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Weight loss dietary knowledge, attitudes, and practices among different body weight groups in Northeast China

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Unhealthy dietary habits are prevalent in Northeast China, contributing to a high prevalence of obesity. This study aimed to assess the knowledge, attitudes, and practices (KAP) of the general population regarding weight loss dietary patterns in this region, with additional analysis of normal weight or underweight versus overweight and obesity subgroups. A cross-sectional study was conducted from September to November 2024 in Liaoning Province, China, using a self-administered questionnaire to collect demographic information and KAP scores. A total of 595 valid responses were analyzed (representing 91.4% of eligible participants), with 450 females (75.63%) and 145 males (24.37%). The overall knowledge score was 13.64 ± 5.88, with median attitude and practice scores of 28[25,31] and 35[32,42], respectively. Participants with overweight and obesity demonstrated higher scores in weight loss plateau understanding ($p = 0.015$) and realistic goal-setting ($p < 0.001$) compared to those with normal weight or underweight. Structural equation modeling identified significant associations between knowledge and both attitude (β=-0.40, 95% CI: -0.54,-0.20, $p < 0.001$) and practice, with knowledge showing a positive direct association with practice (β = 0.44, 95% CI: 0.30,0.58, $p < 0.001$) and a significant indirect association through attitude (β = 0.23, 95% CI: 0.14,0.31, $p < 0.001$) in the overall population. While participants demonstrated moderate levels of knowledge and attitudes regarding weight management, their practice levels were relatively low. Knowledge was significantly associated with both attitudes and practices, suggesting that educational interventions might be considered as a component in comprehensive approaches to weight management behaviors.

Keywords Cross-Sectional studies, Health knowledge, attitudes, practice, Weight loss, Obesity, Diet, Body weight, China

The dramatic rise in the prevalence of overweight and obesity in China over recent decades poses a significant public health challenge. From 1993 to 2015, the prevalence of overweight individuals increased from 26.6 to 41.3%, obesity rates rose from 4.2 to 15.7%, and abdominal obesity from 20.2–46.9%[1]. Key drivers of this epidemic include economic development, urbanization, and lifestyle changes[2], with the most rapid increases observed among younger and urban demographics. The economic impact is substantial, with obesity-related health expenditures accounting for approximately 3.9% of China's total healthcare costs[3].

Concurrently, traditional Chinese dietary habits have shifted markedly towards higher consumption of processed foods and sugar-sweetened beverages, moving away from more balanced diets[4]. Despite the escalating obesity rates, there remains a significant gap in public awareness regarding effective weight management strategies and the associated health risks, especially among the youth[5]. The situation is particularly dire in northern China, including Liaoning Province, which has the fifth-highest obesity rate in the country at 18.2%.

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This region's diet, rich in salt and oil, coupled with the common practice of preserving vegetables through salting and pickling during harsh winters, contributes to its high obesity rates[6]. Moreover, the prevalent poor dietary habits, such as inadequate intake of whole grains, vegetables, fruits, and dairy products, and subpar breakfast quality, exacerbate the situation.

The Knowledge-Attitude-Practice (KAP) model, which is integral to understanding and influencing health behaviors, posits that knowledge influences attitudes, which in turn drive practices[7,8]. This framework is essential in health literacy, where the KAP questionnaire serves as a pivotal tool for assessing these elements within healthcare settings and gauging the acceptance of educational content[9]. Both knowledge and attitudes indirectly impact health outcomes by guiding behavioral changes[10,11].

In response to the growing obesity crisis, particularly in regions like Liaoning Province with high obesity prevalence, this study aims to conduct a comprehensive analysis of the general population's KAP regarding dietary patterns conducive to weight loss. This includes a comparative assessment of normal weight or underweight individuals versus those who are overweight or obese.

Methods

Study design and participants

This cross-sectional study was conducted from September to November 2024 in Liaoning Province, China, targeting the general population as the study group. Ethical approval was obtained from the Ethics Committee of the Affiliated Hospital of Liaoning University of Traditional Chinese Medicine (Approval No. 2024101 CS(LW)−001-01). Informed consent was acquired from all participants through their agreement via an online questionnaire. This study was conducted and reported in accordance with the STROBE guidelines for cross-sectional studies.

The inclusion criteria required participants to be 18 years or older, reside in Northeast China, consent to the study, and complete the questionnaire. Although no strict exclusion criteria were set initially to maximize data collection, certain responses were excluded during the validation process to maintain data quality and consistency. Specifically, questionnaires completed in under 120 s were considered unreliable due to inadequate response time. Responses with a BMI over 40 kg/m² ($n = 22$) were excluded following data cleaning protocols established in previous Chinese population-based research such as the China Health and Nutrition Survey[12], as these extreme values were inconsistent with regional obesity prevalence patterns and likely represented data entry errors. This approach is consistent with recent obesity research methodology[13,14]. Additionally, responses with logical inconsistencies were removed. For instance, participants who selected "no" for having underlying conditions but indicated specific diseases, or those who marked "none" for insurance type or current medication status but also selected other options, were considered contradictory and excluded from analysis.

Sample size calculation

The sample size for this study was calculated using the formula[15]:

$$n = \left(\frac{Z_{1-\frac{\alpha}{2}}}{\delta}\right)^2 \times\ p \times\ (1-p)$$

With parameters set at a 95% confidence level (Z = 1.96), 5% margin of error (δ), and a maximum variability estimate ($p = 0.5$), the minimum required sample size was 384. Accounting for an anticipated 20% non-response or invalid response rate, the target sample size was established at 480 participants.

Questionnaire development and structure

The questionnaire was developed through comprehensive literature review and guideline consultation[16–20]. The attitude section was specifically designed to address common misconceptions about weight management. The initial instrument underwent expert review by three specialists in nutrition and metabolism, leading to content refinement and the addition of relevant items. A pilot study involving 42 respondents demonstrated satisfactory reliability (Cronbach's α = 0.8186).

The final Chinese-language questionnaire comprised demographic characteristics including gender, age, BMI, residence type, education level, employment status, monthly household income, marital status, chronic conditions, smoking status, alcohol consumption, insurance type, medication usage, and primary food source. The knowledge assessment consisted of 10 items scored on a three-point scale ("Well Informed"=2, "Heard of It"=1, "Unaware"=0; range 0–10), evaluating understanding of obesity causes, diagnosis, management, and prevention, emphasizing lifestyle interventions and evidence-based weight management strategies. The attitude evaluation comprised 8 items rated on a five-point Likert scale (range 8–40), with reverse scoring for certain items, assessing perspectives on obesity and weight management, including beliefs about causation, dietary habits, and weight loss approaches. The practice assessment included 12 items scored on a five-point Likert scale ("Always"=5 to "Never"=1; range 12–60), evaluating adherence to weight management behaviors, including dietary modifications, physical activity, and lifestyle routines. Adequate performance in each domain was defined as achieving scores above 60% of the maximum possible score[21].

To further evaluate the construct validity of the questionnaire, exploratory factor analysis (EFA) was conducted. The Kaiser-Meyer-Olkin (KMO) measure was 0.937 ($P < 0.001$), confirming excellent sampling adequacy. The EFA identified three principal factors explaining 51.30% of the total variance (Factor 1: 25.62%, Factor 2: 17.60%, Factor 3: 8.08%). After varimax rotation, Factor 1 predominantly loaded on knowledge items (K2_1-K2_12, loadings 0.659–0.835), Factor 2 on practice items (P2_1-P2_12, loadings 0.507–0.747), and Factor 3 on attitude items (with highest loadings for A2_1, A2_3, A2_7, A2_6, and A2_8) (**Supplementary Fig. 1 &**

Supplementary Table 1). This three-factor structure aligned with the theoretical KAP framework, supporting the construct validity of the instrument.

Data collection
Data collection employed convenience sampling methodology. Survey distribution was conducted through multiple channels within Liaoning Province, including WeChat Moments, patient group networks, clinic recruitment, and professional networks. The questionnaire was administered via Wenjuanxing (http://www.wjx.cn), a widely-used Chinese online survey platform. The platform's built-in features prevented multiple submissions from the same account, ensuring data integrity. Participants accessed the survey through QR code scanning, and data were automatically compiled and exported to Microsoft Excel. Survey access was contingent upon providing informed consent through the platform interface.

