Conclusion

This study applied the Kano model to quantitatively analyze expectations regarding e-cigarette policies among adult respondents in a Chinese online sample. The principal findings were as follows. First, the four-quadrant analysis divided the six policy attributes into a core priority group (K1, K5, and K6) and an optimization and adjustment group (K2, K3, and K4). Kano classification further revealed a three-part pattern characterized by must-be-dominant, one-dimensional-dominant, and indifferent-dominant attributes. These two perspectives complemented each other and provided a multidimensional characterization of public policy expectations. Second, the |Worse| coefficient for every attribute was markedly higher than its

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Better coefficient, reflecting a general pattern of loss aversion. Third, restrictions on flavored e-cigarettes showed the largest difference between users and nonusers, and use status was an important factor associated with differences in classification. These findings provide empirical evidence for the more refined design of e-cigarette regulatory policies.

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Ethics Approval and Informed Consent:

This study was approved by the institutional ethics committee. All respondents provided electronic informed consent.

Competing interests

The author(s) declared no competing interests.

Data Availability

The raw data are available from the corresponding author upon reasonable request.

Supplementary Table S1. Comparison of Kano Classifications Under Standard and Modified Matrices

Attribute	Matrix	M%	A%	O%	I%	R%	Q%	Better	Worse
K1	Standard	47.7	1.5	44.1	6.7	0.0	0.0	0.456	−0.918
K1	Modified	47.7	1.5	44.1	6.7	0.0	0.0	0.456	−0.918
K2	Standard	41.6	2.9	28.5	26.1	0.8	0.1	0.316	−0.708
K2	Modified	41.7	2.9	28.6	26.0	0.8	0.0	0.317	−0.709
K3	Standard	33.5	2.5	25.7	35.1	2.8	0.4	0.292	−0.611
K3	Modified	33.7	2.6	25.9	35.0	2.8	0.0	0.294	−0.613
K4	Standard	26.2	5.3	22.6	39.4	5.7	0.8	0.298	−0.520
K4	Modified	26.5	5.5	22.9	39.4	5.7	0.0	0.301	−0.524
K5	Standard	45.5	1.0	46.7	6.8	0.0	0.0	0.477	−0.922
K5	Modified	45.5	1.0	46.7	6.8	0.0	0.0	0.477	−0.922
K6	Standard	45.3	2.5	35.3	16.7	0.1	0.1	0.378	−0.807
K6	Modified	45.4	2.5	35.4	16.6	0.1	0.0	0.379	−0.808

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