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Non-alcoholic (zero-alcohol) beer as surrogate marketing: misidentification and self-reported alcohol desire in a national survey in Thailand

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Abstract

Background The global growth of non-alcoholic (zero-alcohol/alcohol-free) beer and its potential role in surrogate marketing (brand extension) are increasingly debated, yet evidence from low- and middle-income countries, including Thailand, remains scarce. We examined the prevalence of non-alcoholic beer exposure, misidentification, and self-reported desire to drink alcohol of a corresponding brand among exposed participants.

Methods We conducted a secondary analysis of a national cross-sectional survey of 6,459 Thai residents aged ≥ 15 years in December 2022. Participants were shown images of non-alcoholic beers and asked about exposure within the past 3 months. Misidentification was assessed by drink identification, and desire to drink alcohol of the corresponding brand was rated for each product seen, using a 0–5 ordinal rating scale. Associations among sociodemographic characteristics, drinking status, product misidentification, and self-reported desire were evaluated using logistic regression and cumulative link models.

Results Overall, 32.2% of participants reported exposure to non-alcoholic beers, rising to 40.1% among current drinkers. Among the 2,080 exposed participants, more than four in five (85.3%) misidentified at least one product as alcoholic beer, and about half (51.2%) reported some degree of desire for the alcoholic beverage of at least one corresponding brand. Exposure was more common among participants with higher educational attainment, Bangkok residents, former drinkers, and frequent drinkers. Among exposed participants, misidentifying non-alcoholic beer as alcoholic beer was associated with higher self-reported desire, although in product-specific analyses this association was evident for Heineken 0.0 but not for Asahi 0.00. Higher reported desire was also observed among lower-income participants, former drinkers, and current drinkers, particularly those drinking frequently.

Conclusions Non-alcoholic beer products with branding and packaging similar to alcoholic beer were widely misidentified as alcoholic beer. Among participants reporting prior exposure, approximately half reported some desire for the alcoholic beverage of at least one corresponding brand, and misidentification as alcoholic beer was associated with higher reported desire, although this association differed between the two products examined. These findings support consideration of clearer labelling, packaging, and marketing rules that visually distinguish

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non-alcoholic beer from its alcoholic counterparts and limit surrogate marketing, while recognising that the cross-sectional design precludes causal inference.

Keywords Non-alcoholic beer · Zero-alcohol beverage · Surrogate marketing · Alcohol desire · Alcohol misidentification · Thailand · Former drinkers

Abbreviations

NoLo	Non–and low–alcohol beverages
LR	Logistic regression
CLMs	Cumulative link models
CAS	Centre for Alcohol Studies
CI	Confidence interval
AOR	Adjusted odds ratio
COR	Crude odds ratio

Background

The growth of non-alcoholic alternative beverages is notable in the context of a global trend toward reduced alcohol consumption. According to a report by *The Economist* [1], the global market for alcohol-free beverages expanded by approximately 20% in 2023, compared with only 8% growth in the alcoholic beverage sector. Similar patterns have been observed in Great Britain, where consumption of non- and low-alcohol (NoLo) beverages has increased substantially in recent years [2].

NoLo beverages are formulated to mimic the appearance, taste, and sensory characteristics of traditional alcoholic drinks while containing low to zero levels of ethanol. Those containing no or negligible ethanol are variously described as non-alcoholic, zero-alcohol, or alcohol-free. They span a broad range of beverage categories, including beer, wine, spirits, and cider. For example, NoLo beer is typically produced by either removing ethanol from fully fermented beer or limiting ethanol production during fermentation [3]. Consequently, these products are classified as malt beverages rather than alcoholic drinks under several regulatory frameworks [4].

Alcohol consumption is a major contributor to global morbidity and mortality; it is associated with numerous adverse health and social outcomes, including oesophageal and colorectal cancers, interpersonal violence, and traffic-related injuries [5]. In Thailand, alcohol use was identified as the second leading risk factor contributing to disease burden among men in 2019 [6]. Therefore, a range of public health interventions have been implemented to mitigate alcohol-related harm [7]. Evidence suggests that harm reduction may be achieved through lower ethanol intake, including substitution of conventional alcoholic beverages with lower- or zero-alcohol alternatives [8, 9]. Moreover, reductions in alcohol consumption have been associated with lower mortality among individuals with alcohol use disorder [10]. Simultaneously, the beverage industry has increasingly promoted non-alcoholic variants, including NoLo beverages, as healthier alternatives to traditional alcoholic drinks. These products are often marketed for settings where alcohol consumption is socially or legally inappropriate, such as workplaces or when driving [11].

Under Thai regulations, non-alcoholic beverages are defined as products containing no more than 0.5% alcohol by volume and are therefore exempt from classification as alcoholic beverages [12]. This regulatory distinction raises concerns regarding the adequacy of existing labelling and marketing controls. Many non-alcoholic products are deliberately designed to visually resemble their alcoholic counterparts in terms of appearance, branding, and packaging, potentially facilitating surrogate marketing practices [13]. Such practices allow alcohol companies to indirectly promote alcoholic beverages through the marketing of non-alcoholic alternatives [14]. For example, in Ireland, where alcohol advertising is prohibited at sporting events, NoLo products have been used as

substitutes for alcoholic branding in sponsorship and promotional activities [15]. Moreover, a previous study in Thailand showed that more than half of school students were exposed to some form of surrogate marketing [16].

Empirical evidence from Thailand remains limited. A previous study conducted in southern Thailand reported that approximately 5% of Muslim youth had consumed non-alcoholic beverages bearing branding identical to alcoholic products [17]. Another study examining perceptions of marketing communications found that female consumers with a bachelor's degree who predominantly consumed non-alcoholic beverages demonstrated high levels of awareness regarding public relations activities, advertising, and sales promotions related to NoLo products [18]. However, the broader prevalence of exposure to NoLo beverages in Thailand or their potential influence on alcohol desire and drinking-related behaviours remains unclear.