Statistical analysis
Data analysis was conducted using STATA 17.0 (Stata Corporation, College Station, TX, USA). Questionnaire reliability was assessed using Cronbach's alpha. Continuous variables underwent normality testing. Normally distributed data are presented as mean ± SD; non-normally distributed data as median [25 th, 75 th percentiles]. Categorical data are presented as n (%).

For group comparisons, t-test or ANOVA was used for normally distributed data, while Wilcoxon Mann-Whitney test or Kruskal-Wallis test was applied for non-normally distributed data. Spearman's correlation analysis assessed relationships between knowledge, attitude, and practice scores. Participants were categorized based on BMI (kg/m²) into four groups: underweight (BMI < 18.5), normal weight (18.5 ≤ BMI < 24), overweight (24 ≤ BMI < 28), and obese (BMI ≥ 28). For subgroup analyses, these were combined into two main groups: normal weight or underweight population (BMI < 24) and overweight and obesity population (BMI ≥ 24). Additional stratified analyses were conducted by residence type (rural/suburban vs. urban) to address potential sampling bias. Structural Equation Modeling (SEM) explored relationships between knowledge, attitude, and practice, with separate models for overall population, BMI subgroups, and residence types. Model fit was evaluated through Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Tucker–Lewis Index (TLI), and Comparative Fit Index (CFI). Two-sided P-value < 0.05 was considered statistically significant.

Results
Demographic characteristics
In the initial dataset of 651 respondents, 14 individuals declined to participate, leaving 637 eligible samples. After applying further criteria for data quality—excluding 8 respondents with a response time under 120 s, 22 with a BMI over 40 kg/m² (dataset range: 14.04–88.76 kg/m²), 3 who inconsistently marked both "no underlying disease" and other options, 6 who selected both "no insurance" and additional options, and another 6 who indicated both "no medication" and other options—a final sample of 595 valid responses was retained, representing approximately 91.4% of the eligible participants.

The demographic characteristics of the final sample were analyzed. Among the 595 study participants, females constituted the majority (450, 75.63%) compared to males (145, 24.37%). The mean age was 26.75 ± 10.91 years, and the average BMI was 23.49 ± 4.54 kg/m². The BMI distribution showed that 307 participants (51.60%) were in the normal range (18.528 kg/m²), and 99 (16.64%) were in the obese range (≥ 28 kg/m²). Regarding residence distribution, 451 participants (75.8%) were from urban areas, while 144 (24.20%) were from rural/suburban areas. Educational background analysis revealed that 483 participants (81.18%) held college/undergraduate degrees, 85 (14.29%) had postgraduate or higher education, and 27 (4.54%) had high school education or below. Employment status showed that 329 participants (55.29%) were unemployed. Monthly household income distribution indicated that 194 participants (32.61%) earned 5000–10,000¥, 185 (31.09%) earned 2000–5000¥, 94 (15.8%) earned 10,000–20,000¥, 79 (13.28%) earned < 2000¥, and 43 (7.23%) earned > 20,000¥. Marital status data showed 411 (69.08%) were unmarried. Health-related characteristics indicated that 541 participants (90.92%) reported no chronic conditions, 548 (92.1%) had never smoked, and 424 (71.26%) had never consumed alcohol. Regarding primary food sources, the majority of participants (387, 65.04%) relied on mixed sources, followed by home-cooked meals (98, 16.47%), dining out (60, 10.08%), and ordering takeout (50, 8.4%). Significant differences were observed in practice scores across different primary food sources (p = 0.003) (Table 1).

Knowledge, attitude, and practice scores
The overall knowledge score was 13.64 ± 5.88, while attitude and practice scores demonstrated median values of 28[25,31] and 35[32,42], respectively. Knowledge scores exhibited significant variations across education levels (p = 0.040), with postgraduate or above education showing higher scores (14.05 ± 6.40) compared to those with high school education or below (10.88 ± 6.25). Monthly household income categories displayed significant differences in knowledge scores (p = 0.007), with the highest scores observed in the 10,000–20,000¥ group (15.02 ± 6.06) and lowest in the < 2000¥ group (11.74 ± 4.92). Smoking status significantly influenced knowledge scores (p = 0.006), with current smokers showing lower scores (10.07 ± 6.65) compared to never smokers (13.80 ± 5.83) and former smokers (13.95 ± 4.65).

For attitude scores, significant differences were observed across several characteristics. Gender differences were noted (p = 0.033), with females showing higher median scores (28[25,31]) compared to males (28[24,30]). Employment status was also associated with attitude scores (p = 0.020), with unemployed participants showing higher median scores (29[25,31]) compared to employed participants (27.5[25,30]). Marital status showed

N = 595	*N* (%)	Knowledge		Attitude		Practice	
		Mean ± SD	*P*	Med [q25, q75]	*P*	Med [q25, q75]	*P*
Total		13.64 ± 5.88		28[25,31]		35[32,42]	
Gender			0.059[a]		0.033[c]		0.324 [c]
Male	145(24.37)	12.84 ± 6.52		28[24,30]		34[32,42]	
Female	450(75.63)	13.90 ± 5.63		28[25,31]		35[32,42]	
Age (years) [18–79]	26.75 ± 10.91						
BMI (kg/m²)	23.49 ± 4.54		0.142[b]		0.754 [c]		0.246 [c]
< 18.5	61(10.25)	12.60 ± 6.09		28[25,31]		33[32,38]	
18.5 ~ 24	307(51.60)	13.67 ± 5.84		28[25,31]		35[33,42]	
24 ~ 28	128(21.51)	14.49 ± 5.59		28[25.5,30]		36[32,42]	
≥ 28	99(16.64)	13.09 ± 6.13		27[25,30]		36[32,43]	
Residence Type			0.108[a]		0.278 [c]		0.181 [c]
Rural/Suburban	144(24.20)	12.95 ± 5.92		28[25,31]		34[32,41]	
Urban	451(75.8)	13.86 ± 5.85		28[25,31]		36[32,42]	
Education Level			0.040[b]		0.194 [c]		0.162 [c]
High School or Below	27(4.54)	10.88 ± 6.25		27[25,30]		35[30,39]	
College/Undergraduate	483(81.18)	13.72 ± 5.73		28[25,31]		35[32,42]	
Postgraduate or Above	85(14.29)	14.05 ± 6.40		27[24,30]		37[33,43]	
Employment Status			0.482[a]		0.020 [c]		0.640 [c]
Employed	266(44.71)	13.45 ± 6.09		27.5[25,30]		35[32,42]	
Unemployed	329(55.29)	13.79 ± 5.70		29[25,31]		35[32,42]	
Monthly Household Income (¥)			0.007 [c]		0.600[c]		< 0.001[c]
< 2000	79(13.28)	11.74 ± 4.92		27[24,31]		33[29,36]	
2000–5000	185(31.09)	13.32 ± 5.76		29[25,31]		35[33,41]	
5000–10,000	194(32.61)	13.77 ± 6.01		28[25,31]		35[31,42]	
10,000–20,000	94(15.8)	15.02 ± 6.06		28[25,30]		39[34,44]	
> 20,000	43(7.23)	14.86 ± 6.10		27[24,31]		41[33,46]	
Marital Status			0.069[a]		0.032 [c]		0.750 [c]
Unmarried	411(69.08)	13.93 ± 5.68		28[25,31]		35[32,42]	
Married	184(30.92)	12.98 ± 6.24		27[25,30]		36[32,42]	
Chronic Conditions			0.090[a]		0.243 [c]		0.774 [c]
No	541(90.92)	13.77 ± 5.84		28[25,31]		35[32,42]	
Yes	54(9.08)	12.35 ± 6.09		27[26,29]		36[33,40]	
Smoking Status			0.006[b]		0.126 [c]		0.320 [c]
Never Smoked	548(92.1)	13.80 ± 5.83		28[25,31]		35[32,42]	
Former Smoker	21(3.53)	13.95 ± 4.65		29[25,30]		36[33,40]	
Current Smoker	26(4.37)	10.07 ± 6.65		26.5[24,30]		34[27,41]	
Alcohol Consumption			0.911[b]		0.137 [c]		0.102 [c]
Never Drank	424(71.26)	13.59 ± 5.71		28[25,31]		35[33,42]	
Former Drinker	63(10.59)	13.93 ± 6.05		27[24,30]		36[32,43]	
Current Drinker	108(18.15)	13.66 ± 6.44		28[25,31]		34[29.5,41]	
Insurance Type			0.423[a]		0.831 [c]		0.393 [c]
Uninsured	60(10.08)	13.06 ± 6.13		28[25,31]		34[29.5,41]	
Insured	535(89.92)	13.70 ± 5.85		28[25,31]		35[32,42]	
Medication Usage			0.471[a]		0.862 [c]		0.873 [c]
No	533(89.58)	13.70 ± 5.86		28[25,31]		35[32,42]	
Yes	61(10.27)	13.13 ± 6.10		28[26,30]		36[31,40]	
Primary Food Source			0.486[b]		0.499[c]		0.003[c]
Dining Out (e.g., restaurants, fast food)	60(10.08)	12.65 ± 6.43		27.5[25,31]		33.5[29.5,39.5]	
Ordering Takeout	50(8.4)	13.18 ± 5.02		27[24,30]		33[29,38]	
Home-Cooked Meals	98(16.47)	13.86 ± 6.08		28[26,31]		36[33,45]	
Mixed Sources	387(65.04)	13.80 ± 5.84		28[25,31]		35[33,42]	

