

ORIGINAL ARTICLE

Halving Sugar Intake Increases Sweet Taste Intensity in Thai Adults with Moderate to High Sugar Consumption: A Randomized Controlled Trial

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ABSTRACT

Objectives: To determine whether a 50% reduction in daily sugar intake increases sweet taste intensity among Thai adults, and whether changes in taste perception and dietary sugar intake persist after the restriction period ends.

Materials and Methods: A randomized, double-blind, controlled trial was conducted over 12 weeks among 52 healthy Thai adults. Participants were assigned to either a sugar-reduction group instructed to halve their daily sugar intake ($n = 25$) or a control group that maintained their usual diet ($n = 27$). Sweet taste intensity was evaluated using the general labeled magnitude scale at baseline, week 16 (end of restriction), and week 24 (after resumption of regular diet). The primary outcome was the proportion of participants with increased sweet taste intensity at week 16, while secondary outcomes included sweet taste intensity at week 24 and changes in dietary sugar intake.

Results: At week 16, significantly more participants in the intervention group reported heightened sweet taste intensity compared with the control group (64% vs 33.3%, $p = 0.027$). After participants resumed their usual diets at week 24, this difference was no longer statistically significant (44% vs 38.5%, $p = 0.688$). Dietary sugar intake significantly decreased during the intervention period, but partially rebounded after restriction was lifted. No significant between-group differences were observed in total energy intake or anthropometric outcomes.

Conclusion: A 12-week 50% sugar-reduction intervention increased sweet taste intensity. However, both taste perception and dietary behaviors partially reverted after the restriction was lifted, suggesting that sensory adaptation alone may not sustain long-term change.

Keywords: dietary modification, dietary sugars, noncommunicable diseases, sugar reduction, taste perception

INTRODUCTION

Noncommunicable diseases (NCDs), including cardiovascular disease, diabetes, hypertension, and cancer, are the leading causes of mortality worldwide, accounting for more than 40 million deaths each year.¹ In Thailand, NCDs are responsible for over three-quarters of all deaths, with nearly 400,000 deaths reported annually.^{2,3} Excess dietary sugar intake, particularly from sugar-sweetened beverages, represents a major modifiable risk factor.⁴ Although global sugar consumption averages 22.1 kg per person annually,⁵ Thai adults consume about 25 teaspoons per day, nearly four times the WHO recommendation, despite the implementation of a national sugar tax.^{6,7}

Reducing dietary sugar intake is a cornerstone of NCD prevention. WHO guidelines recommend limiting sugar intake to < 10% of daily energy, with a conditional target of < 5%.⁸ Beyond its direct caloric effects, gradual sugar reduction may recalibrate sweet taste perception, promoting lower-sugar habits. Controlled trials in Western populations have shown that reducing dietary sugar increases sweet taste intensity,⁹ potentially mediated by up regulation of sweet taste receptors such as T1R2/T1R3.¹⁰ However, the persistence of this adaptation once restriction is lifted remains uncertain and evidence from high-sugar environments such as Thailand is scarce.

This study aimed to evaluate whether a 50% reduction in daily sugar intake among Thai adults increases sweet taste intensity, whether the effect persists after restriction ends, and whether the intervention alters dietary sugar intake.

MATERIALS AND METHODS

This study was conducted as a randomized controlled trial among healthy Thai adults between October 2024 and June 2025. The study protocol, titled "Alteration of sweet taste perception after 50% reduction of sweet food and beverage consumption for 12 weeks, compared with unmodified diet," was approved by the Siriraj Institutional Review Board (COA no. Si 456/2024) and registered at ClinicalTrials.gov (NCT06678386). All participants provided written informed consent prior to enrollment, and all procedures adhered to the Declaration of Helsinki and Good Clinical Practice guidelines.

Eligible participants were adults aged 18–59 years with fasting blood glucose < 126 mg/dL or HbA1c < 6.5% within the previous six months, and a Sweet

Food Consumption Behavior Questionnaire score ≥ 10 , indicating high risk of excessive sweet intake.¹¹ Individuals with uncontrolled chronic disease, severe illness, pregnancy, daily medication use (except contraceptives or vitamins), or $\geq 10\%$ unintentional weight change within the past three months were excluded.

Randomization was performed using computer-generated blocks of four, with assignment concealed in sealed opaque envelopes until baseline assessment. Due to the nature of the intervention, dietitians and participants were not blinded to group allocation. Sweet taste testing, however, was conducted under double-blind conditions. Sucrose solutions (5%, 10%, 15%, 20%, and water) were coded and presented in random order by independent staff, ensuring both participants and assessors remained unaware of solution concentrations during testing.