Given these concerns, further investigation is warranted to evaluate the visibility, public perceptions, and potential alcohol-related responses elicited by the consumption of non-alcoholic beer products among the Thai population. This study aimed to: (1) assess the prevalence and sociodemographic correlates of exposure to non-alcoholic beers; (2) evaluate the extent to which these products are misidentified as alcoholic beverages; and (3) describe self-reported desire for the same-brand alcoholic beverage among participants reporting exposure to non-alcoholic beer and examine which factors are associated with stronger reported desire. Particular attention was paid to vulnerable populations, including former drinkers, for whom such exposure has been raised as a potential concern. The findings of this study are intended to inform regulatory strategies governing the marketing and presentation of non-alcoholic products in Thailand, to minimise unintended alcohol-related harm.

Methods

Study design and data source

This study is a secondary data analysis of a national cross-sectional survey conducted in December 2022 by the Research Centre for Social and Business Development, with funding support from the Centre for Alcohol Studies (CAS) and the Thai Health Promotion Foundation. The CAS had no role in the study design, data analysis, interpretation of findings, or manuscript preparation. The original survey was designed to assess exposure to alcohol marketing and alcohol-related branding among Thai residents aged 15 years and above and covered all regions of Thailand, including the Bangkok Metropolitan Area.

Study population and sampling methodology

The target population comprised Thai residents aged 15 years and above. Individuals diagnosed with coronavirus disease at the time of data collection or those unable to communicate effectively with interviewers were excluded. A stratified multistage sampling design was employed, with strata defined by geographic region (Bangkok, central, northern, northeastern, and southern Thailand). Within each stratum, cumulative systematic sampling was used to select participants.

The initial sample size was calculated using the Cochran formula at a 95% confidence level with a margin of error of ± 1.5%, yielding a minimum required sample of 4,268 participants. After adjustment for a design effect of 1.3 and an anticipated response rate of 85%, the final sample size was 6,381. Using a mixed sampling approach combining stratified multistage and cumulative systematic sampling, a total of 6,459 participants were successfully recruited.

Data collection and variable definitions

Data were collected through face-to-face interviews conducted by trained field researchers using a structured questionnaire. Visual aids, including images of beverage packaging, were incorporated to enhance product

recognition. The questionnaire collected information on sociodemographic characteristics, alcohol drinking status, exposure to non-alcoholic beer products, misidentification of non-alcoholic beers, and desire to consume alcohol reported among exposed participants.

Prior to field implementation, the questionnaire was pilot-tested with a sample of 30 participants to assess cognitive understanding, completion time, and response rates. Content validity was subsequently reviewed and confirmed by a panel of subject-matter experts.

Sociodemographic variables included gender (male or female), age group (15–19, 20–29, 30–39, and ≥40 years), marital status (single or others), educational attainment (primary education or below, below bachelor's degree, bachelor's degree or higher), occupation (government/private sector employees, labourers/farmers/small traders, self-employed/professionals, retired/unemployed, and students), average monthly income (<5,000; 5,001–20,000; and >20,000 Thai baht), and residential area (Bangkok, within municipality, and outside municipality). Responses categorised as 'unspecified' or 'other' were treated as missing values and excluded from analyses.

Alcohol drinking status was classified into three groups: lifetime abstainers (never consumed alcohol), former drinkers (previously consumed alcohol but not within the past 12 months), and current drinkers (consumed alcohol within the past 12 months). Current drinkers were further categorised by drinking frequency as monthly (≤3 days/month), occasional weekly (1–4 days/week), or frequent weekly (≥5 days/week).

Assessment of exposure, misidentification, and self-reported desire to drink

Heineken 0.0 and Asahi 0.00 were selected as example non-alcoholic beer products based on packaging and logos that closely resemble their alcoholic counterparts. Heineken 0.0, in particular, was introduced to the Thai market in 2019 [19]. Participants were asked whether they had seen the actual product or an image of it within the previous 3 months, including via social media platforms, with response options of 'yes' or 'no'. Participants were subsequently shown images of the respective products. For analytical purposes, a binary variable was created to capture exposure to either Heineken 0.0 or Asahi 0.00, which served as the measure of exposure to non-alcoholic beer in this study.

For each product to which participants reported exposure, product identification was assessed by asking, 'What type of drink do you think this is?' while displaying the product image. Respondents were instructed to rely on their initial impression when selecting from predefined response options, including 'alcoholic beer', 'malt drink', 'spirit', 'soda', and 'other'. For analysis, responses were grouped into two categories: 'misidentified as alcoholic beer' and 'not misidentified as alcoholic beer'. For participants who were exposed to both brands and had a discrepancy in misidentification for each brand, only the response with 'misidentified as alcoholic beer' was chosen as a representation of their response.

Among participants who reported exposure to either product, responses were retained separately at the product level for sensitivity analyses. For the primary participant-level analysis, misidentification was defined as misidentification of at least one exposed product, and alcohol desire was defined as the highest reported desire across exposed products. These participant-level variables provided a single outcome measure per participant while retaining the occurrence of any misidentification and the maximum level of reported desire.

Self-reported desire to drink alcohol among exposed participants was assessed using the question, 'If you have seen this product, how much do you want to drink the alcoholic beverage of the same brand afterwards?' Responses were recorded on a 0–5 ordinal rating scale, where 0 indicated no desire, and 5 indicated very high desire. For analysis, responses were categorised as 'no desire' (Score 0), 'low desire' (Score 1 and 2), and 'moderate-to-high desire' (Score 3 to 5). For participants with dual-brand exposure who responded differently, the response with the higher level of desire was chosen as a representation of their response.