Table 1. Demographic information and KAP scores. P values indicate significance tests, with a: ANOVA, b: T-test, and c: Mann-Whitney.

significant differences ($p = 0.032$), with unmarried participants demonstrating higher median scores (28[25,31]) compared to married participants (27[25,30]).

Practice scores showed significant variations across monthly household income categories ($p < 0.001$), with the highest median scores observed in the > 20,000¥ group (41[33,46]) and the lowest in the < 2000¥ group (33[29,36]). Primary food source was also significantly associated with practice scores ($p = 0.003$), with home-cooked meals showing higher median scores (36[33,45]) compared to dining out (33.5[29.5,39.5]) and ordering takeout (33[29,38]) (Table 1).

Knowledge, attitudes and practices

Knowledge assessment revealed varying levels of awareness across different aspects of obesity management. The highest level of understanding was observed regarding sleep-related obesity risks (K10), with 235 participants (39.5%) being well-informed about the relationship between irregular sleep patterns and obesity risk, while 320 (53.78%) had heard of it. Understanding of obesity's multifactorial nature and management approaches (K1) was well-established among 196 participants (32.94%), with 348 (58.49%) having heard of it. Knowledge about rapid weight loss mechanisms (K11) was evident in 204 participants (34.29%), with 348 (58.49%) having heard of it. Awareness of energy intake control and balanced diet principles (K3) was demonstrated by 122 participants (20.5%), while 362 (60.84%) had heard of it. Understanding of BMI-based diagnosis criteria (K2) showed 169 participants (28.4%) were well-informed, and 328 (55.13%) had heard of it. Comparative analysis between overweight and obesity group versus normal weight or underweight group revealed no significant differences in knowledge scores across all items (Table 2).

Attitude assessment demonstrated varied perspectives across different aspects of weight management. Regarding breakfast importance (A2), 324 participants (54.45%) strongly agreed and 203 (34.12%) agreed that it should not be skipped. For weight loss rates (A4), 203 participants (34.12%) strongly agreed and 250 (42.02%)

Knowledge	N (%)			Scores		P*
	Well Informed	Heard of It	Unaware	Normal Weight or Underweight	Overweight and Obesity	
1. Overweight and obesity result from an imbalance between energy intake and expenditure, with multifactorial causes, including genetic, dietary, lifestyle, behavioral, psychological, and other factors (e.g., occupation, educational attainment, socioeconomic status, health literacy, disease conditions, and medication use). Management of overweight and obesity involves various lifestyle interventions, primarily including dietary management, physical activity, and behavioral modification.	196(32.94)	348(58.49)	51(8.57)	1.24 ± 0.59	1.22 ± 0.63	0.693
2. In China, overweight and obesity in adults are diagnosed based on body mass index (BMI): overweight is defined as 24.0 kg/m² ≤ BMI < 28.0 kg/m², and obesity as BMI ≥ 28.0 kg/m². Central obesity is diagnosed using waist circumference thresholds of ≥ 90.0 cm for men and ≥ 85.0 cm for women.	169(28.4)	328(55.13)	98(16.47)	1.12 ± 0.65	1.08 ± 0.66	0.517
3. Controlling total energy intake and maintaining a balanced diet are essential for weight management. Specific approaches include reducing daily energy intake by 30–50% on average, lowering caloric intake by 500–1000 kcal per day, or tailoring intake to individual needs, such as providing 85% or 80% of standard intake for overweight and obese individuals.	122(20.5)	362(60.84)	111(18.66)	1.03 ± 0.62	0.94 ± 0.62	0.875
4. Total energy expenditure in the human body comprises basal metabolic rate (BMR), the thermic effect of food, and energy expenditure from physical activity. Among these, BMR is the largest contributor, accounting for 60–70% of daily energy expenditure.	137(23.03)	350(58.82)	108(18.15)	1.05 ± 0.63	1.03 ± 0.64	0.619
5. Increased muscle mass can enhance BMR. Simply put, when the "calories burned by basal metabolism + calories burned by physical activity > calories consumed through diet," it may lead to the phenomenon where individuals "don't gain weight no matter how much they eat."	147(24.71)	350(58.82)	98(16.47)	1.08 ± 0.64	1.07 ± 0.59	0.301
6. While energy-restricted diets provide an effective method for reducing fat mass and abdominal obesity, consuming energy below basal metabolic requirements can also lead to skeletal muscle loss.	132(22.18)	349(58.66)	114(19.16)	1.03 ± 0.64	1.01 ± 0.63	0.946
7. Weight loss strategies should focus on post-weight-loss body composition rather than simply weight reduction. Specifically, interventions should aim to reduce fat mass, particularly visceral fat, while preserving muscle mass.	140(23.53)	366(61.51)	89(14.96)	1.08 ± 0.62	1.07 ± 0.55	0.342
8. Maintaining relatively fixed meal times and having three regular meals per day, with consistent timing and portion sizes, can prevent overeating caused by delayed satiety due to excessive hunger.	151(25.38)	375(63.03)	69(11.6)	1.15 ± 0.60	1.04 ± 0.53	0.464
9. Eating slowly and chewing thoroughly can help reduce total food intake even with the same meal. Slowing the eating pace can enhance satiety and reduce hunger. Modifying the eating sequence, such as starting with vegetables, followed by protein-rich foods, and ending with staple foods, can also help reduce the consumption of high-energy foods.	182(30.59)	365(61.34)	48(8.07)	1.24 ± 0.57	1.11 ± 0.56	0.908
10. Frequent late nights, insufficient sleep, and irregular routines can lead to endocrine disorders, abnormal fat metabolism, and an increased risk of obesity, commonly referred to as "overwork obesity." Adhering to circadian rhythms, ensuring about seven hours of sleep daily, and going to bed before 11 p.m. are recommended.	235(39.5)	320(53.78)	40(6.72)	1.33 ± 0.59	1.27 ± 0.60	0.324
11. Rapid weight loss over a short period is mainly due to water loss rather than fat reduction. Once normal eating habits resume, the body replenishes water stores to maintain normal function, leading to quick weight regain.	204(34.29)	348(58.49)	43(7.23)	1.28 ± 0.57	1.19 ± 0.61	0.675
12. An ideal weight loss goal is to reduce 5–10% of current body weight within six months. A reasonable rate of weight loss is 2–4 kg per month.	133(22.35)	361(60.67)	101(16.97)	1.05 ± 0.62	1.04 ± 0.62	0.417

Table 2. Knowledge dimension. *P-values were calculated using the chi-square test to evaluate the differences in knowledge levels between non-obese and obese individuals for each item listed.

agreed about the importance of appropriate pacing. Weight loss plateau understanding (A8) showed significant differences between groups ($p = 0.015$), with the overweight and obesity group demonstrating higher scores compared to the normal weight or underweight group (3.98 ± 0.81 vs. 3.92 ± 0.77). Perception of obesity causes (A1) also differed significantly between groups ($p = 0.033$). Assessment of energy restriction attitudes (A6) revealed that 126 participants (21.18%) strongly agreed and 322 (54.12%) agreed with the necessity of adjusting energy intake during weight loss progression (Table 3).

