Original Paper

National Nutrition Week Engagement and Behavioral Adherence to Dietary Recommendations Across BMI Categories in Chinese Adults: Cross-Sectional Study

Qingshuang Wei[1*], MPH; Kui Yao[2*], PhD; Shangjin Liu[1], MA; Lin Wang[3], PhD; Li Xiao[4], PhD; Fan Wang[5,6], PhD

[1]School of Public Health, Fudan University, Shanghai, China

[2]Chinese Center for Disease Control and Prevention (Chinese Academy of Preventive Medicine), Beijing, China

[3]College of Humanities and Development, China Agricultural University, Beijing, China

[4]Publicity Division, Chinese Center for Health Education, Beijing, China

[5]Fudan Development Institute, Fudan University, Shanghai, China

[6]Health Communication Institute, Fudan University, Shanghai, China, Shanghai, China

[*]these authors contributed equally

Corresponding Author:
Fan Wang, PhD
Fudan Development Institute, Fudan University
Think Tank Building
220 Handan Road
Shanghai, 200433
China
Phone: 86 13817285663
Email: wangfan512@126.com

Abstract

Background: Nutrition communication campaigns are an important public health strategy for promoting adherence to dietary recommendations. National Nutrition Week (NNW) is a major nationwide nutrition education campaign in China that promotes dietary recommendations through diverse communication channels and public activities. However, evidence linking public engagement with NNW to behavioral adherence remains limited, including whether these associations differ across population groups.

Objective: This study examined associations between NNW engagement and behavioral adherence, focusing on engagement mode, channel breadth, and activity diversity. We further assessed nonlinear patterns, differences across BMI categories, and associations with NNW-related cognition, attitudes, and perceived environmental support.

Methods: A nationwide cross-sectional online survey was conducted from September 2025 to April 2026, with 5136 adults aged 18 to 64 years included in the primary analysis. Engagement was assessed by engagement mode, online and offline channel breadth, overall channel breadth, and activity diversity. Behavioral adherence was measured using a study-specific 50-item index. Multivariable linear regression, restricted cubic splines, exploratory segmented regression, and hierarchical regression were used. Sensitivity analyses assessed alternative spline knot specifications, inclusion of older adults, exclusion of the BMI-status item, and robustness to unmeasured confounding.

Results: All engagement indicators were positively associated with behavioral adherence in adjusted linear models. Compared with no engagement, single-mode and dual-mode engagement were associated with higher behavioral adherence index values (β=2.14, 95% CI 0.72-3.57 and β=6.27, 95% CI 5.19-7.34, respectively). Dual-mode engagement was also associated with higher adherence than single-mode engagement (β=4.12, 95% CI 3.10-5.14). All 4 count-based indicators showed nonlinear associations (all P<.001). Activity diversity was the only indicator with a significant nonlinear BMI interaction in the primary spline models (P=.001), with inverse associations at higher activity counts among participants with normal weight and positive associations among those with overweight or obesity. Adding perceived environmental support increased model R^2 from 0.1569 to 0.2561. Findings were similar after excluding the BMI-status item and including older adults, although activity-diversity findings were sensitive to spline specification, break point selection, and unmeasured confounding.

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Conclusions: Public NNW engagement was associated with behavioral adherence, with nonlinear patterns and differences across BMI categories. The findings support considering engagement mode, channel breadth, and activity diversity alongside population characteristics and environmental support in nutrition campaign evaluation. Prospective studies are needed to assess how these dimensions relate to behavioral change and inform future campaign design.

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KEYWORDS

behavioral adherence; BMI; China; National Nutrition Week; nutrition communication; public engagement

Introduction

Unhealthy diets remain a major public health challenge worldwide. The Global Burden of Disease Study 2021 estimated that 7.22 million deaths worldwide were attributable to dietary risks in 2021 [1]. In China, the proportion of energy derived from fat increased from 24% in 1991 to 35.8% in 2015, while overall diet quality remained suboptimal despite some improvement [2]. High sodium intake and insufficient consumption of fruit and whole grains remain leading dietary risk factors [2,3]. In 2021, dietary risks accounted for an estimated 1.70 million deaths and 38.39 million disability-adjusted life years among Chinese adults aged 25 years or older [4]. China also faces a growing burden of excess body weight, with the prevalence of overweight and obesity among adults increasing from 29.9% in 2002 to 50.7% in 2018 [5]. A modeling study estimated that suboptimal diet quality accounted for 50.6% of overweight and obesity cases in China in 2011, with associated medical costs projected to increase from 32.5 billion yuan in 2011 to 313.6 billion yuan by 2031 [6]. These findings underscore the importance of population-level strategies to improve dietary behaviors.

The Dietary Guidelines for Chinese Residents 2022 provide the core recommendations for balanced diets [7,8], including dietary variety, balanced food intake, physical activity, and healthy weight. National Nutrition Week (NNW), held annually in the third week of May, serves as a national platform for promoting these recommendations through public education, television programs, live broadcasts, online platforms, and dissemination materials [9]. Health professionals, educational institutions, and communities contribute to their dissemination through both online and offline channels [9]. Public engagement in health communication campaigns can include interpersonal discussion and community activities alongside exposure to media messages [10]. It can be characterized by the frequency of involvement, the content accessed, and interaction with intervention materials [11]. Previous research suggests that how people engage with health campaigns may be associated with behavioral outcomes [10,12].

However, evidence remains limited on which aspects of engagement are associated with behavioral outcomes. A systematic review of 46 health communication campaign evaluations found that reach and recruitment were frequently assessed, while other aspects of audience engagement were reported less consistently [13]. Similar limitations have been identified in nutrition education. Across 18 infant and young child feeding interventions using mass media and nutrition education, few studies assessed both program delivery and participants' actual exposure [14]. Social media research has broadened engagement measurement to include likes, comments, and shares. However, a synthesis of 93 public health campaigns found that evaluations focused largely on these online metrics, with less attention to their relationship with behavioral change [15]. Evidence from campaigns promoting healthy eating, physical activity, and healthy weight also remains insufficient to determine how exposure frequency and audience engagement relate to campaign effectiveness [16]. More direct evidence comes from a systematic review of 7 digital dietary intervention studies, which found mixed associations between program use and dietary intake. Differences in engagement measures and dietary outcomes precluded meta-analysis [17]. In particular, evidence remains limited on how the structural dimensions of campaign engagement, including engagement mode, channel breadth, and activity diversity, relate to behavioral adherence to dietary recommendations.

Body weight is relevant to nutrition communication both as a target of dietary guidance and as a characteristic associated with responses to dietary information [7,18]. Qualitative research on a portion-control campaign identified differences in message acceptance and preferences across weight groups [19]. Evidence also extends to dietary practices. A US study found that the positive association between menu calorie label use and overall diet quality differed by BMI category, with a larger association among adults with overweight than among those with normal weight or obesity [20]. In an experiment involving 1098 UK adults, weight status did not significantly modify the association between healthy-weight advertisement exposure and adaptive behavioral intentions [21]. However, evidence on BMI-related differences in the association between broader campaign engagement and behavioral adherence to dietary recommendations remains limited.

Hence, following the tenth anniversary of NNW, we conducted a nationwide cross-sectional survey among Chinese adults. This study aimed to examine associations between public engagement with NNW and behavioral adherence to dietary recommendations, focusing on engagement mode, channel breadth, and activity diversity. We further assessed nonlinear and BMI-specific patterns and examined the associations of NNW-related cognition, attitudes, and perceived environmental support with behavioral adherence.

Methods

Study Design and Sample Collection

A nationwide cross-sectional online survey was conducted in China from September 2025 to April 2026 using Wenjuanxing

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[22], an online survey platform. With support from the Chinese Nutrition Society, the survey was distributed through its national professional network and provincial branches to recruit members of the public across China. Participation was voluntary and anonymous. All questionnaire items were mandatory, resulting in complete data for all analytical variables among eligible respondents. The study followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) reporting guidelines, with the completed checklist provided in Multimedia Appendix 1.