Statistical analysis

All statistical analyses were conducted using R software (version 4.4.1; R Foundation for Statistical Computing, Vienna, Austria). Descriptive statistics are presented as unweighted frequencies and percentages based on the analytical sample. Among participants exposed to non-alcoholic beer, the number and proportion exposed to one product and to both products were described. For the primary participant-level analyses, exposure to non-alcoholic beer was defined as exposure to either Heineken 0.0 or Asahi 0.00. Among exposed participants, misidentification of at least one exposed product was defined as misidentifying at least one of the exposed products as alcoholic beer. The highest reported desire across exposed products was defined as the highest self-reported desire rating for the alcoholic beverage of the same brand among the products to which the participant was exposed. These aggregation rules were used to obtain one observation per participant while retaining whether the participant misidentified any exposed product, and the highest level of alcohol desire reported across exposed products.

Associations between sociodemographic characteristics, drinking status, and exposure to non-alcoholic beer were examined using logistic regression (LR) models. Multivariable models were adjusted for gender, age group, marital status, educational level, occupation, income, residential area, and drinking status. Similar LR models were used to examine factors associated with misidentification of at least one exposed product. Associations between these factors and the highest reported desire across exposed products were examined using cumulative link models (CLMs), adjusting for the same set of covariates as in the models above and for misidentification of at least one exposed product. The CLMs were fitted with a logit link and flexible threshold using the ordinal package. The reported odds ratios are proportional odds—the odds of being in a higher self-reported desire category (no desire / low / moderate-to-high) versus a lower one— assumed constant across the category thresholds. The proportional-odds assumption was assessed by likelihood-ratio tests comparing each term's proportional-odds specification with one allowing threshold-specific (nominal) effects.

As a sensitivity analysis, the models were refitted separately for each product using product-specific responses, so that each participant's misidentification response and desire rating referred to the same product. Factors associated with exposure to each product were examined among all participants ($n = 6{,}459$). Among participants reporting exposure to each product (Heineken 0.0, $n = 1{,}786$; Asahi 0.00, $n = 1{,}085$), the LR models were used to examine misidentification of the non-alcoholic product as its alcoholic counterpart, and the CLMs were used to examine self-reported desire, adjusting for the same covariates as in the primary analysis. The results were compared with those of the primary participant-level analysis to assess whether the association between misidentification and alcohol desire depended on the aggregation rule (Supplementary Tables 3–8).

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Data collection was conducted anonymously, and verbal informed consent was obtained from all participants prior to participation. Ethical approval was granted by the Human Research Ethics Committee of the Faculty of Medicine, Prince of Songkla University (REC. 68-220-9-1). Under the policy of the ethics committee, separate parental or guardian consent together with child assent is required for participants aged 7 to under 13 years; participants aged 13 years and above provide their own informed consent. Verbal informed consent was therefore obtained directly from participants aged 15–17 years.

Results

Exposure to non-alcoholic beer by participant characteristics

Among the 6,459 participants included in the analysis, 32.2% of the sample reported having seen non-alcoholic beer products within the past 3 months, either as physical products or through various media sources. Exposure was substantially higher among current drinkers ($n=3,231$), of whom 40.1% of the sample reported visual exposure (Table 1). Exposure prevalence differed across sociodemographic subgroups.

Table 1 Sociodemographic characteristics, alcohol drinking status, and exposure to non-alcoholic beer products ($n=6,459$)

Variable	Participants ($n=6,459$)	Participants exposed to non-alcoholic beers ($n=2,080$)
Sociodemographic characteristics		
Gender		
Male	3,052	1,110 (36.4%)
Female	3,407	970 (28.5%)
Age group (years)		
15–19	465	164 (35.3%)
20–29	1,062	455 (42.8%)
30–39	1,122	448 (39.9%)
≥40	3,810	1,013 (26.6%)
Marital status		
Single	1,850	778 (42.1%)
Others	4,609	1,302 (28.2%)
Education level		
Primary education or below	1,720	374 (21.7%)
Below bachelor's degree	3,695	1,284 (34.7%)
Bachelor's degree or higher	1,017	414 (40.7%)
Occupation		
Government/private employees	1,375	593 (43.1%)
Labourers/farmers/small traders	3,423	1,000 (29.2%)
Self-employed/professionals	392	126 (32.1%)
Retiree/unemployed	633	123 (19.4%)
Students	617	230 (37.3%)
Average monthly income (THB)		
<5,000	996	271 (27.2%)
5,001–20,000	4,373	1,448 (33.1%)
>20,000	1,056	353 (33.4%)
Living area		
Bangkok	627	248 (39.6%)
Within municipality	1,930	667 (34.6%)
Outside municipality	3,902	1,165 (29.9%)
Alcohol drinking status		
Lifetime abstainer	1,394	285 (20.4%)
Former drinker	1,834	499 (27.2%)
Current drinker: monthly≤3 days	1,883	718 (38.1%)
Current drinker: occasional 1–4 days/week	952	403 (42.3%)
Current drinker: frequent≥5 days/week	396	175 (44.2%)

Totals may not sum to 100% due to missing data. Percentages represent the proportion of participants within each category who reported exposure to non-alcoholic beers. THB=Thai baht; approximate exchange rate at the time of analysis is 1 USD≈35 THB. Below bachelor's degree=secondary education, vocational certificate/diploma, or associate degree

Factors associated with exposure to non-alcoholic beer

Table 2 presents the results from LR examining factors associated with exposure to non-alcoholic beer. Of 6,459 participants, 79 participants with missing values on education level ($n=27$), occupation ($n=19$), and income ($n=34$) were excluded from the multivariable analysis. Educational attainment was positively associated with exposure. Compared with participants with primary education or below, those with education below a bachelor's degree had higher odds of exposure (adjusted odds ratio [AOR] = 1.36; 95% confidence interval [CI]: 1.17–1.60), as did those with a bachelor's degree or higher (AOR = 1.57; 95% CI: 1.26–1.97).