Practice behaviors demonstrated varying levels of adherence across different weight management strategies. Alcohol consumption limitation (P7) showed the highest compliance, with 305 participants (51.26%) always adhering and 108 (18.15%) often adhering. Dietary practices indicated that 119 participants (20%) always prioritized low-fat food options (P2), while 188 (31.6%) often did so. Regular meal patterns (P8) were maintained by 136 participants (22.86%) always and 190 (31.93%) often. Calorie monitoring (P9) showed lower adherence, with only 58 participants (9.75%) always and 72 (12.1%) often tracking their intake. Physical activity engagement (P11) revealed that 81 participants (13.61%) always and 135 (22.69%) often maintained regular exercise routines. Goal-setting behaviors (P10) showed significant differences between groups ($p < 0.001$), with the overweight and obesity group demonstrating higher scores in realistic goal-setting compared to the normal weight or underweight group (3.31 ± 1.20 vs. 3.02 ± 1.21) (Table 4).

Correlation analysis

Correlation analysis revealed significant positive relationships among all KAP dimensions. Knowledge demonstrated moderate positive correlations with both attitude ($r = 0.2958$, $p = 0.0091$) and practice ($r = 0.4265$, $p = 0.0091$). The relationship between attitude and practice, while significant, showed a weaker positive correlation ($r = 0.0884$, $p = 0.0311$) (Table 5).

Multivariable analysis of factors influencing practice scores

To examine potential confounding factors, we conducted multivariable analyses on practice behaviors. Stepwise logistic regression identified knowledge score (OR = 1.16, 95% CI: 1.11–1.20, $p < 0.001$) and higher income levels (10000–20000¥: OR = 1.67, 95% CI: 1.01–2.75, $p = 0.043$; >20000¥: OR = 2.73, 95% CI: 1.37–5.42, $p = 0.004$) as significant predictors of adequate practice (> 60%). A comprehensive multivariable logistic regression incorporating education, employment status, and income with their interactions was statistically significant overall ($\chi^2 = 39.63$, $p = 0.0194$). While individual variables did not reach statistical significance when controlling for interactions, the model demonstrated a complex relationship between socioeconomic factors and practice scores. Several interaction combinations between education, employment, and income levels could not be fully assessed due to insufficient subgroup sample sizes. Detailed results of this model are presented in **Supplementary Table 2**.

Structural equation modeling results

Overall population SEM

The overall population model demonstrated adequate fit (RMSEA = 0.064, SRMR = 0.070, TLI = 0.882, CFI = 0.892). Knowledge exhibited a significant negative effect on attitude (β=−0.40, 95% CI: −0.54,−0.20, $p < 0.001$). Both knowledge and attitude significantly influenced practice, with knowledge showing a positive direct effect (β = 0.44, 95% CI: 0.30,0.58, $p < 0.001$) and attitude demonstrating a negative effect (β=−0.57, 95% CI: −0.81,−0.30, $p < 0.001$). Knowledge also had a significant indirect effect on practice through attitude (β = 0.23, 95% CI: 0.14,0.31, $p < 0.001$), resulting in a total effect of β = 0.67 (95% CI: 0.53,0.81, $p < 0.001$) (Fig. 1; Tables 6 and 7; **Supplementary Table 3**).

Attitude	Overall					Scores		P*
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Normal Weight or Underweight	Overweight and Obesity	
1. Obesity is caused by overeating and lack of physical activity. (N)	114(19.16)	189(31.76)	57(9.58)	196(32.94)	39(6.55)	2.78 ± 1.25	2.62 ± 1.35	0.033
2. Breakfast is very important and should not be skipped. (P)	324(54.45)	203(34.12)	55(9.24)	7(1.18)	6(1.01)	4.40 ± 0.76	4.34 ± 0.88	0.589
3. The most important aspect of weight loss is the change in body weight. (N)	49(8.24)	133(22.35)	78(13.11)	277(46.55)	58(9.75)	3.29 ± 1.15	3.16 ± 1.14	0.517
4. A faster weight loss rate is not necessarily better. (P)	203(34.12)	250(42.02)	52(8.74)	55(9.24)	35(5.88)	3.87 ± 1.15	4 ± 1.13	0.451
5. Eating less always leads to better weight loss results. (N)	36(6.05)	88(14.79)	59(9.92)	280(47.06)	132(22.18)	3.65 ± 1.16	3.60 ± 1.11	0.257
6. As the weight loss process progresses, it is necessary to increase energy expenditure or further restrict energy intake at a certain stage to continue losing weight. (P)	126(21.18)	322(54.12)	90(15.13)	48(8.07)	9(1.51)	3.86 ± 0.88	3.80 ± 0.96	0.684
7. Setting a "perfect" goal is essential for better motivation in weight loss. (N)	100(16.81)	263(44.2)	101(16.97)	103(17.31)	28(4.71)	2.52 ± 1.10	2.30 ± 1.09	0.284
8. If weight loss plateaus during the process, it indicates a "weight loss plateau" phase, which may last for weeks or even months. After overcoming this phase, weight loss will continue. (P)	123(20.67)	351(58.99)	88(14.79)	28(4.71)	5(0.84)	3.92 ± 0.77	3.98 ± 0.81	0.015

Table 3. Attitude dimension. Note: N represents a negative belief, while P represents a positive belief. *P-values were calculated using the chi-square test to evaluate the differences in knowledge levels between non-obese and obese individuals for each item listed.

Practice	Overall					Scores		P*
	Always	Often	Sometimes	Rarely	Never	Normal Weight or Underweight	Overweight and Obesity	
1. Reduce the intake of high-sugar fruits and vegetables with high starch content.	90(15.13)	169(28.4)	264(44.37)	57(9.58)	15(2.52)	3.44 ± 0.94	3.43 ± 0.97	0.457
2. Prioritize low-fat food options, such as lean meat, skinless chicken breast, fish, and shrimp.	119(20)	188(31.6)	222(37.31)	50(8.4)	16(2.69)	3.56 ± 0.98	3.63 ± 1.00	0.246
3. Opt for low-fat or non-fat dairy products.	88(14.79)	127(21.34)	238(40)	83(13.95)	59(9.92)	3.16 ± 1.14	3.21 ± 1.18	0.569
4. Avoid or minimize the consumption of fried foods, processed meats, sugary baked goods, preserved fruits, candies, ice cream, and sugary beverages.	86(14.45)	136(22.86)	256(43.03)	92(15.46)	25(4.2)	3.26 ± 1.00	3.34 ± 1.11	0.558
5. Consume more foods rich in dietary fiber, such as whole grains.	88(14.79)	170(28.57)	266(44.71)	63(10.59)	8(1.34)	3.43 ± 0.91	3.49 ± 0.90	0.532
6. Reduce the use of cooking oil, salt, and sugar during food preparation, and opt for cooking methods such as steaming, boiling, simmering, or poaching instead of frying.	89(14.96)	157(26.39)	268(45.04)	70(11.76)	11(1.85)	3.41 ± 0.93	3.38 ± 0.96	0.956
7. Strictly limit alcohol consumption.	305(51.26)	108(18.15)	134(22.52)	24(4.03)	24(4.03)	4.06 ± 1.13	4.19 ± 1.05	0.968
8. Maintain regular eating habits with fixed meal times and consistent portion sizes.	136(22.86)	190(31.93)	203(34.12)	57(9.58)	9(1.51)	3.64 ± 0.98	3.67 ± 0.98	0.851
9. Monitor and calculate calorie intake.	58(9.75)	72(12.1)	142(23.87)	150(25.21)	173(29.08)	2.47 ± 1.28	2.50 ± 1.32	0.430
10. Set realistic and personalized weight-loss goals.	95(15.97)	108(18.15)	210(35.29)	110(18.49)	72(12.1)	3.02 ± 1.21	3.31 ± 1.20	< 0.001
11. Stay physically active. Engage in at least 150 min of moderate-intensity aerobic exercise per week, ideally 30–90 min daily, for 3–7 days a week, with a total of 200–300 min per week. Perform resistance training 2–3 times per week on non-consecutive days.	81(13.61)	135(22.69)	219(36.81)	114(19.16)	46(7.73)	3.17 ± 1.08	3.05 ± 1.25	0.538
12. Record daily body weight.	76(12.77)	111(18.66)	191(32.1)	132(22.18)	85(14.29)	2.91 ± 1.21	3.03 ± 1.24	0.070

Table 4. Practice dimension. *P-values were calculated using the chi-square test to evaluate the differences in knowledge levels between non-obese and obese individuals for each item listed.