Of 6891 submitted questionnaires, 1661 were excluded during quality screening for completion times of less than 1 minute, implausible self-reported height or weight values, duplicate submissions, or failure of the attention check. After excluding 40 respondents aged younger than 18 years and 1 residing outside China, 5189 eligible adults remained. Because the *National Guidelines for Weight Management* (2024 Edition) specify different recommended BMI ranges for adults aged 65 years or older [23], the primary analysis was restricted to 5136 adults aged 18 to 64 years. All 5189 eligible adults, including 53 adults aged 65 years or older (24 aged 65-79 years and 29 aged ≥80 years), were retained for sensitivity analyses. Further details on recruitment, quality screening, anthropometric data handling, and sample eligibility are provided in the supplementary methods in Multimedia Appendix 2.

Questionnaire Development

Questionnaire content was informed by the *Dietary Guidelines for Chinese Residents*, official NNW communication materials, and annual NNW implementation summaries [9]. It collected information on sociodemographic characteristics, NNW-related cognition, attitudes, engagement, perceived environmental support, and behavioral adherence to dietary recommendations. The English-language questionnaire is provided in Multimedia Appendix 3.

Sociodemographic Characteristics and BMI

Sociodemographic characteristics included sex, age, region, residence, education, and self-reported height and weight. BMI was calculated as weight in kilograms divided by height in meters squared. In the primary analysis, BMI was classified as underweight (<18.5 kg/m^2), normal weight (18.5 to <24.0 kg/m^2), overweight (24.0 to <28.0 kg/m^2), or obesity (≥28.0 kg/m^2). Sensitivity analyses additionally classified BMI as below, within, or above age-specific recommended ranges (18.5 to <24.0 kg/m^2 for ages 18-64 years, 20.0 to <27.0 kg/m^2 for ages 65-79 years, and 22.0 to <27.0 kg/m^2 for ages ≥80 years [23]).

NNW-Related Cognition, Attitude, and Perceived Environmental Support

Study-specific measures were used to assess NNW-related cognition, attitude, and perceived environmental support. NNW-related cognition was assessed using eight 5-point Likert items on self-rated understanding of the 8 principles of balanced diets in the *Dietary Guidelines for Chinese Residents 2022*, which are key messages promoted during NNW.

NNW-related attitudes were measured using three 5-point Likert items covering interest in NNW activities, perceived scientific soundness and relevance to everyday life, and perceived value for improving nutrition awareness.

Perceived external environmental support was assessed using four 5-point Likert items covering awareness of NNW-related policies, access to promoted healthy foods, access to recommended health resources, and perceived support for healthy dietary choices in everyday settings.

Items were scored from 1 to 5 and summed within each measure, yielding total scores of 8 to 40 for cognition, 3 to 15 for attitude, and 4 to 20 for environmental support. Higher scores indicated greater self-rated understanding, more favorable attitudes, and stronger perceived environmental support. The internal consistency of the 3 multiitem measures was assessed using Cronbach α, with 95% CIs estimated from 1000 bootstrap samples; results are presented in Table S1 in Multimedia Appendix 2.

NNW Engagement

NNW engagement was measured using multiple-response items informed by annual summaries of NNW activities. Participants reported the online channels, offline channels, and activity types through which they had engaged with the 2025 NNW campaign. Online channels included traditional media, official websites or apps, social media, and short-video or livestreaming platforms. Offline channels included activities delivered through health care institutions, communities, townships, schools, commercial venues, and restaurants, as well as interpersonal recommendations. Activity types covered nutrition counseling, health lectures, salons, meal-planning competitions, sports activities, nutrition knowledge contests, and consumer-facing or industry-oriented activities.

Engagement measures were derived from the reported channel categories and activity types described above. Engagement mode was classified as no engagement, single-mode engagement through either online or offline channels, or dual-mode engagement through both, with “other” responses counted as engagement in the corresponding mode. Online and offline channel breadth were defined as the numbers of predefined channel categories selected, excluding “other,” and ranged from 0 to 4 and from 0 to 7, respectively. Overall channel breadth was their sum and ranged from 0 to 11. Activity diversity was calculated as the number of distinct predefined activity types in which participants reported taking part, with each type counted once, yielding a score from 0 to 8. Respondents who selected “never participated” were assigned a score of 0. The “other” option was excluded from the activity-diversity count, and no additional activity types were reported under this option.

Behavioral Adherence Index

The behavioral adherence index comprised 50 equally weighted items adapted from self-assessment tools included in NNW materials. The index was treated as a descriptive count of reported adherence across distinct domains. The first 4 domains covered dietary diversity and a balanced diet (7 items); balance between food intake, physical activity, and healthy body weight (6 items); consumption of vegetables, fruits, dairy products,

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whole grains, and soybeans (6 items); and appropriate intake of fish, poultry, eggs, and lean meat (6 items). The remaining domains covered limiting salt, oil, sugar, and alcohol (6 items); regular meals and adequate water intake (6 items); cooking skills, food selection, and food-label use (6 items); and serving practices, individual portions, and avoidance of food waste (7 items).

Each response consistent with the corresponding recommendation was assigned 1 point, and all other responses were assigned 0 points. The equally weighted item scores were summed to produce a behavioral adherence index ranging from 0 to 50, with higher scores indicating a greater number of guideline-consistent responses. All items used yes/no response options, with an additional "not applicable" option for the BMI-status item. This item reflected the guideline recommendation on maintaining a healthy body weight; "not applicable" responses covered pregnancy, lactation, or other circumstances in which BMI may be inappropriate and were assigned 0 points in the primary index.

Statistical Analysis

Descriptive Analysis

Categorical variables were summarized as numbers and percentages, questionnaire-derived scores as means and SDs, and count-based engagement measures as medians and IQRs. Participant characteristics were compared across BMI categories and engagement modes using Pearson chi-square tests for categorical variables and Kruskal-Wallis tests for scores and count variables.

Regression Analysis and BMI Interactions

Each engagement indicator was entered into a separate model. Models adjusted for sex, age, region, residence, education, and BMI category. Age was represented by a restricted cubic spline with knots at 18, 30, 45, and 64 years. Normal weight and no engagement were the reference categories. The difference between dual-mode and single-mode engagement was estimated using a linear contrast.

Overall estimates were obtained from models without engagement-by-BMI interaction terms. Separate interaction models provided BMI-specific estimates and joint tests of interaction. Joint interaction tests assessed whether associations differed across BMI categories, with 6 degrees of freedom for engagement mode and 3 degrees of freedom for each count-based measure modeled linearly. Linear count coefficients represented average associations across the observed exposure range. Heteroscedasticity-consistent covariance estimator type 3 (HC3) was used to calculate 95% CIs and conduct robust Wald tests.

The adjusted models were repeated for each of the 8 behavioral domains. The Benjamini-Hochberg procedure was applied across the 56 domain-specific exposure tests. Holm correction was applied separately to the families of overall exposure tests, BMI interaction tests, spline nonlinearity tests, and nonlinear BMI interaction tests.

Nonlinear and Break Point Analyses

The 4 count-based engagement measures were additionally modeled using restricted cubic splines. Engagement mode was treated as a nominal variable and was not included in the spline or break point analyses. Models used the same covariate adjustment as the linear models. Four knots were placed at the empirical 5th, 35th, 65th, and 95th percentiles. Knot locations were 0, 2, 3, and 4 for online channel breadth; 0, 2, 4, and 7 for offline channel breadth; 0, 4, 7, and 11 for overall channel breadth; and 0, 1, 3, and 8 for activity diversity.