Residential location was also significantly associated with exposure. Participants residing in Bangkok had substantially higher odds of exposure than those living within municipal areas (AOR = 1.35; 95% CI: 1.11–1.64), whereas living outside urban centres was associated with lower odds of exposure (AOR = 0.78; 95% CI: 0.69–0.88). Regarding occupation, compared with government or private sector employees, labourers/farmers/small traders (AOR = 0.77; 95% CI: 0.66–0.90) and retired or unemployed participants (AOR = 0.53; 95% CI: 0.40–0.70) had significantly lower odds of exposure.

Alcohol consumption status was strongly associated with exposure to non-alcoholic beer. Compared with lifetime abstainers, former drinkers had significantly higher odds of exposure (AOR = 1.75; 95% CI: 1.47–2.09). A graded association was observed across all drinking status categories, with increasing exposure corresponding to greater lifetime and current alcohol use.

Misidentification of non-alcoholic beers as alcoholic products

Among the 2,080 participants who reported exposure to non-alcoholic beer, 1,289 (62.0%) were exposed to one product, whereas 791 (38.0%) were exposed to both Heineken 0.0 and Asahi 0.00 (Supplementary Table 3). Across the 2,080 exposed participants, 85.3% misidentified at least one exposed product as alcoholic beer, while 13.5% identified the product as a malt drink and 1.2% identified it as other types of beverage. LR analyses examining factors associated with misidentification of at least one exposed product as alcoholic beer are shown in Table 3. Missing data on education level ($n=8$), occupation ($n=8$) and income ($n=8$) were excluded from the multivariable analysis.

Among participants who reported exposure to non-alcoholic beer, participants with a bachelor's degree or higher were substantially less likely to misidentify it as alcoholic beer compared with participants with primary education or below (AOR = 0.52; 95% CI: 0.30–0.89). Meanwhile, participants with a monthly income of 5,001–20,000 baht were significantly more likely to misidentify compared with those with higher income (AOR = 1.53; 95% CI: 1.08–2.17). Interestingly, those living in Bangkok (AOR = 2.17; 95% CI: 1.32–3.54) and outside the municipality area (AOR = 1.51; 95% CI: 1.16–1.97) had higher odds of misidentifying non-alcoholic beer as alcoholic compared with those living within the municipality area. Descriptive statistics for these analyses are provided in Supplementary Table 1.

Self-reported desire to drink alcohol of either brand among exposed participants

Among participants who reported exposure to non-alcoholic beer ($n=2,080$), 51.2% indicated some level of self-reported desire to drink alcohol of at least one corresponding brand. Results from CLMs assessing factors associated with reported desire are presented in Table 4. Missing data ($n=24$), same as Table 3, were excluded from the multivariable analysis.

Monthly income was also strongly associated with self-reported alcohol desire: participants in lower-income groups had significantly greater odds of self-reported desire than those earning more than 20,000 THB per month (< 5,000 THB: AOR = 1.51; 95% CI: 1.01–2.24; 5,001–20,000 THB: AOR = 1.44; 95% CI: 1.12–1.87).

Alcohol consumption status exhibited a monotonic pattern across drinking status categories in relation to self-reported alcohol desire. Compared with lifetime abstainers, former drinkers (AOR = 3.30; 95% CI: 2.33–4.68),

Table 2 Factors associated with exposure to non-alcoholic beer products ($n=6,459$ participants)

Variables	Exposure to non-alcoholic beer			
	Univariable analysis		Multivariable analysis	
	COR (95% CI)	*p*-value	AOR (95% CI)	*p*-value
Gender				
Male	**1.44 (1.29, 1.60)***	**<0.001**	1.10 (0.98, 1.24)	0.103
Female (ref.)	1		1	
Age group				
15–19 (ref.)	1		1	
20–29	**1.38 (1.10,1.72)***	**0.006**	1.12 (0.83, 1.51)	0.476
30–39	1.22 (0.98,1.53)	0.083	1.16 (0.82, 1.64)	0.409
≥40	**0.67 (0.54, 0.82)***	**<0.001**	0.95 (0.67, 1.33)	0.749
Marital status				
Single	**1.84 (1.65, 2.06)***	**<0.001**	**1.43 (1.21, 1.68)***	**<0.001**
Others (ref.)	1		1	
Education level				
Primary education or below (ref.)	1		1	
Below bachelor's degree	**1.92 (1.68,2.19)***	**<0.001**	**1.36 (1.17, 1.60)***	**<0.001**
Bachelor's degree or higher	**2.47 (2.09,2.93)***	**<0.001**	**1.57 (1.26, 1.97)***	**<0.001**
Occupation				
Government/private employees (ref.)	1		1	
Labourers/farmers/small traders	**0.54 (0.48, 0.62)***	**<0.001**	**0.77 (0.66, 0.90)***	**<0.001**
Self-employed/professionals	**0.63 (0.49, 0.79)***	**<0.001**	0.78 (0.61, 1.01)	0.058
Retiree/unemployed	**0.32 (0.25, 0.40)***	**<0.001**	**0.53 (0.40, 0.70)***	**<0.001**
Students	**0.78 (0.65, 0.95)***	**0.014**	0.85 (0.63, 1.16)	0.313
Average monthly income (THB)				
<5,000	**0.74 (0.62, 0.90)***	**0.002**	1.26 (0.97, 1.63)	0.085
5,001–20,000	0.99 (0.86, 1.14)	0.845	1.13 (0.96, 1.33)	0.147
>20,000 (ref.)	1		1	
Living area				
Bangkok	**1.24 (1.03, 1.49)***	**0.024**	**1.35 (1.11, 1.64)***	**0.003**
Within municipality (ref.)	1		1	
Outside municipality	**0.81 (0.72, 0.91)***	**<0.001**	**0.78 (0.69, 0.88)***	**<0.001**
Alcohol drinking status				
Lifetime abstainer (ref.)	1		1	
Former drinker	**1.45 (1.23, 1.72)***	**<0.001**	**1.75 (1.47, 2.09)***	**<0.001**
Current drinker: ≤3 days/month	**2.40 (2.04, 2.81)***	**<0.001**	**2.27 (1.91, 2.69)***	**<0.001**
Current drinker: occasional 1–4 days/week	**2.86 (2.38, 3.43)***	**<0.001**	**2.48 (2.03, 3.04)***	**<0.001**
Current drinker: frequent≥5 days/week	**3.08 (2.43, 3.91)***	**<0.001**	**3.34 (2.58, 4.32)***	**<0.001**