	Knowledge	Attitude	Practice
Knowledge	1		
Attitude	0.2958 (P = 0.0091)	1	
Practice	0.4265 (P = 0.0091)	0.0884 (P = 0.0311)	1

Table 5. Correction analysis.

BMI-Stratified analysis

BMI < 18.5

The SEM for individuals with BMI < 18.5 showed inadequate model fit (RMSEA = 0.110, SRMR = 0.137, TLI = 0.764, CFI = 0.787). Knowledge had a positive but non-significant effect on attitude (β = 0.29, p = 0.159). Both knowledge and attitude significantly influenced practice, with knowledge demonstrating a strong positive direct effect (β = 0.78, 95% CI: 0.29,1.27, p = 0.002) and attitude showing a significant negative effect (β=−0.53, 95% CI: −0.97,−0.08, p = 0.02). The indirect effect of knowledge on practice through attitude was non-significant (β=−0.15, 95% CI: −0.38,0.07, p = 0.185), resulting in a significant total effect of knowledge on practice (β = 0.62, 95% CI: 0.16,1.09, p = 0.008) (**Supplementary Tables 4–6**).

BMI 18.5–24

The model for the normal weight group demonstrated good fit (RMSEA = 0.056, SRMR = 0.071, TLI = 0.905, CFI = 0.916). Knowledge had a significant negative effect on attitude (β=−0.53, 95% CI: −0.75,−0.30, p < 0.001). Attitude significantly negatively influenced practice (β=−0.53, 95% CI: −0.79,−0.25, p < 0.001). Knowledge showed a significant direct effect on practice (β = 0.40, 95% CI: 0.21,0.59, p < 0.001) and a significant indirect effect through attitude (β = 0.27, 95% CI: 0.14,0.41, p < 0.001), yielding a strong total effect (β = 0.68, 95% CI: 0.49,0.87, p < 0.001) (**Supplementary Tables 4–6**).

BMI 24–28

For the overweight group, the model showed acceptable fit (RMSEA = 0.063, SRMR = 0.105, TLI = 0.881, CFI = 0.892). Knowledge positively influenced attitude (β = 0.61, 95% CI: 0.21,1.01, p = 0.002). Attitude had a marginally significant negative effect on practice (β=−0.19, 95% CI: −0.39,0.01, p = 0.072). Knowledge demonstrated a significant direct effect on practice (β = 0.56, 95% CI: 0.24,0.88, p = 0.001), while the indirect effect through attitude was non-significant (β=−0.11, 95% CI: −0.25,0.02, p = 0.105), yielding a significant total effect (β = 0.44, 95% CI: 0.16,0.73, p = 0.002) (**Supplementary Tables 4–6**).

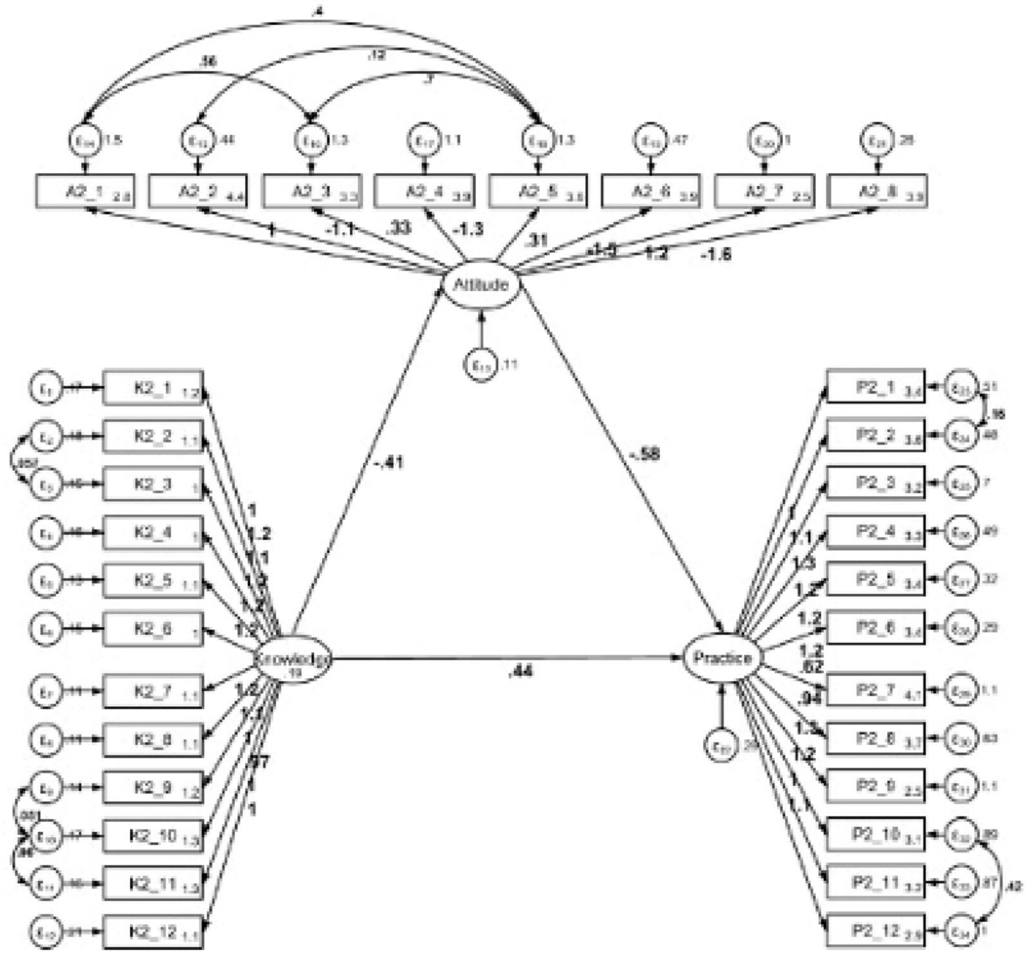

Fig. 1. SEM Path Diagram for the Overall Population.

	Estimate	*P*>|z|
Attitude		
Knowledge	0.21	< 0.001
Practice		
Attitude	−0.16	0.049
Knowledge	0.65	< 0.001

Table 6. SEM path coefficients for the overall population.

	Total effects		Direct Effect		Indirect effect	
Model paths	**β (95% CI)**	***P***	**β (95% CI)**	***P***	**β (95% CI)**	***P***
Attitude						
Knowledge	−0.40(−0.54,−0.2)	< 0.001	−0.40(−0.54,−0.2)	< 0.001		
Practice						
Attitude	−0.57(−0.81,−0.3)	< 0.001	−0.57(−0.81,−0.3)	< 0.001		
Knowledge	0.67(0.53,0.81)	< 0.001	0.44(0.30,0.58)	< 0.001	0.23(0.14,0.31)	< 0.001

Table 7. Total, direct, and indirect effects for the overall population.

BMI > 28

For the obese group, the model demonstrated marginally acceptable fit (RMSEA = 0.086, SRMR = 0.111, TLI = 0.852, CFI = 0.867). The relationship between knowledge and attitude was negative but non-significant (β=−0.29, 95% CI: −0.61,0.04, p = 0.087). Attitude had a significant negative effect on practice (β=−0.30, 95% CI: −0.53,−0.06, p = 0.012). Knowledge showed a strong direct effect on practice (β = 0.81, 95% CI: 0.48,1.13, p < 0.001), while the indirect effect through attitude was non-significant (β = 0.08, 95% CI: −0.02,0.19, p = 0.135), resulting in a strong total effect (β = 0.89, 95% CI: 0.55,1.23, p < 0.001) (**Supplementary Tables 4–6**).