Each spline comprised 1 linear and 2 nonlinear terms (3 df). Overall association tests jointly assessed all 3 terms, and nonlinearity tests assessed the 2 nonlinear terms. BMI interaction models included interactions between the 3 BMI indicators and all 3 spline terms. Overall BMI interaction tests jointly assessed all 9 interaction terms (9 df); nonlinear BMI interaction tests assessed the 6 nonlinear interaction terms (6 df), retaining the linear interactions. All tests used HC3-robust Wald tests. Adjusted predictions were standardized to the empirical covariate distribution of the primary sample. Pointwise 95% CIs were calculated using HC3 covariance estimates.

Exploratory 2-piece linear models were fitted for all 4 count-based engagement measures. Candidate break points were restricted to interior integer values with at least 5% of participants on each side. Candidate values were 1 to 3 for online breadth, 1 to 6 for offline breadth, 1 to 10 for overall breadth, and 1 to 7 for activity diversity. The break point with the lowest residual sum of squares was selected separately for the overall and BMI interaction models. Each BMI interaction model used a common break point while allowing the segment-specific slopes to differ across BMI categories.

Search-adjusted P values were calculated using a maximum-F procedure with 1999 Rademacher wild-null resamples. Holm correction was applied across the 8 break point searches. Break point stability was examined by repeating the complete selection procedure in 2000 case-bootstrap samples. Categorical exposure models were compared with the selected 2-piece models to assess remaining curve shape. Segment-specific confidence intervals were conditional on the selected break point, and the break point analyses were considered exploratory.

Hierarchical Regression

Hierarchical regression examined the additional variance in behavioral adherence associated with NNW-related cognition, attitude, and perceived external environmental support. The base model included the covariates, the 4-knot activity-diversity spline, and all BMI-by-activity-spline interactions. The sequence of cognition, attitude, and environmental support was conceptually informed by the knowledge, attitudes, and practices (KAP) approach and a social ecological perspective [24,25]. Cognition and attitude were entered first to examine individual understanding and evaluations of NNW, followed by environmental support to assess its additional contribution beyond these individual factors. Models were compared using R^2, adjusted R^2, change in R^2, and HC3-robust Wald tests of the added terms. Standardized coefficients, partial R^2, and grouped variance inflation factors were also calculated. All 6 entry orders

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were examined to assess the dependence of incremental R^2 on model sequence.

Sensitivity Analyses

Primary analyses were repeated using the 49-item behavioral adherence index that excluded the BMI-status item. Analyses were also repeated among all 5189 eligible adults using the common adult BMI categories and age-specific categories indicating BMI below, within, or above the recommended range. Corresponding 3-category BMI models were fitted in the primary sample to separate the influence of BMI classification from that of including older participants.

Nonlinear findings were examined using alternative 3-knot and 5-knot spline specifications. Moreover, 3-knot models used the empirical 10th, 50th, and 90th percentiles, and 5-knot models used the 5th, 27.5th, 50th, 72.5th, and 95th percentiles. For online breadth, the 5 distinct values 0, 1, 2, 3, and 4 were used because of tied quantiles. Each count-based engagement measure was also modeled categorically, with 0 as the reference. Models specifying an activity-diversity break point at 2 activity types were retained as supplementary comparisons.

Sensitivity to unmeasured confounding was assessed using the Cinelli-Hazlett framework. Robustness values quantified the confounding strength required to reduce estimates to 0 or render them nonsignificant at α=.05. Hypothetical confounders were assigned partial R^2 values of 1%, 3%, 5%, and 10% with the exposure conditional on covariates and with the outcome conditional on the exposure and covariates. Age, sex, and education provided descriptive benchmarks. Calculations used conventional ordinary least-squares SEs.

Model Diagnostics and Statistical Software

Model diagnostics included assessments of heteroscedasticity, leverage, influential observations using distance, and collinearity by Cook. Primary analyses were performed in R (version 4.5.2). Quantitative sensitivity analyses for unmeasured confounding were implemented in Python using the Cinelli-Hazlett ordinary least-squares formulas. All tests were 2-sided, with P<.05 considered statistically significant before the specified multiplicity adjustments.

Ethical Considerations

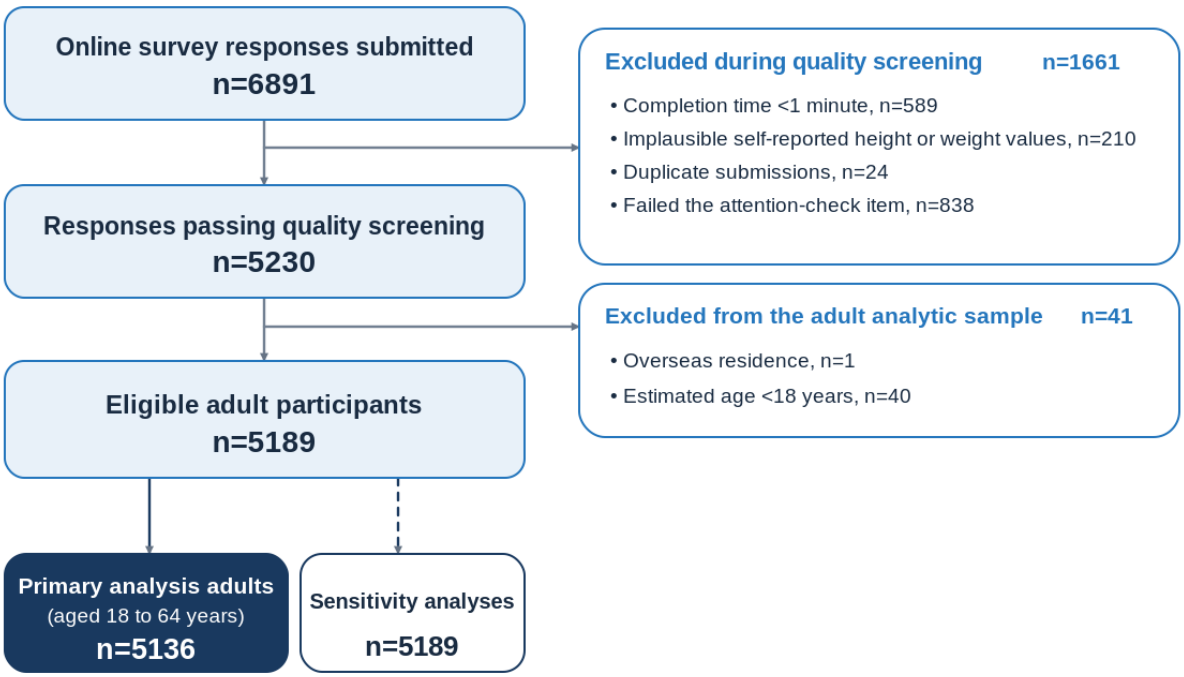
The study was approved by the Ethics Committee of the School of Public Health, Fudan University (approval number IRB#2025-07-1247) and was conducted in accordance with the Declaration of Helsinki. All participants were informed about the study before participation, and participation was voluntary and anonymous. No financial remuneration was offered to participants for their involvement in this research.

Results

Participant Selection and Characteristics

The primary analysis included 5136 adults aged 18 to 64 years, while sensitivity analyses included all 5189 eligible adults (Figure 1). The primary sample comprised 467 participants with underweight, 3192 with normal weight, 912 with overweight, and 565 with obesity. Most participants were female (3616/5136, 70.4%), younger than 45 years (4037/5136, 78.6%), urban residents (4471/5136, 87.1%), and had a bachelor's degree or above (3306/5136, 64.4%; Table 1).

Figure 1. Participant selection for a nationwide cross-sectional online survey in China, September 2025 to April 2026.



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Table 1. Participant characteristics by BMI category among adults aged 18 to 64 years in China, September 2025 to April 2026 (n=5136).