Crude odds ratios (CORs), adjusted odds ratios (AORs), and 95% confidence intervals (CIs) are estimated using logistic regression (LR). Multivariable models were fitted on 6,380 participants with complete data on all covariates (79 excluded: education $n=27$, occupation $n=19$, income $n=34$) and were adjusted for all covariates shown. Missing data were regarded as NA (not available) and removed from the analysis. *Statistical significance is defined as $p<0.05$. THB = Thai baht (1 USD ≈ 35 THB). Reference category = 1. Below bachelor's degree = secondary education, vocational certificate/diploma, or associate degree

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Table 3 Factors associated with misidentification of non-alcoholic beer as alcoholic beer among participants exposed to non-alcoholic beer ($n=2,080$ participants)

Variables	Misidentified as alcoholic beer vs. Not misidentified as alcoholic beer			
	Univariable analysis		Multivariable analysis	
	COR (95% CI)	*p*-value	AOR (95% CI)	*p*-value
Gender				
Male	0.85 (0.67, 1.09)	0.204	0.87 (0.66, 1.14)	0.303
Female (ref.)	1		1	
Age group				
15–19 (ref.)	1		1	
20–29	0.97 (0.60, 1.56)	0.893	0.77 (0.42, 1.42)	0.404
30–39	0.80 (0.50, 1.28)	0.342	0.58 (0.29, 1.18)	0.131
≥40	**1.59 (1.00, 2.50)***	**0.048**	1.00 (0.49, 2.04)	0.995
Marital status				
Single	**0.67 (0.53, 0.86)***	**0.002**	0.85 (0.60, 1.19)	0.334
Others (ref.)	1		1	
Education level				
Primary education or below (ref.)	1		1	
Below bachelor's degree	**0.47 (0.31, 0.70)***	**<0.001**	0.64 (0.41, 1.00)	0.050
Bachelor's degree or higher	**0.36 (0.23, 0.57)***	**<0.001**	**0.52 (0.30, 0.89)***	**0.017**
Occupation				
Government/private employees (ref.)	1		1	
Labourers/farmers/small traders	1.08 (0.81, 1.43)	0.596	**0.70 (0.50, 0.97)***	**0.033**
Self-employed/professionals	1.38 (0.77, 2.47)	0.283	1.47 (0.79, 2.73)	0.222
Retiree/unemployed	**4.39 (1.75, 11.03)***	**0.002**	2.24 (0.84, 5.99)	0.108
Students	0.77 (0.52, 1.13)	0.182	0.60 (0.33, 1.09)	0.094
Average monthly income (THB)				
<5,000	**1.56 (1.00, 2.42)***	**0.048**	1.54 (0.84, 2.82)	0.162
5,001–20,000	**1.49 (1.10, 2.02)***	**0.010**	**1.53 (1.08, 2.17)***	**0.016**
>20,000 (ref.)	1		1	
Living area				
Bangkok	**2.17 (1.37, 3.46)***	**0.001**	**2.17 (1.32, 3.54)***	**0.002**
Within municipality (ref.)	1		1	
Outside municipality	**1.52 (1.17, 1.96)***	**0.002**	**1.51 (1.16, 1.97)***	**0.002**
Alcohol drinking status				
Lifetime abstainer (ref.)	1		1	
Former drinker	1.17 (0.76, 1.80)	0.467	1.09 (0.70, 1.72)	0.699
Current drinker: ≤3 days/month	0.89 (0.60, 1.32)	0.570	1.01 (0.66, 1.53)	0.979
Current drinker: occasional 1–4 days/week	0.67 (0.44, 1.01)	0.058	0.84 (0.53, 1.34)	0.463
Current drinker: frequent ≥ 5 days/week	1.88 (0.99, 3.56)	0.054	**2.05 (1.04, 4.04)***	**0.038**

Crude odds ratios (CORs), adjusted odds ratios (AORs), and 95% confidence intervals (CIs) are estimated using logistic regression (LR). Multivariable models were fitted on 2,056 participants with complete data on all covariates (24 excluded: education $n=8$, occupation $n=8$, income $n=8$) and were adjusted for all covariates shown. Missing data were regarded as NA (not available) and removed from the analysis. *Statistical significance is defined as $p<0.05$. THB = Thai baht (1 USD ≈ 35 THB). Reference category = 1. Below bachelor's degree = secondary education, vocational certificate/diploma, or associate degree

Table 4 Factors associated with self-reported desire to drink alcohol among participants exposed to non-alcoholic beer (n=2,080 participants)