Combined BMI groups analysis

Overweight and obesity population SEM

The combined obese group model showed good fit (RMSEA = 0.060, SRMR = 0.088, TLI = 0.904, CFI = 0.915). Knowledge had a significant negative effect on attitude (β=−0.35, 95% CI: −0.55,−0.14, p = 0.001). Attitude significantly negatively influenced practice (β=−0.52, 95% CI: −0.86,−0.17, p = 0.003). Knowledge exhibited a significant direct effect on practice (β = 0.44, 95% CI: 0.22,0.66, p < 0.001) and a significant indirect effect through attitude (β = 0.18, 95% CI: 0.06,0.29, p = 0.002), resulting in a strong total effect (β = 0.62, 95% CI: 0.40,0.84, p < 0.001) (Fig. 2; Tables 8 and 9; **Supplementary Table 7**).

Normal weight or underweight population SEM

The combined non-obese group model exhibited good fit (RMSEA = 0.055, SRMR = 0.070, TLI = 0.910, CFI = 0.920). Knowledge significantly negatively influenced attitude (β=−0.44, 95% CI: −0.63,−0.24, p < 0.001). Attitude had a significant negative effect on practice (β=−0.63, 95% CI: −0.96,−0.29, p < 0.001). Knowledge demonstrated a significant direct effect on practice (β = 0.40, 95% CI: 0.22,0.57, p < 0.001) and a significant indirect effect through attitude (β = 0.27, 95% CI: 0.15,0.40, p < 0.001), yielding a strong total effect (β = 0.67, 95% CI: 0.50,0.85, p < 0.001) (Fig. 3; Tables 10 and 11; **Supplementary Table 8**).

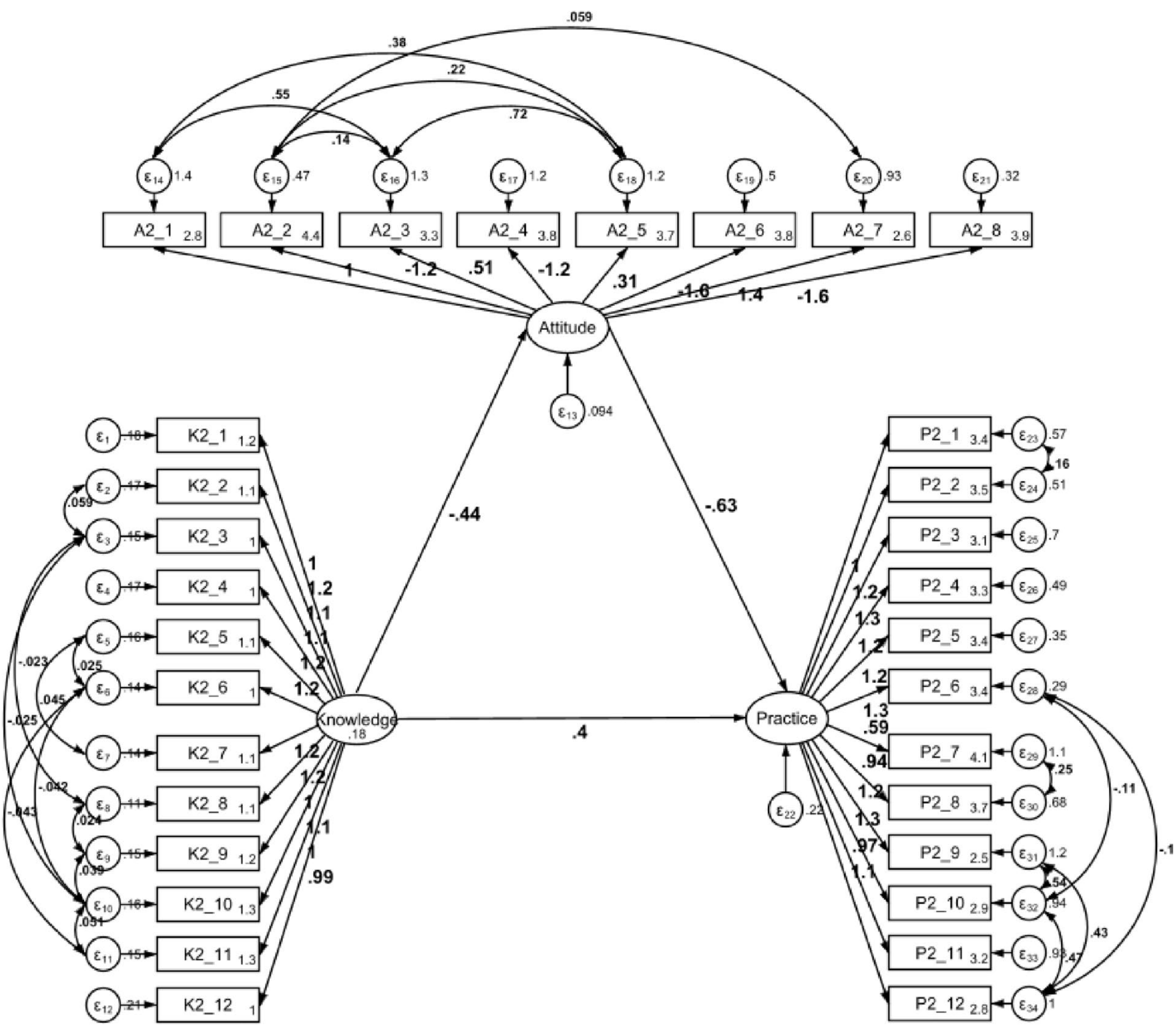

Fig. 2. SEM Path Diagram for the Overweight and Obesity Population.

	Estimate	*P*>|z|
Attitude		
Knowledge	−0.35	0.001
Practice		
Attitude	−0.52	0.003
Knowledge	0.45	< 0.001

Table 8. SEM path coefficients for the overweight and obesity population SEM.

	Total effects		Direct Effect		Indirect effect	
Model paths	β (95% CI)	*P*	β (95% CI)	*P*	β (95% CI)	*P*
Attitude						
Knowledge	−0.35(−0.55,−0.14)	0.001	−0.35(−0.55,−0.14)	0.001		
Practice						
Attitude	−0.52(−0.86,−0.17)	0.003	−0.52(−0.86,−0.17)	0.003		
Knowledge	0.62(0.40,0.84)	< 0.001	0.44(0.22,0.66)	< 0.001	0.18(0.06,0.29)	0.002

Table 9. Total, direct, and indirect effects for the overweight and obesity population SEM.