Characteristic	Overall (n=5136)	Underweight (n=467)	Normal weight (n=3192)	Overweight (n=912)	Obesity (n=565)	*P* value
Sociodemographic characteristics						
Sex, n (%)						<.001
Male	1520 (29.6)	75 (16.1)	895 (28.0)	362 (39.7)	188 (33.3)	
Female	3616 (70.4)	392 (83.9)	2297 (72.0)	550 (60.3)	377 (66.7)	
Age (years), mean (SD)						<.001
18-29	2520 (49.1)	397 (85.0)	1484 (46.5)	324 (35.5)	315 (55.8)	
30-44	1517 (29.5)	52 (11.1)	1057 (33.1)	288 (31.6)	120 (21.2)	
45-64	1099 (21.4)	18 (3.9)	651 (20.4)	300 (32.9)	130 (23.0)	
Geographic region, n (%)						<.001
Eastern China	2864 (55.8)	265 (56.7)	1920 (60.2)	389 (42.7)	290 (51.3)	
Central China	1150 (22.4)	77 (16.5)	649 (20.3)	282 (30.9)	142 (25.1)	
Western China	1122 (21.8)	125 (26.8)	623 (19.5)	241 (26.4)	133 (23.5)	
Residence, n (%)						<.001
Urban	4471 (87.1)	371 (79.4)	2854 (89.4)	791 (86.7)	455 (80.5)	
Rural	665 (12.9)	96 (20.6)	338 (10.6)	121 (13.3)	110 (19.5)	
Educational attainment, n (%)						<.001
Junior college or below	1830 (35.6)	155 (33.2)	1210 (37.9)	264 (28.9)	201 (35.6)	
Bachelor’s degree	2800 (54.5)	274 (58.7)	1683 (52.7)	528 (57.9)	315 (55.8)	
Master’s degree or above	506 (9.9)	38 (8.1)	299 (9.4)	120 (13.2)	49 (8.7)	
NNW[a] engagement						
Engagement mode						<.001
No engagement, n (%)	342 (6.7)	38 (8.1)	188 (5.9)	65 (7.1)	51 (9.0)	
Single-mode engagement, n (%)	268 (5.2)	23 (4.9)	135 (4.2)	75 (8.2)	35 (6.2)	
Dual-mode engagement, n (%)	4526 (88.1)	406 (86.9)	2869 (89.9)	772 (84.6)	479 (84.8)	
Online channel breadth, median (IQR)	3 (1-4)	2 (1-3)	3 (2-4)	2 (1-3)	2 (1-3)	
Offline channel breadth, median (IQR)	3 (1-4)	2 (1-4)	3 (2-5)	2 (1-4)	2 (1-4)	
Overall channel breadth, median (IQR)	5 (3-8)	5 (3-7)	6 (4-8)	4 (2-7)	4 (2-7)	
Activity diversity, median (IQR)	2 (1-4)	1 (0-3)	2 (1-4)	1 (0-3)	1 (0-3)	
Questionnaire-derived scores, n (%)						<.001
NNW-related cognition	33.68 (6.16)	32.37 (5.83)	34.52 (6.03)	32.51 (6.37)	31.87 (5.87)	
NNW-related attitude	12.95 (1.89)	12.47 (1.82)	13.22 (1.87)	12.65 (1.81)	12.36 (1.87)	
Perceived environmental support	14.49 (2.59)	14.48 (2.43)	14.39 (2.58)	14.76 (2.66)	14.56 (2.60)	
Behavioral adherence index	33.50 (9.57)	32.69 (9.57)	33.00 (9.55)	35.11 (9.04)	34.44 (10.17)	

[a]NNW: National Nutrition Week.

Dual-mode NNW engagement was reported by 88.1% (4526/5136) of participants. Engagement indicators and questionnaire-derived scores differed across BMI categories (all *P*<.001; Table 1). Participants with normal weight had the highest prevalence of dual-mode engagement (2869/3192, 89.9%), overall channel breadth (median 6, IQR 4-8), activity diversity (median 2, IQR 1-4), and cognition and attitude scores (34.52, SD 6.03 and 13.22, SD 1.87, respectively). Participants with overweight had the highest perceived environmental support score (14.76, SD 2.66) and behavioral adherence index (35.11, SD 9.04).

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Participant characteristics differed across engagement modes (all *P*<.05; Table S2 in Multimedia Appendix 2). The behavioral adherence index increased from 28.45 (SD 9.78) among participants with no engagement to 30.98 (SD 8.38) among those with single-mode engagement and 34.04 (SD 9.49) among those with dual-mode engagement. Domain-specific scores also showed different descriptive patterns across BMI categories. Participants with overweight had the highest mean scores in 6 of the 8 behavioral domains, whereas domain 2 was highest among participants with normal weight (Table S3 in Multimedia Appendix 2).

NNW Engagement and Behavioral Adherence: Associations and BMI Interactions

Compared with no engagement, single-mode and dual-mode engagement were associated with 2.14-point (95% CI 0.72-3.57) and 6.27-point (95% CI 5.19-7.34) higher behavioral adherence index scores, respectively. Dual-mode engagement was also associated with a higher behavioral adherence index than single-mode engagement (β=4.12, 95% CI 3.10-5.14). In models treating the count indicators as linear terms, each additional online channel, offline channel, overall channel, and activity type was associated with a 1.03-, 0.61-, 0.46-, and 0.41-point higher behavioral adherence index, respectively (Table 2).

Table 2. Adjusted associations between NNW[a] engagement and the behavioral adherence index and interactions with BMI. Overall estimates are from models without BMI interactions; BMI-specific estimates and interaction *P* values are from separate interaction models.

Engagement indicator	Overall, β (95% CI)	Underweight, β (95% CI)	Normal weight, β (95% CI)	Overweight, β (95% CI)	Obesity, β (95% CI)	BMI interaction, *P* value
Engagement mode						.002
Single-mode vs no engagement	2.14 (0.72 to 3.57)	0.93 (−4.19 to 6.04)	1.83 (−0.09 to 3.76)	2.88 (0.01 to 5.76)	3.40 (−0.46 to 7.26)	
Dual-mode vs no engagement	6.27 (5.19 to 7.34)	7.79 (4.46 to 11.12)	4.52 (3.10 to 5.95)	7.87 (5.52 to 10.23)	9.61 (6.74 to 12.49)	
Dual-mode vs single-mode	4.12 (3.10 to 5.14)	6.87 (2.78 to 10.96)	2.69 (1.29 to 4.09)	4.99 (3.11 to 6.86)	6.21 (3.34 to 9.08)	
Channel breadth, per additional channel						<.001
Online channel breadth	1.03 (0.82 to 1.23)	1.36 (0.67 to 2.06)	0.39 (0.12 to 0.65)	1.85 (1.42 to 2.28)	2.49 (1.91 to 3.08)	
Offline channel breadth	0.61 (0.48 to 0.74)	0.91 (0.46 to 1.36)	0.16 (−0.01 to 0.32)	1.17 (0.88 to 1.46)	2.00 (1.63 to 2.38)	
Overall channel breadth	0.46 (0.37 to 0.55)	0.64 (0.34 to 0.93)	0.14 (0.03 to 0.25)	0.85 (0.66 to 1.04)	1.32 (1.07 to 1.57)	
Activity diversity, per additional activity type	0.41 (0.29 to 0.54)	1.06 (0.63 to 1.48)	−0.12 (−0.27 to 0.03)	1.32 (1.02 to 1.63)	2.20 (1.87 to 2.54)	

[a]NNW: National Nutrition Week.