Variables	Self-reported desire to drink alcohol			
	Univariable analysis		Multivariable analysis	
	COR (95% CI)	p-value	AOR (95% CI)	p-value
Gender				
Male	**1.28 (1.09, 1.51)***	**0.003**	0.93 (0.78, 1.12)	0.464
Female (ref.)	1		1	
Age group (years)				
15–19 (ref.)	1		1	
20–29	**1.51 (1.08, 2.12)***	**0.017**	0.88 (0.55, 1.40)	0.589
30–39	1.27 (0.90, 1.78)	0.173	0.82 (0.49, 1.39)	0.466
≥40	1.22 (0.89, 1.67)	0.219	0.90 (0.53, 1.51)	0.676
Marital status				
Single	1.14 (0.97, 1.35)	0.120	1.12 (0.88, 1.42)	0.357
Others (ref.)	1		1	
Education level				
Primary education or below (ref.)	1		1	
Below bachelor's degree	1.00 (0.81, 1.24)	0.986	0.96 (0.74, 1.23)	0.730
Bachelor's degree or higher	**1.34 (1.03, 1.74)***	**0.027**	1.34 (0.96, 1.87)	0.086
Occupation				
Government/private employees (ref.)	1		1	
Labourers/farmers/small traders	0.86 (0.71, 1.04)	0.127	1.10 (0.87, 1.39)	0.423
Self-employed/professionals	**0.68 (0.47, 0.97)***	**0.035**	0.81 (0.55, 1.19)	0.281
Retiree/unemployed	0.86 (0.60, 1.23)	0.421	1.28 (0.83, 1.98)	0.271
Students	0.77 (0.58, 1.02)	0.072	1.15 (0.73, 1.79)	0.550
Average monthly income (THB)				
<5,000	1.14 (0.85, 1.53)	0.387	**1.51 (1.01, 2.24)***	**0.042**
5,001–20,000	**1.26 (1.01, 1.58)***	**0.041**	**1.44 (1.12, 1.87)***	**0.005**
>20,000 (ref.)	1		1	
Living area				
Bangkok	0.75 (0.56, 1.00)	0.052	0.74 (0.54, 1.00)	0.053
Within municipality (ref.)	1		1	
Outside municipality	**1.21 (1.01, 1.45)***	**0.040**	1.19 (0.98, 1.44)	0.073
Alcohol drinking status				
Lifetime abstainer (ref.)	1		1	
Former drinker	**3.21 (2.30, 4.48)***	**<0.001**	**3.30 (2.33, 4.68)***	**<0.001**
Current drinker: ≤3 days/month	**6.07 (4.41, 8.37)***	**<0.001**	**6.90 (4.92, 9.67)***	**<0.001**
Current drinker: 1–4 days/week	**6.96 (4.95, 9.80)***	**<0.001**	**8.40 (5.80, 12.18)***	**<0.001**
Current drinker: frequent≥5 days/week	**8.15 (5.44, 12.21)***	**<0.001**	**9.64 (6.25, 14.85)***	**<0.001**
Misidentification				

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Table 4 (continued)

Variables	Self-reported desire to drink alcohol			
	Univariable analysis		Multivariable analysis	
	COR (95% CI)	*p*-value	AOR (95% CI)	*p*-value
Misidentified as alcoholic beer	**2.10 (1.63, 2.69)***	**<0.001**	**2.31 (1.77, 3.01)***	**<0.001**
Not misidentified as alcoholic beer	1		1	

Model fit: AIC = 4051.2; log-likelihood = −2003.6 (22 df); likelihood-ratio test against the null model $\chi^2 = 286.7$, df = 20, $p < 0.001$; $n = 2{,}056$ complete cases of 2,080 exposed participants. Crude odds ratios (CORs), adjusted odds ratios (AORs), and 95% confidence intervals (CIs) are estimated using cumulative link (ordinal logistic regression) models (CLMs). Multivariable models were adjusted for all covariates shown. Missing data were regarded as NA (not available) and removed from the analysis. *Statistical significance is defined as $p < 0.05$. THB = Thai baht (1 USD ≈ 35 THB). Reference category = 1. Below bachelor's degree = secondary education, vocational certificate/diploma, or associate degree

participants who reported drinking≤3 days/month (AOR=6.90; 95% CI: 4.92–9.67), those drinking 1–4 days/week (AOR=8.40; 95% CI: 5.80–12.18), those drinking at least 5 days per week (AOR=9.64; 95% CI: 6.25–14.85) had markedly higher odds of being in a higher self-reported alcohol desire category.

Participants who misidentified at least one exposed product as alcoholic beer had higher odds of being in a higher self-reported alcohol desire category than those who did not misidentify the product as alcoholic beer (AOR=2.31; 95% CI: 1.77–3.01). Descriptive statistics for these analyses are presented in Supplementary Table 2.

Sensitivity analyses

In the sensitivity analysis using product-specific responses, misidentification as alcoholic beer remained associated with higher odds of desire for the alcoholic beverage of the same brand for Heineken 0.0 (AOR=1.34; 95% CI: 1.06–1.70), although the association was weaker than in the pooled analysis (AOR=2.31; 95% CI: 1.77–3.01). In contrast, no association was observed for Asahi 0.00 (AOR=0.96; 95% CI: 0.65–1.43). Associations with exposure were consistent across pooled and product-specific models (Supplementary Tables 3–8).

The proportional-odds assumption held for gender, age group, marital status, education and occupation (all $p>0.15$), but was not supported for income (LRT=15.24, df=2, $p<0.001$), residential area (LRT=11.57, df=2, $p=0.003$), drinking status (LRT=17.31, df=4, $p=0.002$), or misidentification (LRT=10.76, df=1, $p=0.001$). The model was refitted as a partial proportional-odds model allowing threshold-specific effects for income, residential area and drinking status. The association between misidentification and higher desire was essentially unchanged (AOR=2.26; 95% CI: 1.74–2.95, versus AOR=2.31; 95% CI: 1.77–3.01 under full proportional odds), and model fit improved (AIC 4027.3 versus 4051.2). Misidentification was retained as a proportional-odds term because allowing it to vary across thresholds yielded associations in the same direction at each cut-point (OR=2.52 for any desire versus none; OR=1.75 for moderate-to-high versus lower); the single proportional-odds estimate therefore averages two effects of differing magnitude rather than masking a reversal.