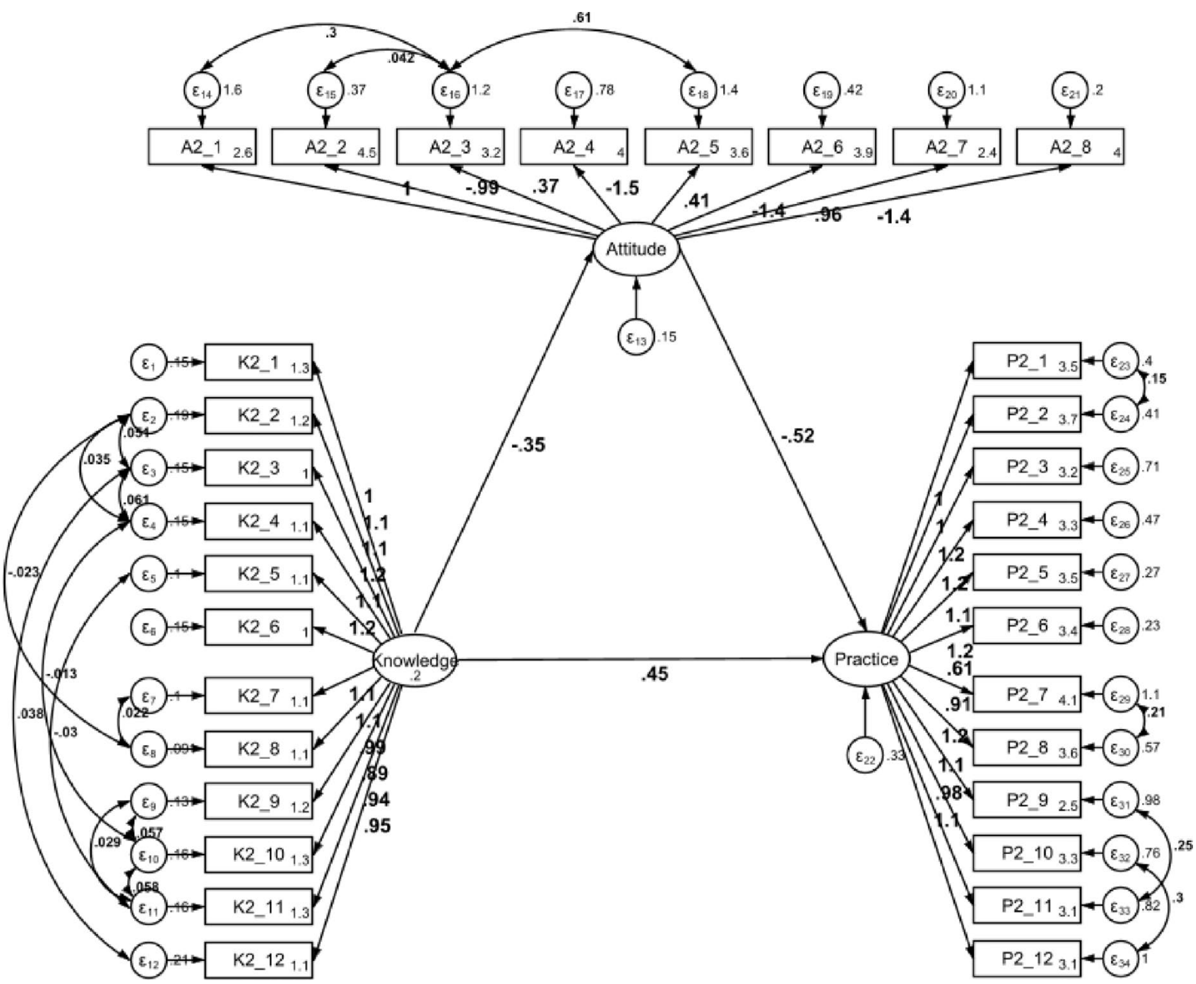

Fig. 3. SEM Path Diagram for the Normal Weight or Underweight Population.

	Estimate	P>|z|
Attitude		
Knowledge	−0.44	< 0.001
Practice		
Attitude	−0.63	< 0.001
Knowledge	0.40	< 0.001

Table 10. SEM path coefficients for the normal weight or underweight population SEM.

	Total effects		Direct Effect		Indirect effect	
Model paths	β (95% CI)	P	β (95% CI)	P	β (95% CI)	P
Attitude						
Knowledge	−0.44(−0.63,−0.24)	< 0.001	−0.44(−0.63,−0.24)	< 0.001		
Practice						
Attitude	−0.63(−0.96,−0.29)	< 0.001	−0.63(−0.96,−0.29)	< 0.001		
Knowledge	0.67(0.50,0.85)	< 0.001	0.40(0.22,0.57)	< 0.001	0.27(0.15,0.40)	< 0.001

Table 11. Total, direct, and indirect effects for the normal weight or underweight population SEM.

Stratified analysis by residence type

To address potential sampling bias and enhance the robustness of our findings, we conducted stratified SEM analyses by residence type. Model fit indices for both rural/suburban (n = 144) and urban (n = 451) subgroups showed comparable values (RMSEA = 0.086, SRMR = 0.092, TLI = 0.794, CFI = 0.796) (**Supplementary Table 9**).

In the rural/suburban model, knowledge demonstrated a stronger negative effect on attitude (β=−0.55, $p < 0.001$) compared to the urban model (β=−0.40, $p < 0.001$). Similarly, the relationship between attitude and practice was more pronounced in the rural/suburban group (β=−0.63, $p < 0.001$) than in the urban group (β=−0.54, $p < 0.001$). Conversely, the direct effect of knowledge on practice was slightly stronger in the urban population (β = 0.47, $p < 0.001$) compared to the rural/suburban group (β = 0.41, $p = 0.004$).

Despite these differences in individual path coefficients, the total effect of knowledge on practice remained substantial and significant in both groups (rural/suburban: β = 0.75, 95% CI: 0.49,1.01, $p < 0.001$; urban: β = 0.68, 95% CI: 0.53,0.83, $p < 0.001$). The indirect effect of knowledge on practice through attitude was also significant in both subgroups (rural/suburban: β = 0.34, 95% CI: 0.14,0.54, $p = 0.001$; urban: β = 0.21, 95% CI: 0.12,0.31, $p < 0.001$) (**Supplementary Tables 9–10**).

Discussion

This study revealed moderate levels of knowledge and attitudes but relatively low practice levels regarding weight management among participants in Northeast China. The findings demonstrated significant variations across different demographic characteristics, particularly in education levels and income categories. Notably, participants with overweight and obesity showed better understanding of weight loss plateaus and more realistic goal-setting behaviors. The structural equation modeling analysis identified significant associations between knowledge and both attitudes and practices, while also revealing complex relationships among these components across different weight status subgroups.

This study investigated the relationships among KAP regarding weight management among participants in Northeast China. The findings revealed moderate levels of knowledge and attitudes but notably low levels of practice, indicating significant gaps between cognitive understanding and behavioral implementation. Research has shown that dietary adherence, rather than diet type, is the primary determinant of successful weight loss outcomes[22,23]. This knowledge-behavior gap is further complicated by physiological defense mechanisms that actively resist changes to body composition.

The SEM analysis, conducted across both the overall population and specific BMI subgroups, enhances our understanding of KAP interactions across different body weight categories. Our analysis revealed distinct relationship patterns that varied notably across weight categories. The knowledge-attitude relationship showed interesting variations across BMI categories. While most groups exhibited a negative knowledge-attitude relationship, the overweight group (BMI 24–28) demonstrated a significant positive relationship. This notable contrast suggests that overweight individuals may perceive nutrition knowledge as empowering and motivating, while those with normal weight or obesity may develop more cautious attitudes with increased knowledge. This divergence might reflect different psychological responses to health information based on weight status, where overweight individuals—perhaps more receptive to change than those with obesity—view knowledge as a catalyst for positive attitude formation.

Knowledge maintained a strong positive direct effect on practice across all BMI categories, with substantial effects observed in both underweight and obese populations. This consistent finding emphasizes the fundamental role of education in promoting healthier behaviors regardless of weight status, aligning with KAP theory that positions knowledge as a crucial precursor to behavioral change in public health outcomes[24] The persistence of this positive relationship across all weight categories reinforces the importance of nutrition education as a cornerstone of dietary behavior change strategies.

The marginally significant attitude-practice relationship in the overweight population (BMI 24–28) is particularly noteworthy and warrants further exploration. This attenuated relationship might reflect the complex psychological dynamics specific to individuals in the overweight category. Unlike those with obesity who may face more entrenched barriers, or normal-weight individuals who may lack personal experience with weight management struggles, overweight individuals may occupy a unique psychological space. Research shows that perceiving oneself as being “overweight” can paradoxically lead to future weight gain through psychological distress mechanisms[25]. They might experience weight stigma and management challenges without having reached the clinical threshold where medical intervention is strongly emphasized. Several psychological factors could significantly moderate this relationship: self-efficacy, which has been established as a crucial predictor of sustained behavioral change in weight management[26]; emotional eating patterns, with research demonstrating that overweight individuals report significantly more eating during negative emotional states compared to normal-weight or underweight counterparts[27]; weight cycling history; and internalized weight bias, which has been shown to disrupt autonomous motivation for health behaviors essential for long-term weight control success[26].

The impact of attitudes on practice was consistently negative across all groups, contrary to what might be intuitively expected. This relationship was particularly strong in the normal weight group and non-obese combined group, while being less pronounced though still marginally significant in the overweight population. This counterintuitive finding suggests that more realistic attitudes about weight management challenges might actually be associated with lower practice levels due to perceived barriers. For obese individuals, this negative attitude-practice relationship may reflect psychological barriers from previous failed attempts. Qualitative research demonstrates that repeated unsuccessful weight loss experiences can lead to feelings of anxiety, failure, and rebellion, ultimately contributing to the abandonment of healthy behaviors[28].