The associations varied across BMI categories. The interaction with BMI was significant for engagement mode (*P*=.002) and all 4 count indicators (all *P*<.001). The association between dual-mode engagement and adherence was observed across all BMI categories, ranging from β=4.52 (95% CI 3.10-5.95) among participants with normal weight to β=9.61 (95% CI 6.74-12.49) among those with obesity. Single-mode engagement was significantly associated with adherence only among participants with overweight (β=2.88, 95% CI 0.01-5.76). Associations with online, offline, and overall channel breadth had the smallest coefficients among participants with normal weight and the largest among those with obesity. Activity diversity was positively associated with adherence in the underweight, overweight, and obesity groups, with the strongest association observed among participants with obesity (β=2.20, 95% CI 1.87-2.54), while no clear association was observed among participants with normal weight (β=−0.12, 95% CI −0.27 to 0.03; Table 2).

Domain-specific analyses showed that dual-mode engagement was positively associated with all 8 behavioral domains compared with either no engagement or single-mode engagement. Single-mode engagement was positively associated with domains 1, 5, 7, and 8 compared with no engagement. Online, offline, and overall channel breadth were positively associated with domains 1 through 5 and domain 7. Activity diversity was positively associated with domains 1, 2, 3, and 5, but inversely associated with domains 6 and 8, with coefficients of −0.03 (95% CI −0.05 to −0.01) and −0.08 (95% CI −0.10 to −0.06), respectively (Table S3 in Multimedia Appendix 2).

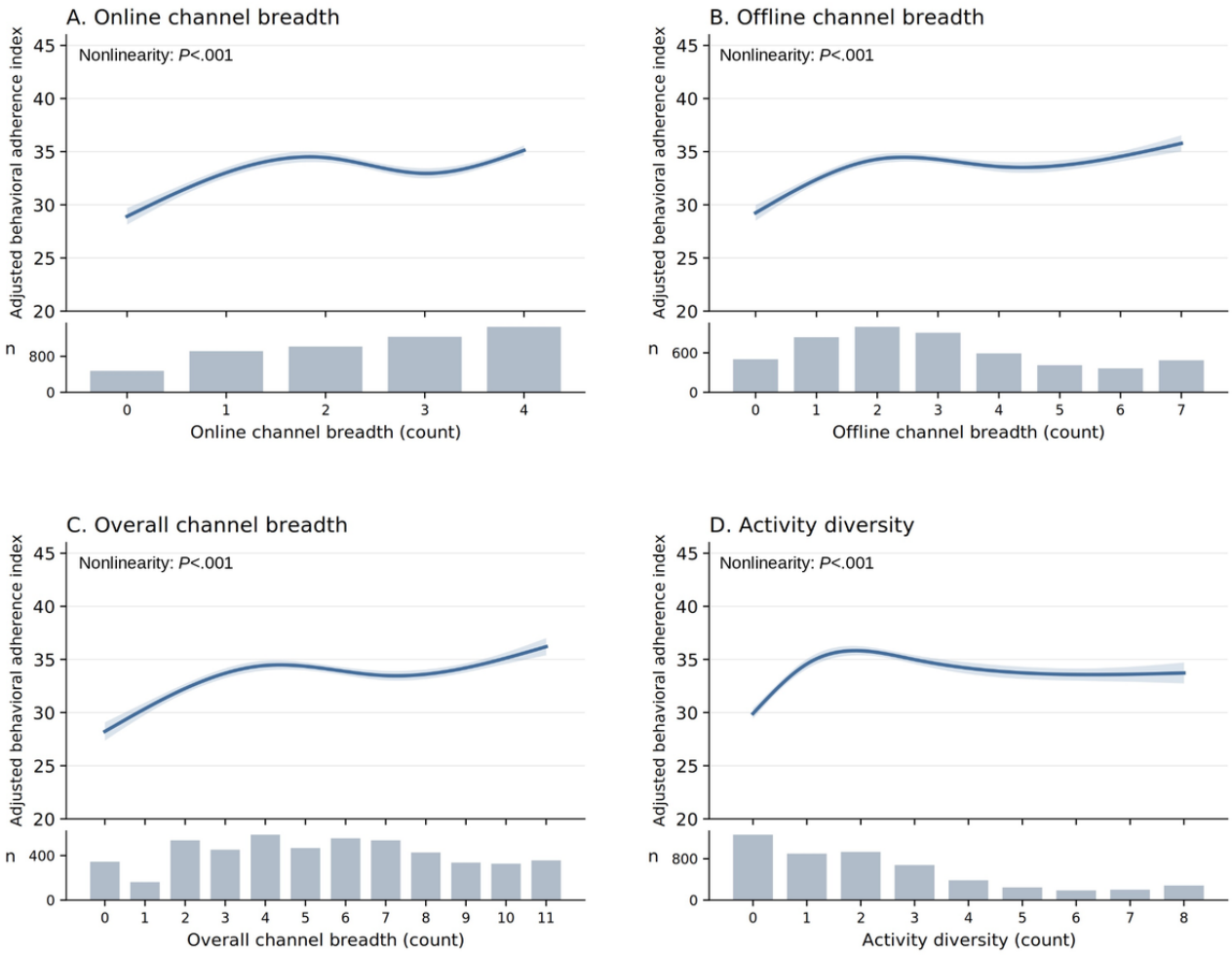
Nonlinear Patterns in Engagement-Adherence Associations

All 4 engagement indicators showed nonlinear associations with the behavioral adherence index (for nonlinearity: all *P*<.001; Figure 2). The predicted index increased between 0 and 2 online channels, decreased slightly at 3 channels, and increased again at 4 channels. Similar patterns were observed for offline and overall channel breadth, with initial increases up to approximately 2 and 4 channels, respectively, followed by small decreases and subsequent increases. For activity diversity, the

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predicted index increased up to approximately 2 activity types, followed by a decline and a relatively flat pattern at higher counts.

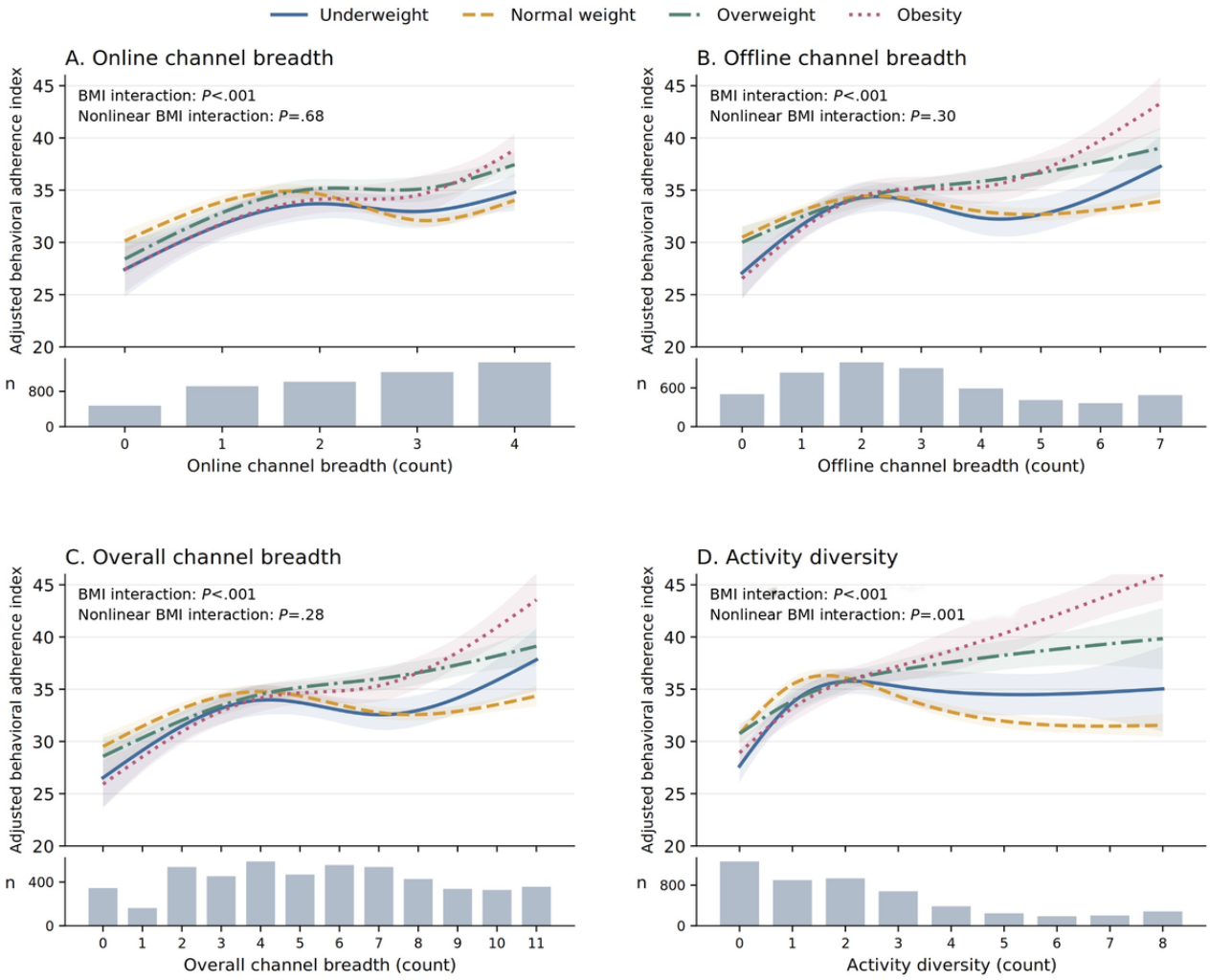
Figure 2. Nonlinear associations between National Nutrition Week (NNW) engagement and the behavioral adherence index.