Discussion

This study provides timely, policy-relevant evidence on public exposure to non-alcoholic beer products in Thailand, where regulation of alcohol marketing remains highly salient. Approximately 32.2% of participants reported having seen either Heineken 0.0 or Asahi 0.00 within the preceding 3 months, with substantially higher exposure among current drinkers (40.1%). Among those exposed, more than four in five participants misidentified at least one exposed product as alcoholic beer, and half expressed some degree of self-reported desire for alcohol. Because desire was measured only among exposed participants and without a pre-exposure baseline, these findings describe the level of desire reported within this exposed group and cannot imply any inference about whether the past exposure influenced that desire.

Exposure to non-alcoholic beer was more common among individuals with higher educational attainment, residents of Bangkok, and frequent drinkers, with exposure increasing across drinking-frequency categories. These patterns are consistent with previous research showing that non-alcoholic products are often associated with urban and more educated consumers [20], and that drinking experience is associated with greater exposure to alcohol advertising in Thailand [21]. Previous evidence also suggests that the purchase and consumption of non-alcoholic beer are more common among individuals who regularly consume alcohol [22]. Taken together, these findings raise the possibility that existing drinkers may represent an important consumer group for non-alcoholic beer and that industry marketing may preferentially reach this group. However, this study did not measure marketing strategies, advertising placement, marketing expenditure or industry intent, and therefore cannot determine whether the observed exposure pattern reflects deliberate industry targeting. Greater reported exposure among drinkers may also reflect greater attentiveness to beer branding, familiarity with the products

or parent brands, selective recall, or differences in media use. From a harm reduction perspective, non-alcoholic beer may have potential as a substitution option for current drinkers; however, the effectiveness and unintended consequences of such substitution require further evaluation.

Misidentification of at least one exposed product as an alcoholic beer was widespread. This may be partly explained by the close visual similarity between the non-alcoholic products and their alcoholic counterparts, although this explanation was not directly tested in the present study. Other factors may also contribute, including attention to alcohol-content information on product labels, familiarity with the parent alcoholic brand, or limited familiarity with the non-alcoholic beverage category. Interestingly, misidentification was significantly associated with education level, occupation, income, and residential area. Compared with participants living within municipality areas, those in Bangkok and those outside municipality areas were both more likely to misidentify non-alcoholic beer as alcoholic beer, despite showing different patterns of exposure to non-alcoholic beer itself. These differences may reflect distinct mechanisms. Among Bangkok residents, greater exposure to alcohol marketing may result in more frequent exposure to the parent alcoholic brand's logo and packaging, potentially facilitating rapid association between non-alcoholic products and their alcoholic counterparts. Among residents outside municipality areas, lower familiarity with the non-alcoholic category may make distinguishing visual cues, such as 'alcohol-free' or 'Alc. 0.00%', less salient. These interpretations are speculative and require further investigation.

The question remains whether the non-alcoholic beer may have different implications for individuals who have previously consumed alcohol but are no longer drinking. In our data, among exposed participants, former drinkers had higher odds of reporting a higher alcohol desire category than lifetime abstainers. This finding may indicate that individuals with prior drinking experience respond differently to alcohol-related product cues; however, the cross-sectional design does not allow us to determine whether exposure to non-alcoholic beer contributed to this higher reported desire. Previous research has suggested that alcohol-related cues may evoke subjective desire to drink, although evidence regarding whether non-alcoholic beer or low-alcohol beverages contribute to relapse is mixed [23, 24]. Former drinkers are also a heterogeneous group, and our dataset contained no information on alcohol dependence, treatment history, recovery status, duration of abstinence beyond 12 months, or reasons for stopping alcohol use. Therefore, any interpretation linking the observed higher alcohol desire among former drinkers to relapse vulnerability or psychological triggering remains hypothetical. Further research, particularly longitudinal and clinical studies, is needed to determine whether exposure to non-alcoholic beer is associated with alcohol craving or relapse-related outcomes among different groups of former drinkers.

Heineken 0.0 and Asahi 0.00 were selected as exemplars of non-alcoholic beer products marketed in Thailand, based on their market presence and their close visual similarity to their alcoholic counterparts. The product-specific analyses showed that the two products did not behave alike: the association between misidentification and self-reported desire was evident for Heineken 0.0, but not for Asahi 0.00. Because Heineken 0.0 accounted for 1,786 of 2,080 exposed participants, the pooled estimates among exposed participants largely reflect that product. These findings therefore characterise these two products, rather than non-alcoholic beer as a category, and may not extend to products with different packaging or market presence.

Finally, participants who misidentified at least one exposed product as alcoholic beer were significantly more likely to report a higher alcohol desire category than those who did not misidentify the product as alcoholic beer. Within this exposed group, therefore, higher reported desire was associated with perceiving the product as an alcoholic beverage rather than simply with exposure to the product. This finding suggests that the perception of the product as an alcoholic beverage may be relevant to alcohol-related desire, although the cross-sectional design and absence of a pre-exposure measure prevent us from determining whether misidentification contributes causally to alcohol desire.

Ultimately, both misidentification and the elevated alcohol desire reported raise concerns regarding the unintentional normalisation of alcohol consumption, particularly among vulnerable populations such as youth and individuals in recovery [14]. These findings support concerns raised in prior studies regarding surrogate marketing and brand extension strategies, in which non-alcoholic beverages leverage familiar branding to inadvertently promote their alcoholic counterparts, a practice documented in jurisdictions with stringent alcohol advertising

restrictions [25–27]. Together, these results highlight the challenges of enforcing alcohol marketing regulations when visual cues can bypass restrictions on alcohol advertising, underscoring the importance of considering cue-driven effects alongside informational content when developing alcohol marketing policies.