Our multivariable analyses further illuminate the complex interplay between sociodemographic factors and weight management behaviors. The stepwise regression revealed that knowledge remains a robust predictor of practice behaviors even after controlling for potential confounding factors, with each point increase in knowledge score associated with 16% higher odds of adequate practice. This finding reinforces the foundational role of education in promoting healthier weight management behaviors, consistent with the KAP theoretical framework. Income emerged as another significant determinant, with participants in higher income brackets demonstrating substantially better adherence to recommended practices. These socioeconomic factors significantly influence health behaviors, as participants with higher income levels demonstrated better knowledge and improved practices, highlighting the role of financial resources in both accessing information and implementing healthier lifestyles. The challenges for lower-income groups are multifaceted, including limited financial resources and time constraints that significantly impact health behaviors, as evidenced by barriers such as inability to afford gym memberships and reliance on convenience foods due to long work hours[28]. This suggests that effective interventions should address not only knowledge gaps but also practical socioeconomic barriers that may prevent individuals from translating knowledge into sustainable health.

Weight stigmatization leads to negative psychosocial consequences and impedes obese patients’ participation in healthy lifestyles and healthcare-seeking behaviors, affecting their overall health management[29–32]. A substantial proportion of patients experience weight-related discrimination in healthcare settings (31.9%) and workplaces (19.8%), significantly impacting obesity prevention and treatment[33].

The absence of obesity as an independent chronic disease category in China’s healthcare system has led to its inadequate integration into the country’s three-tier medical system. This gap is particularly concerning in Northeast China, where obesity rates rank fifth highest nationally, characterized by a dietary pattern high in salt and oil, traditional food preservation methods during winter, limited dietary diversity, and poor breakfast quality. To address this systemic gap, it is recommended that China establish a more systematic obesity prevention and control framework, with special attention to regions like Northeast China where dietary habits pose additional challenges. Furthermore, China lacks policy support in addressing obesity. Evidence-based policy mechanisms proven effective in other countries, such as restrictions on marketing unhealthy foods to children, food nutrition labeling, and sugar-sweetened beverage taxation, lack research and practical exploration in China[34]. Implementation of these evidence-based policies should be prioritized to create a more supportive environment for weight management, with particular consideration for regional dietary patterns such as those in Northeast China, where interventions must address unique challenges like the prevalence of high-calorie preserved foods and limited fresh food accessibility during winter months. Moreover, China lacks mature institutional mechanisms to prevent and balance food industry interests in food governance and policy-making processes[35]. Development of transparent regulatory frameworks to manage industry influence in policy-making is essential.

In Chinese sociocultural norms, larger body sizes are often viewed as symbols of wealth and health, particularly among generations that experienced the 1959–1961 famine. Caregivers frequently misinterpret larger body size as an indicator of healthy growth in children. To address these cultural misconceptions, public health education should focus on evidence-based health indicators rather than traditional beliefs. Notable cultural factors include pregnancy-related dietary traditions, where Chinese women are often encouraged to overeat certain foods and maintain sedentary behavior, believed to benefit maternal and infant health. These practices may lead to excessive gestational weight gain and postpartum weight retention while increasing the risk of macrosomia[36,37]. Healthcare providers should develop culturally sensitive interventions that respect traditional practices.

Genome-wide association studies (GWAS) have identified 26 BMI-associated genetic variants in East Asian populations, including genes affecting insulin secretion, lipids, blood pressure, and body fat. However, these genetic variants explain only 1.5% of BMI variation in East Asians[38]. Research indicates significant interactions between genetic factors and lifestyle - for example, higher levels of physical activity can attenuate the influence of genetic susceptibility to obesity[39,40]. This suggests that personalized intervention strategies should consider both genetic predisposition and modifiable lifestyle factors. Simultaneously, environmental factors such as urbanization, food system changes, and built environment shape individual dietary and exercise behaviors. The rapid expansion of the fast-food industry (from $13 billion in 1999 to $84.8 billion in 2013) and the prevalence of ultra-processed foods have subtly influenced dietary choices[41]. Policy interventions should therefore target both individual behaviors and environmental factors.

Community environmental factors significantly influence obesity rates. Research indicates that community green space coverage and walkability correlate closely with residents' weight status[42]. Urban planning should prioritize the creation of health-promoting environments with adequate green spaces and walking infrastructure. Longitudinal studies show that childhood obesity often persists into adulthood, with a 13-year follow-up study demonstrating significantly increased risk of adult obesity among obese children[43]. This emphasizes the need for early intervention programs targeting childhood obesity through family education, school-based interventions, and community support. Cultural perspectives on weight management require attention, as traditional beliefs about "plumpness as prosperity" persist, particularly among elderly populations[44]. Health education programs should address these cultural beliefs while promoting evidence-based health concepts.

Healthcare professionals should implement comprehensive, person-centered approaches when treating patients with obesity. Evidence suggests practitioners should seek permission before initiating weight-related discussions, employ person-first language avoiding stigmatization, and emphasize positive outcomes rather than negative consequences. When providing guidance, healthcare professionals should recognize obesity as a complex chronic condition influenced by multiple factors, including genetic predisposition[45]. Professional training programs should be developed to enhance healthcare providers' competency in obesity management. Furthermore, practitioners should ensure appropriate clinical environments with suitable equipment and private spaces for weight measurements, while maintaining collaborative goal-setting that focuses on meaningful patient-centered outcomes rather than just numerical weight targets[45]. Healthcare facilities should be equipped with appropriate infrastructure and resources to support dignified and effective obesity care, with enhanced support in regions like Northeast China where the combination of dietary habits, food preservation practices, and seasonal variations create unique challenges for weight management.

Several limitations should be considered when interpreting our findings. First, our sampling approach has notable demographic imbalances: convenience sampling with predominance of female participants (75.63%), higher educational attainment (81.18% with college degrees), and urban residents (75.8%). These imbalances may limit generalizability to the broader Northeast Chinese population. Second, the uneven distribution across BMI categories, particularly the smaller underweight group ($n = 61$, 10.25%), means our BMI-stratified analyses should be considered exploratory rather than confirmatory. Third, the exclusion of participants with BMI > 40 kg/m² ($n = 22$) may limit the generalizability of our findings to individuals with severe obesity, a population that may be increasing with ongoing urbanization in Northeast China. Fourth, our cross-sectional design prevents establishing causal relationships between knowledge, attitudes, and practices over time. Fifth, the self-reported nature of data collection may have introduced social desirability bias, particularly regarding dietary practices and weight management behaviors. Finally, our study focused primarily on the basic KAP framework without measuring important psychological constructs (such as self-efficacy, emotional eating) or environmental factors that might mediate or moderate the observed relationships. Future research should address these limitations through more diverse sampling, longitudinal designs, objective measurements, and expansion of the theoretical framework to include additional psychological and environmental constructs.

The findings of this study highlight the observed relationships among knowledge, attitudes, and practices in weight management. While moderate levels of knowledge and attitudes were observed, the relatively low practice scores suggest a gap between understanding and implementation. These results suggest that future interventions may consider addressing both educational aspects and potential barriers to implementation. Healthcare providers and policymakers might consider developing comprehensive strategies that address the specific needs and characteristics of different weight status categories, with attention to factors associated with sustainable practice behaviors in the Northeast Chinese population.

Data availability

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

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Author contributions

Yanchun Li and Yixin Ma were responsible for the questionnaire design. Yanchun Li. and Yixin Ma drafted the manuscript. Qiqi Wu and Shunyu Ning reviewed and provided critical feedback on the manuscript. Mengdi Zhao and Q.Z. collected the questionnaire data. Yanyun Zhang organized and processed the questionnaire data. All authors have read and approved the final version of the manuscript.

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Declarations

Ethics approval and consent to participate

I confirm that all methods were performed in accordance with the relevant guidelines. All procedures were performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments from September to November 2024 in Liaoning Province, China. Ethical approval was obtained from the Ethics Committee of the Affiliated Hospital of Liaoning University of Traditional Chinese Medicine (Approval No. 2024101 CS(LW)-001-01). Informed consent was acquired from all participants through their agreement via an online questionnaire.

Competing interests

The authors declare no competing interests.

Additional information

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