Participants in the intervention group received individualized dietary counseling at week 4, which included tailored feedback on habitual dietary patterns and strategies to reduce added sugar in food and beverages. From weeks 5 to 16, participants were instructed to reduce daily sugar intake by 50%. Compliance was assessed through 3-day food records and photographic dietary logs submitted online at weeks 1, 5, 10, 16, and 24. Control participants were instructed to maintain their usual diets for the duration of the intervention. From weeks 17 to 24, both groups resumed unrestricted dietary intake.

The primary outcome was the proportion of participants who demonstrated increased sweet taste intensity at week 16 compared with baseline. Secondary outcomes included the proportion with increased sweet taste intensity at week 24, changes in daily sugar intake, anthropometric measures (weight, body mass index (BMI), waist circumference), and self-reported sweet consumption behaviors. Sweet taste intensity was assessed using the general labeled magnitude scale (gLMS)^{12,13}; the scale template is provided in the Supplementary Material, with video instructions provided before each testing session. Dietary sugar intake was evaluated using 3-day food records corroborated by participant-submitted photographs.

The sample size was calculated to detect a 30% increase in sweet taste intensity in the intervention group versus a 2% increase in the control group, assuming $\alpha = 0.05$ and power = 80%. A minimum of 26 participants per group was required, and the target sample was increased to 58 to account for an

anticipated 10% attrition rate.

Baseline characteristics were compared using independent T-tests for continuous variables and Chi-square tests for categorical variables. Proportions of participants with increased sweet taste intensity at weeks 16 and 24 were analyzed using Chi-square tests. Repeated-measure continuous outcomes, including daily sugar intake, were analyzed using generalized estimating equations with an exchangeable correlation structure to account for within-subject correlations. Bonferroni correction was applied for multiple comparisons. Analyses followed a modified intention-to-treat approach, excluding only those later identified as ineligible after randomization. Results are presented as estimated means with standard errors, with statistical significance defined as $p < 0.05$.

RESULTS

A total of 76 individuals were screened, of whom 58 were randomized (28 in the intervention group and 30 in the control group). At the primary endpoint, 55 participants completed follow-up, with minimal attrition: one due to pregnancy and two lost to follow-up. By the secondary endpoint, 54 participants completed the study, with one participant relocating. Three participants who reported daily medication use were excluded prior to analysis, resulting in a final analysis set of 52 participants. (Figure 1)

Baseline characteristics of the analysis set ($n = 52$) are summarized in Table 1. The mean age was 33.5 ± 7.5 years, and the mean BMI was 23.7 ± 4.0 kg/m², with the majority being female (94.2%). No significant differences were observed between groups