Strengths and limitations

A major strength of this study is the use of data from a survey employing a stratified multistage sampling design covering all regions of Thailand, providing broader geographic and demographic coverage than the convenience samples typical of this literature. The descriptive estimates are presented as unweighted sample proportions and are not intended as population-level prevalence estimates. In addition, this study assesses misidentification using images of non-alcoholic products, instead of self-reported awareness, providing a more objective test of visual misidentification, and traces the pathway from exposure to misidentification and desire, rather than examining an isolated outcome. Further, given the limited empirical literature on non-alcoholic beverages in low- and middle-income countries, this study provides novel and important insights into patterns of exposure to non-alcoholic beer products in a large national sample in Thailand.

Some limitations include: (1) The cross-sectional design precludes causal inference and does not allow for the determination of temporal ordering between exposure to non-alcoholic beer branding and subsequent alcohol desire. (2) Alcohol desire was assessed using a single self-reported post-exposure item ('How much do you want to drink the alcoholic beverage of the same brand afterwards?') without a pre-exposure baseline; the subjective interpretation of desire may vary across drinking histories, limiting comparability between lifetime abstainers and individuals with prior alcohol use. Because self-reported desire was measured only among exposed participants and without a pre-exposure baseline, the study cannot estimate whether exposure increases desire; hence the desire analyses are descriptive of, and internal to, the exposed group. (3) The study focused on self-reported alcohol-related desire among exposed participants but did not assess desire or intention to consume non-alcoholic beverages themselves. Consequently, potential substitution or harm reduction effects could not be evaluated, and the findings reflect one specific alcohol-related cognitive response rather than the net behavioural impact of exposure. (4) Exposure was self-reported and thus subject to recall and misclassification bias; the visual similarity between non-alcoholic and alcoholic beers may have contributed to difficulty distinguishing the products. (5) Residual confounding by unmeasured factors, such as severity of prior alcohol dependence or duration of abstinence, along with restriction to two product brands and the Thailand-specific regulatory environment, may limit the generalisability of the findings. (6) Although the study employed a national sampling design, the sampling weights were available but not applied or adjusted for in the multivariable models. The regression results should therefore be interpreted as associations observed within this sample rather than as population-adjusted estimates. (7) The proportional-odds assumption was not supported for four covariates in the cumulative link models. A partial proportional-odds model allowing threshold-specific effects for income, residential area, and drinking status, while retaining misidentification as a proportional term, yielded materially unchanged estimates for the association between misidentification and higher desire, but the single odds ratios reported for those covariates should be read as averages across the category thresholds.

Implications and prospects

Our findings highlight concerns regarding surrogate marketing. Although non-alcoholic beer products do not exceed legally defined alcohol-content thresholds, they differ substantially from conventional soft drinks in both appearance and sensory characteristics. Similarly, previous research has demonstrated that adolescents often classify alcohol-free beverages as alcoholic rather than as soft drinks [28]. Despite this, regulatory approaches to non-alcoholic products remain inconsistent and under active debate globally, particularly with respect to advertising and availability [29]. Clear definition and classification of non-alcoholic beverages as a distinct product category, accompanied by tailored marketing and labelling restrictions, may be warranted to mitigate unintended alcohol-related harm.

Given the study's focus on mechanisms relevant to surrogate marketing, analyses were limited to exposure to non-alcoholic products rather than consumption. Future research should therefore examine the prevalence and patterns of non-alcoholic beverage consumption, drinking motivations, and substitution behaviours to better understand their overall impact on alcohol use trajectories. Further, comparative studies across countries could elucidate how differing regulatory frameworks shape marketing practices and consumer responses to non-alcoholic products.

Conclusions

In this sample, 32.2% of all participants and 40.1% of current drinkers reported recent exposure to non-alcoholic beer products. Among exposed participants, 85.3% misidentified at least one product as alcoholic beer, while 51.2% reported some degree of alcohol-related desire. Exposure was more common among individuals with higher educational attainment, residents of Bangkok, and frequent drinkers. Among exposed participants, self-reported alcohol desire was higher among individuals with lower income, frequent drinkers, and former drinkers. However, these associations should not be interpreted as evidence that non-alcoholic beer exposure increases alcohol craving or relapse risk, given the cross-sectional design and the absence of information on former drinkers' dependence, treatment, recovery, and abstinence histories. Given the unweighted nature of the descriptive estimates and the lack of adjustment for the complex survey design in the regression analyses, these findings should be interpreted as sample-based associations rather than population-representative estimates. These findings support consideration of evidence-informed regulatory frameworks governing the marketing, packaging, and branding of non-alcoholic beverages. Such regulatory approaches may benefit from explicitly considering the potential for surrogate marketing and protecting vulnerable populations from unintended alcohol-related harm.

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Authors' contributions P.V. conceptualized the study, administered the project, and drafted the manuscript. S.A., S. Lappharat, S. Liangpunsakul, J.N., and A.P. supervised the project and reviewed and edited the manuscript. N.P. performed the data analysis. M.S. conducted the data analysis and was a major contributor to writing the manuscript. All authors read and approved the final manuscript.

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Data availability The dataset was obtained with permission from the Centre for Alcohol Studies (https://cas.or.th/). Owing to ethical limitations governing the dissemination of a deidentified dataset, it is not permissible to share the data publicly. Interested researchers are welcome to contact the corresponding author, Monsicha Sittisombut, to facilitate discussions regarding their requests for confidential data access. Furthermore, researchers can contact the Centre for Alcohol Studies directly via polathep.v@psu.ac.th to obtain the dataset.

Declarations

Ethics approval and consent to participate The study was conducted in accordance with the Declaration of Helsinki. Data collection was conducted anonymously, and verbal informed consent was obtained from all participants prior to participation. Ethical approval was granted by the Human Research Ethics Committee of the Faculty of Medicine, Prince of Songkla University (REC. 68-220-9-1). Under the policy of the ethics committee, separate parental or guardian consent together with child assent is required for participants aged 7 to under 13 years; participants aged 13 years and above provide their own informed consent. Verbal informed consent was therefore obtained directly from participants aged 15–17 years.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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