Overall BMI interactions were significant for all 4 engagement indicators (all $P<.001$; Figure 3). Nonlinear interaction components were not significant for online, offline, or overall channel breadth ($P=.68$, $P=.30$, and $P=.28$, respectively). Activity diversity showed a clearer divergence across BMI categories. After approximately 1 to 2 activity types, the predicted adherence index declined among participants with normal weight, remained relatively stable among those with underweight, and continued to increase among those with overweight or obesity (nonlinear BMI interaction: $P=.001$).

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Figure 3. BMI-specific nonlinear associations between National Nutrition Week (NNW) engagement and the behavioral adherence index.



After Holm correction, all 4 nonlinear associations remained significant (all adjusted $P<.001$), as did the nonlinear BMI interaction for activity diversity (adjusted $P=.004$). The overall associations remained nonlinear, and the overall BMI interactions remained significant, in models using 3 or 5 knots. However, the nonlinear BMI interaction for activity diversity remained significant in the 5-knot model but did not reach significance in the 3-knot model ($P=.05$), indicating some sensitivity to knot specification. Categorical analyses supported the nonmonotonic associations observed in the primary spline models (Table S4 and Figure S1 in Multimedia Appendix 2).

Exploratory Break Point and Segmented Regression Analyses

The search across candidate integer break points selected 1 channel for online and offline channel breadth, 2 channels for overall channel breadth, and 2 activity types for activity diversity by minimizing the residual sum of squares in the overall models (Table 3). Associations with the behavioral adherence index were stronger below these break points, with coefficients ranging from 2.74 to 4.76 per additional channel or activity type. Above the break points, the associations were attenuated for online, offline, and overall channel breadth (β=0.46, 0.30, and 0.22, respectively) and became negative for activity diversity (β=−0.50, 95% CI −0.68 to −0.32).

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Table 3. Exploratory break points and segment-specific overall associations between NNW[a] engagement and the behavioral adherence index.

Engagement indicator	Selected break point, c	β below the break point (95% CI)	*P* value	β above the break point (95% CI)	*P* value
Online channel breadth	1	4.68 (3.71 to 5.66)	<.001	0.46 (0.20 to 0.72)	<.001
Offline channel breadth	1	4.76 (3.83 to 5.69)	<.001	0.30 (0.15 to 0.45)	<.001
Overall channel breadth	2	2.74 (2.19 to 3.30)	<.001	0.22 (0.12 to 0.33)	<.001
Activity diversity	2	2.80 (2.47 to 3.14)	<.001	−0.50 (−0.68 to −0.32)	<.001

[a]NNW: National Nutrition Week.

The corresponding search in the BMI-interaction models identified the same break points for the channel-breadth indicators and a break point of 1 for activity diversity. Below the break points, associations were positive across all BMI categories. Above the channel-breadth break points, positive associations remained among participants with overweight or obesity but were not significant among those with underweight or normal weight. Above 1 activity type, the association was negative among participants with normal weight (β=−0.69), nonsignificant among those with underweight (β=0.13), and positive among those with overweight or obesity (β=0.84 and 1.79, respectively; Table 4). When the overall-model break point of 2 activity types was applied, the corresponding post–break point coefficients were −0.31 (95% CI −0.94 to 0.32) for underweight, −0.94 (95% CI −1.15 to −0.73) for normal weight, 0.75 (95% CI 0.27 to 1.23) for overweight, and 1.61 (95% CI 1.13 to 2.08) for obesity (Table S5 in Multimedia Appendix 2).

Table 4. Exploratory break points and BMI-specific segment associations between NNW[a] engagement and the behavioral adherence index.

Engagement indicator and BMI category	β below the break point (95% CI)	*P* value	β above the break point (95% CI)	*P* value	Selected break point, c
Online channel breadth					1
Underweight	6.60 (3.37 to 9.82)	<.001	0.49 (−0.38 to 1.36)	.27	
Normal weight	4.04 (2.74 to 5.35)	<.001	−0.15 (−0.48 to 0.18)	.38	
Overweight	5.52 (3.59 to 7.46)	<.001	1.24 (0.70 to 1.78)	<.001	
Obesity	3.99 (1.26 to 6.71)	.004	2.24 (1.50 to 2.98)	<.001	
Offline channel breadth					1
Underweight	6.61 (3.55 to 9.67)	<.001	0.37 (−0.14 to 0.87)	.16	
Normal weight	4.22 (2.97 to 5.46)	<.001	−0.12 (−0.31 to 0.07)	.21	
Overweight	3.72 (1.81 to 5.63)	<.001	0.96 (0.63 to 1.28)	<.001	
Obesity	5.89 (3.44 to 8.34)	<.001	1.65 (1.21 to 2.08)	<.001	
Overall channel breadth					2
Underweight	3.67 (1.92 to 5.43)	<.001	0.26 (−0.10 to 0.61)	.16	
Normal weight	2.45 (1.72 to 3.19)	<.001	−0.08 (−0.22 to 0.05)	.23	
Overweight	2.88 (1.72 to 4.03)	<.001	0.64 (0.42 to 0.86)	<.001	
Obesity	2.53 (1.06 to 3.99)	<.001	1.17 (0.87 to 1.48)	<.001	
Activity diversity					1
Underweight	6.92 (4.87 to 8.96)	<.001	0.13 (−0.40 to 0.65)	.64	
Normal weight	4.84 (3.97 to 5.72)	<.001	−0.69 (−0.88 to −0.51)	<.001	
Overweight	4.13 (2.79 to 5.48)	<.001	0.84 (0.45 to 1.23)	<.001	
Obesity	4.59 (2.77 to 6.40)	<.001	1.79 (1.37 to 2.21)	<.001	

[a]NNW: National Nutrition Week.