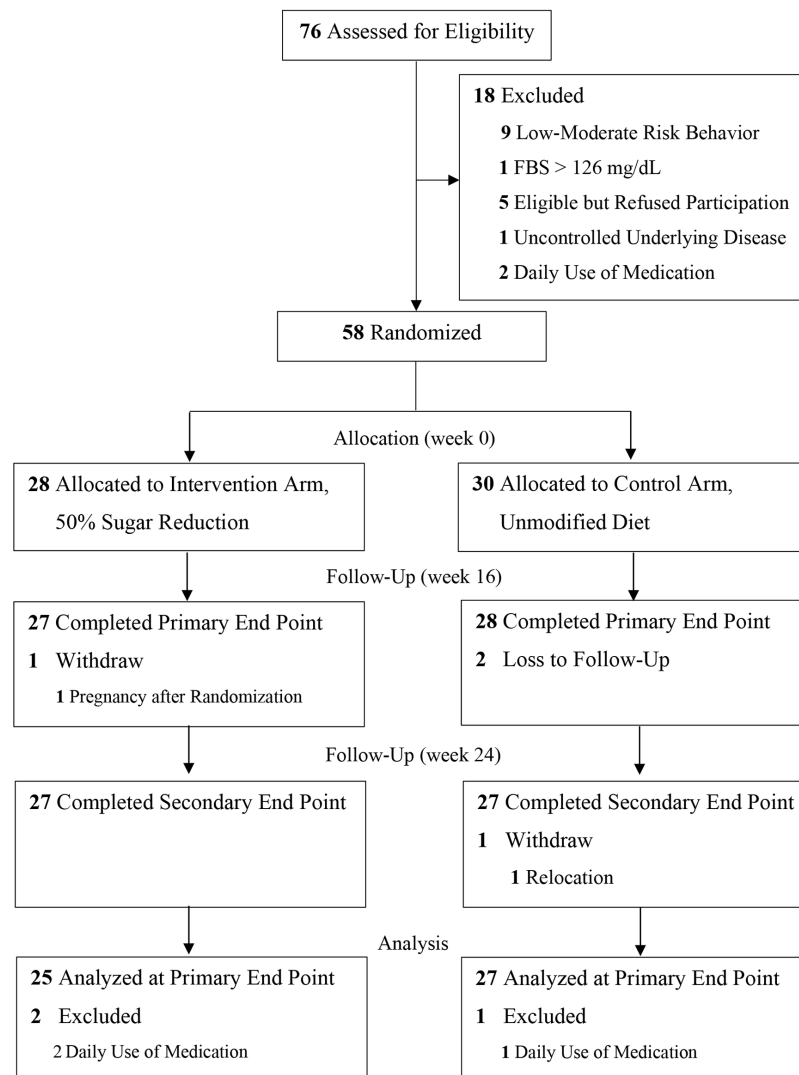


Figure 1 Study Flow Diagram of Participant Recruitment, Randomization, and Follow-Up

Table 1 Baseline Characteristics of Participants

Variables	Control (n = 27)		Intervention (n = 25)		P-value ^a
	n	%	n	%	
Sex					0.507
Female	26	96.3	23	92.0	
Male	1	3.7	2	8.0	
Age, years, mean $\pm$ SD	33.37 $\pm$ 7.54		33.76 $\pm$ 7.47		0.852
BW, kg, mean $\pm$ SD	60.32 $\pm$ 11.30		60.66 $\pm$ 10.78		0.911
BMI, kg/m ² , mean $\pm$ SD	24.15 $\pm$ 4.20		23.32 $\pm$ 3.81		0.457
WC, cm, mean $\pm$ SD	81.41 $\pm$ 9.90		80.36 $\pm$ 8.61		0.687
FBS, mg/dL, mean $\pm$ SD	91.63 $\pm$ 8.40		94.32 $\pm$ 6.32		0.201
Underlying disease ^b					0.515
Yes	5	18.5	3	12.0	
No	22	81.5	22	88.0	
Smoking					0.956
Quit	1	3.7	1	4	
Never use	26	96.3	24	96.0	
Alcohol drinking					0.701
Current use	7	25.9	6	24.0	
Quit	4	14.8	6	24.0	
Never use	16	59.3	13	52.0	
Exercise ^c					0.186
Yes	4	14.8	1	4.0	
No	23	85.2	24	96.0	
Sweet consumption behavior ^d					0.884
Very high risk behavior	1	3.7	1	4.0	
High risk behavior	19	70.4	16	64.0	
Moderate risk behavior	7	25.9	8	32.0	

Abbreviations: BMI, body mass index; BW, body weight; cm, centimeter; dL, deciliter; FBS, fasting blood sugar; kg, kilogram; m², square meter; mg, milligrams; n, number; SD, standard deviation; WC, waist circumference

^a Statistically significant at $p < 0.05$ (independent T-test for continuous variables; Chi-square test for categorical variables).

^b Self-reported underlying diseases: participants reported having anemia, polycystic ovarian syndrome, allergic rhinitis or gastroesophageal reflux, and were taking vitamins, oral contraceptives, or intermittent medications to relieve symptoms.

^c Exercise: "Yes" indicates ≥ 150 minutes/week; "No" indicates < 150 minutes/week

^d Sweet consumption behavior was assessed using the sweet food consumption behavior questionnaire: appropriate intake (score < 5), moderate risk (6–9), high risk (10–13), very high risk (14–15). All participants scored ≥ 10 during eligibility screening; scores may have changed at baseline assessment.

in age, anthropometric measures (BMI, body weight, waist circumference), fasting blood sugar, or sweet consumption behaviors (all $p > 0.05$).

At week 16, a significantly greater proportion of participants in the intervention group reported increased sweet taste intensity compared with the control group (64% vs 33.3%, $p = 0.027$; **Table 2**). By week 24,

after both groups had resumed their usual diets, the difference was no longer significant (44% vs 38.5%, $p = 0.688$). The distribution of stepwise changes in sweet taste intensity at weeks 16 and 24 is shown in **Table 3**.

Daily sugar calorie intake decreased significantly in the intervention group during the 12-week intervention

Table 2 Proportion of Participants by Change in Sweet Taste Intensity

Change in Sweet Taste Intensity	Control		Intervention		P-value
	n	%	n	%	
At week 16					
Increased ^a	9	33.3	16	64.0	0.027
Not increased	18	66.7	9	36.0	
At week 24					
Increased ^a	10	38.5	11	44.0	0.688
Not increased	16	61.5	14	56.0	

^a Proportion of participants with increased sweet taste intensity at week 16 (primary outcome) and at week 24 (secondary outcome) compared with baseline. Statistical significance was assessed using Chi-square test ($p < 0.05$).