All break point tests remained significant after adjustment for the search procedure and multiple comparisons (all Holm-adjusted *P*=.004). Bootstrap selection was highly consistent for online, offline, and overall channel breadth,

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whereas both 1 and 2 were frequently selected for activity diversity, indicating less stable break point identification. Significant remaining curve shape was also detected for all 4 indicators, suggesting that the segmented models provide exploratory summaries of the nonlinear associations (Table S5 in Multimedia Appendix 2).

Hierarchical Regression of Cognition, Attitude, and Environmental Support

Model explanatory performance improved modestly after NNW-related cognition was added (ΔR^2=0.0067; P<.001) and changed little after attitude was added (ΔR^2=0.0005; P=.14). Adding perceived environmental support produced a substantially larger increase in explained variance (ΔR^2=0.0992; P<.001), raising the model R^2 from 0.1569 to 0.2561 (Table 5).

Table 5. Hierarchical regression model fit and incremental explained variance.

Model	Variables added	R^2	Adjusted R^2	ΔR^2	P for added variable
Model 1	Covariates, activity-diversity spline, and BMI-by-spline interactions	0.1497	0.1457	N/A[a]	N/A
Model 2	Model 1 + NNW[b]-related cognition	0.1564	0.1523	0.0067	<.001
Model 3	Model 2 + NNW-related attitude	0.1569	0.1526	0.0005	.14
Model 4	Model 3 + perceived environmental support	0.2561	0.2521	0.0992	<.001

[a]N/A: not applicable.

[b]NNW: National Nutrition Week.

In the final model, perceived environmental support was positively associated with behavioral adherence (β=1.338, 95% CI 1.239-1.437; standardized β=0.362; partial R^2=0.1176; P<.001). Attitude showed a modest inverse association (β=−0.262, 95% CI −0.450 to −0.074; standardized β=−0.052; P=.006), whereas cognition was not significantly associated with adherence (β=0.039, 95% CI −0.016 to 0.094; P=.16; Table 6). The attitude coefficient changed from 0.15 before adjustment for environmental support to −0.26 afterward. Variance inflation factors (VIFs) for the 3 constructs ranged from 1.32 to 1.73. Environmental support yielded the largest increment in explained variance across all 6 entry orders (ΔR^2=0.0981-0.1048; Table S6 in Multimedia Appendix 2).

Table 6. Associations of NNW[a]-related cognition, attitude, and perceived environmental support with the behavioral adherence index in the final hierarchical regression model.

Variable	Unstandardized β (95% CI)	Standardized β	Partial R^2	VIF[b]	P value
NNW-related cognition	0.039 (−0.016 to 0.094)	0.025	0.0005	1.60	.16
NNW-related attitude	−0.262 (−0.450 to −0.074)	−0.052	0.0021	1.73	.006
Perceived environmental support	1.338 (1.239 to 1.437)	0.362	0.1176	1.32	<.001

[a]NNW: National Nutrition Week.

[b]VIF: variance inflation factor.

Sensitivity Analyses

Results were similar after excluding the BMI-status item. The adjusted coefficients were 6.18 (95% CI 5.11-7.25) for dual-mode vs no engagement and 0.39 (95% CI 0.26-0.51) for activity diversity. Nonlinearity and BMI-interaction findings were consistent with the primary analysis, and adding environmental support increased R^2 by 0.0994 (Table S7 in Multimedia Appendix 2).

Including adults aged 65 years or older increased the analytical sample from 5136 to 5189 and yielded similar estimates. The adjusted difference for dual-mode vs no engagement was 6.42 points (95% CI 5.33-7.50), while the association with activity diversity was β=0.41 (95% CI 0.28-0.53). Results were also consistent when 3-level and age-specific BMI classifications were applied. Across these alternative specifications, significant nonlinear BMI interaction remained specific to activity diversity, and the incremental variance explained by environmental support remained similar (ΔR^2=0.0997; Table S7 in Multimedia Appendix 2).

Sensitivity to unmeasured confounding varied across associations. For dual-mode vs no engagement, robustness values were 15.64% for reducing the estimate to 0 and 13.31% for rendering it statistically nonsignificant; corresponding values for activity diversity were 9% and 6.48%. Robustness values for statistical nonsignificance were lower for single-mode vs no engagement (1.29%) and ranged from 9.99% to 11.51% for channel-breadth measures. Under the hypothetical scenario with partial R^2 values of 10% for both confounder relationships, the dual-mode association remained positive (bias-adjusted β=2.39, 95% CI 1.38-3.40), whereas the activity-diversity estimate was close to 0 (β=−0.05, 95% CI −0.17 to 0.07; Table S7 in Multimedia Appendix 2).

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Discussion

Principal Findings

In this nationwide online survey, public participation in both online and offline NNW activities was associated with higher behavioral adherence across all 8 domains. All 4 count-based engagement indicators showed nonlinear associations with behavioral adherence. In the primary spline models, activity diversity was the only indicator with a statistically significant nonlinear interaction with BMI category. Perceived environmental support accounted for substantially more additional variance in adherence than cognition or attitude, irrespective of their order of entry into the models. Sensitivity analyses were broadly consistent with the participation-mode findings, although the estimated break point for activity diversity was unstable and its overall association was more sensitive to potential unmeasured confounding.

Structured Engagement Was Associated With Higher Behavioral Adherence

Dual-mode engagement was associated with a behavioral adherence index 6.27 points higher than no engagement and 4.12 points higher than single-mode engagement in adjusted analyses. Positive associations were observed across all 8 behavioral domains in both comparisons. This pattern extends previous nutrition campaign evaluations, in which campaign awareness or recall has been associated with selected dietary responses, although findings have varied across outcomes [26-28]. In the Celebrate Your Plate campaign, campaign recall was associated with higher fruit and vegetable consumption and greater readiness to increase intake [29]. In the Fruits and Veggies campaign, awareness was associated with stronger intentions and a greater likelihood of trying a new fruit or vegetable, while no corresponding difference was observed in daily intake frequency [26]. Such variation is consistent with a meta-analysis showing that mass-mediated health campaigns generally have modest effects on behavior (r=0.05) and knowledge (r=0.10; [30]). The higher behavioral adherence observed among participants with dual-mode engagement may partly reflect the complementary functions of online and offline settings. Online channels can facilitate repeated access to nutritional information, whereas offline activities such as counseling, lectures, competitions, and interpersonal exchange may help participants interpret recommendations and relate them to everyday practice [15]. Consistent with this interpretation, a meta-analysis of 28 studies involving 138,898 participants found that campaign-generated interpersonal communication was associated with more favorable campaign-targeted outcomes [31]. These findings suggest that participation mode warrants consideration alongside engagement breadth when examining associations between nutrition campaign engagement and behavioral adherence.

Engagement-Adherence Associations Were Nonlinear and Varied Across BMI Categories

The spline curves and exploratory segmented models generally showed steeper associations at lower levels of engagement, followed by smaller slopes. Similar nonlinearity has been reported in an online dietary intervention, in which engagement showed an inverse U-shaped relationship with planning and subsequent fruit and vegetable intake [32]. A systematic review likewise found that only 5 of 12 associations between usage measures and dietary intake were positive, while 7 were inconclusive [17]. These findings caution against interpreting additional channels or activities as equivalent increments in engagement. Engagement encompasses the amount and depth of participation as well as attention, interest, and involvement [32]. Smaller slopes at higher counts may reflect differences in the relevance and content of additional activities.

The shape of the association between activity diversity and behavioral adherence differed across BMI categories in the primary spline analysis. At lower activity counts, greater activity diversity was associated with higher behavioral adherence across BMI groups. Beyond the selected break point, associations were positive among participants with overweight or obesity, inverse among those with normal weight, and nonsignificant among those with underweight. Differences in weight-related motivation may partly explain this pattern. In the National Health and Nutrition Examination Survey (NHANES 2013-2016), 66.7% of adults with obesity reported attempting to lose weight, compared with 26.5% of adults with underweight or normal weight [33]. Perceived overweight has also been associated with greater use of both healthy and unhealthy weight-control strategies [34], while studies in UK and US adults found that higher BMI was associated with stronger weight-control motives but weaker health-based food-choice motives [35]. Weight-control motivation may therefore contribute to the positive associations observed among participants with overweight or obesity. Among those with normal weight, greater activity diversity may reflect attempts to address existing dietary difficulties, consistent with evidence that nutrition-information seeking is motivated by perceived health needs and uncertainty [36]. Such needs-driven participation offers a possible explanation for the inverse association, alongside residual confounding.

Perceived Environmental Support Was Associated With Behavioral Adherence

Hierarchical analyses showed that perceived environmental support accounted for more additional variance in behavioral adherence than cognition or attitude across all 6 entry orders, consistent with its standardized coefficient and partial R^2. This finding accords with evidence that nutrition knowledge alone has a limited relationship with dietary behavior. A systematic review of 29 studies found positive associations between nutrition knowledge and dietary intake in 65.5% of studies, although most correlations were below 0.5 [37]. Diet-quality misperception provides further evidence of the gap between perceptions and actual practices. In a 2025 analysis of 31,644 US adults, 47% had poor diet quality, of whom 23% perceived their diet as healthy [38]. Because cognition in the present study reflected self-rated understanding of NNW recommendations, this comparison remains conceptual.

Perceived environmental support may capture conditions more directly relevant to applying nutritional guidance, including access to promoted healthy foods, health resources, and

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supportive daily settings [39]. Ecological models similarly locate dietary behavior within household, organizational, community, and policy contexts [40]. Among 2420 rural adults, healthy-food availability and psychosocial factors were positively associated with diet quality, fruit and vegetable intake, and fiber intake [41], while a qualitative systematic review of 35 lifestyle interventions identified barriers and facilitators at individual, environmental, and intervention levels [42]. Experimental evidence also showed that a 12.5% discount on healthier foods increased their purchase by 11% at 6 months, whereas tailored nutrition education alone had no effect on food purchases [43]. These studies provide context for the observed association between perceived environmental support and behavioral adherence and highlight environmental conditions as a relevant consideration in nutrition campaign evaluation. The small inverse attitude coefficient emerged after adjustment for environmental support and may reflect suppression or shared variance among the measures, despite low construct-level VIFs. It should therefore be interpreted as a conditional association.

Implications for Campaign Evaluation and Practice

These findings have broader implications for large-scale nutrition and health communication campaigns. Campaign design may first account for population needs. The BMI-specific patterns warrant further investigation of whether associations between activity diversity and behavioral adherence differ across weight groups. Broader evidence also supports considering age, sex, socioeconomic position, health literacy, motivation, and readiness to act when designing campaign activities [44,45]. Audience segmentation and tailoring can therefore guide message framing, activity selection, delivery settings, and engagement intensity [46]. Alongside tailored design, public participation can be integrated into campaign delivery and assessed as a key implementation outcome. Campaign delivery may incorporate varied opportunities for repeated message contact, interactive activities, skill-building sessions, peer exchange, and follow-up support [47,48].

Evaluation can further capture participation intensity, duration, recurrence, activity content, and perceived usefulness, consistent with public health guidance emphasizing program operation, implementation improvement, and evidence-informed decision-making [48,49]. The association with perceived environmental support also highlights the value of assessing access to healthy foods, credible resources, and supportive daily settings alongside campaign engagement [50]. Policy, systems, and environmental approaches similarly emphasize organizational, social, physical, and economic changes that make healthier choices easier to adopt and sustain [51,52]. Future research should evaluate whether combining opportunities for public engagement with practical and environmental support improves behavioral adherence, and whether outcomes differ across population groups.

Limitations and Future Research

Several limitations should be acknowledged. First, the cross-sectional design precludes establishing temporality or causality. Reverse causation is possible, as existing dietary practices and perceived nutritional needs may have influenced participation. Residual confounding may arise from incompletely captured socioeconomic circumstances, health and digital literacy, health consciousness, weight-control motivation, chronic disease, health care use, and local availability of NNW activities, which could influence both engagement and behavioral adherence. Sensitivity analyses indicated that some associations were vulnerable to unmeasured confounding, particularly single-mode engagement and activity diversity. Second, all key variables were self-reported in the same survey and were therefore susceptible to recall error, social desirability bias, and common-method bias. The delay between NNW in May and data collection from September 2025 to April 2026 may have affected recall of engagement, which was also temporally misaligned with practices reported for the survey day or preceding week. The equally weighted adherence index may obscure different behavioral profiles at the same total score, despite the accompanying domain-specific analyses. The study-specific measures require further validation. Internal consistency was modest for perceived environmental support (Cronbach α=0.667), while substantial ceiling effects in cognition and attitude scores may have limited discrimination at the upper end of these measures. Third, online convenience sampling through the Chinese Nutrition Society's network may have overrepresented individuals with better digital access or stronger nutrition interests and underrepresented those engaging mainly through offline activities. Potential overlap between recruitment and campaign dissemination channels may have further increased selection bias. These processes limit generalizability and may have biased the observed associations. The small no-engagement and single-mode groups may also reduce the precision of between-group estimates.

Future evaluations of NNW and other large-scale nutrition campaigns should use prospective designs to establish temporal order and assess whether behavioral changes persist. Objective participation records, validated dietary measures, and baseline data on motivation and socioeconomic characteristics would help reduce common-method bias and separate campaign-related changes from pre-existing differences. Engagement measures should capture the content, frequency, and duration of participation, as well as participants' attention and interest. Randomized or quasi-experimental studies could compare communication-only strategies with approaches that also provide practical or environmental support. Process evaluations should assess reach, fidelity, participant receipt and use, underlying mechanisms, and contextual influences [53]. Finally, the BMI-specific patterns and candidate break points should be replicated in independent samples before they are used to define engagement targets or guide campaign design.

Conclusions

NNW engagement was associated with behavioral adherence to dietary recommendations, with higher index scores among participants reporting dual-mode engagement. Associations were nonlinear, and activity-diversity patterns differed across BMI categories, although spline specification and break point uncertainty affected interpretation. Perceived environmental support accounted for additional variance across model entry orders. These findings support assessing engagement structure and environmental context in campaign evaluation. Prospective

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and intervention studies are needed to establish temporal relationships and assess behavioral change.

Acknowledgments

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Data Availability

Summary results are reported in the article and supplementary materials. The datasets analyzed during this study are available from the corresponding author upon reasonable request.

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Generative AI Use

No generative AI tools were used in the conceptualization of the study, data analysis, or preparation of the manuscript.

Authors' Contributions

Conceptualization: QW, FW, KY, LX
Formal analysis: QW, KY, SL, LW
Funding acquisition: FW
Supervision: FW
Writing – original draft: QW
Writing – review & editing: QW, KY, SL, LW, LX, FW

Conflicts of Interest

None declared.

Multimedia Appendix 1

STROBE checklist.
[DOCX File , 31 KB-Multimedia Appendix 1]

Multimedia Appendix 2

Supplementary methods, participant characteristics, behavioral adherence analyses, regression models, and sensitivity analyses.
[DOCX File , 281 KB-Multimedia Appendix 2]

Multimedia Appendix 3

Questionnaire on National Nutrition Week Engagement and Behavioral Adherence among Chinese Adults.
[DOCX File , 41 KB-Multimedia Appendix 3]

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Abbreviations

HC3: heteroscedasticity-consistent covariance estimator type 3
KAP: knowledge, attitudes, and practices
NHANES: National Health and Nutrition Examination Survey
NNW: National Nutrition Week
STROBE: Strengthening the Reporting of Observational Studies in Epidemiology
VIF: variance inflation factor

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