Table 3 Distribution of Stepwise Changes in Sweet Taste Intensity at Weeks 16 and 24 by Study Group

Change in Sweet Taste Intensity	Control		Intervention	
	n	%	n	%
At week 16				
3-steps increase	1	3.7	1	4.0
2-steps increase	1	3.7	1	4.0
1-step increase	7	25.9	8	32.0
No change	14	51.9	14	56.0
1-step decrease	3	11.1	1	4.0
2-steps decrease	1	3.7	1	4.0
At week 24				
3-steps increase	1	3.8	0	0
2-steps increase	7	26.9	4	16.0
1-step increase	8	30.8	7	28
No change	7	26.9	11	45.8
1-step decrease	2	7.7	1	4.0
2-steps decrease	0	0	2	0

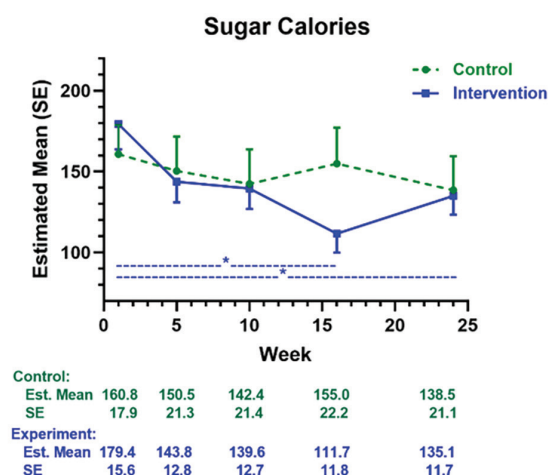
and partially rebounded after diet normalization (**Figure 2**). Within-group analysis revealed significant reductions at both week 16 ($p < 0.001$) and week 24 ($p = 0.019$) relative to baseline. Between-group comparisons revealed the largest difference at week 16, with the intervention group consuming 43.26 kcal/day less than the control group ($p = 0.085$). By week 24, this difference was minimal (-3.39 kcal/day, $p = 0.888$).

Additional outcomes, including total energy intake, anthropometric data, and self-reported sweet consumption behaviors, are provided in the supplementary materials. The estimated mean difference in total energy intake at week 16 was -17.52 kcal/day ($p = 0.803$). Both groups reported significant within-group reductions

in sweet consumption behaviors at weeks 16 and 24 compared with baseline, however, between-group differences were not statistically significant.

DISCUSSION

This trial found that reducing dietary sugar intake by 50% for 12 weeks significantly increased perceived sweet taste intensity. These findings suggest that real-world sugar reduction can shift sensory sensitivity to sweetness. However, once dietary restriction ended, the effect diminished rapidly, indicating that sensory adaptation is short-lived in the absence of continued reinforcement.



Abbreviations: Est mean, estimated mean; SE, standard error

Figure 2 Estimated Mean Daily Sugar Calories from Baseline to Week 24 by Study Group

Our results are consistent with those of Wise et al.,⁹ who reported increased sweet taste perception following sugar reduction in a Western population. The transient reversal observed in our study mirrors that finding, supporting the notion that sensory adaptation is robust but temporary. Notably, our trial extends this evidence to an Asian population regularly exposed to a high-sugar food environment with hidden sugars in sauces, street foods, and beverages,⁶ demonstrating the generalizability of this phenomenon across cultural contexts.

The novelty of our study lies in its focus on participants with high sugar exposure. Despite this challenging baseline, participants achieved measurable sensory adaptation, suggesting that even partial reduction can influence perception. However, although participants were instructed to reduce sugar intake by 50%, the observed reduction in daily sugar calories was lower than planned, reflecting real-world adherence challenges. This partial adherence may have attenuated both the magnitude and durability of sensory adaptation, highlighting the potential importance of continued behavioral support and follow-up to sustain dietary change. Whether greater or longer reductions in sugar intake could lead to more sustained changes in sweet taste perception or delay rebound remains unclear and warrants further investigation.

Strengths of this study include its randomized

design, blinded outcome assessment, and use of validated dietary and taste measures. The intervention reduced sugar intake by 43 kcal/day (11 g, 3 teaspoons), which could yield health benefits if sustained. Nonetheless, total caloric intake did not change, suggesting caloric compensation from other nutrients, a pattern reported in prior literature.¹⁴ Limitations include modest sample size, predominance of female participants (94%), reliance on self-reported dietary data, and short intervention period. Additionally, a modified intention-to-treat analysis was performed to avoid bias from ineligible participants.

CONCLUSION

Halving sugar intake for 12 weeks increased sweet taste intensity. However, both taste perception and dietary behaviors partially reverted after the restriction was lifted, suggesting that sensory adaptation alone may not sustain long-term dietary change.

Conflict of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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 Writing – review & editing: T.N.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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