

Table S1 Characteristics of the participants.

Variables	n (%)	Knowledge score		Attitude score		Practice score		Lifestyle score	
		Mean ± SD	P	Mean ± SD	P	Mean ± SD	P	Mean ± SD	P
Gender			0.385		0.694		0.384		0.027
Male	289 (71.89)	6.69±3.39		41.32±4.63		30.86±3.98		41.95±6.24	
Female	113 (28.11)	6.35±3.79		41.10±6.05		30.45±4.73		43.43±5.36	
Age (years)	56.84±11.93								
Body mass index (kg/m²)			0.550		0.687		0.406		0.570
<18.5	55 (13.68)	6.16±3.68		41.69±4.57		30.05±4.17		43.07±6.99	
18.5-23.9	245 (60.95)	6.61±3.44		41.09±5.13		30.90±4.37		42.36±5.78	
≥24	102 (25.37)	6.80±3.59		41.41±5.16		30.75±3.78		42.00±6.12	
Residential area			0.061		0.010		0.347		0.274
Rural	225 (55.97)	6.31±3.53		40.68±4.89		30.57±4.16		42.08±5.51	

City	177 (44.03)	6.97±3.46	41.99±5.19	30.97±4.25	42.74±6.65
Residential status		0.560	0.035	0.084	0.136
Living alone	43 (10.70)	6.30±3.56	39.72±4.76	29.70±4.68	41.07±6.00
Living with others	359 (89.30)	6.63±3.50	41.44±5.07	30.87±4.13	42.52±6.03
Marital Status		0.918	0.148	0.153	0.031
Unmarried	22 (5.47)	6.14±3.76	40.36±4.75	29.91±4.91	39.09±6.45
Married	362 (90.05)	6.64±3.50	41.32±5.09	30.75±4.13	42.49±5.99
Divorced	8 (1.99)	6.25±3.49	38.25±5.47	29.50±5.53	42.38±5.15
Widowed	10 (2.49)	6.50±3.81	43.40±3.53	33.30±3.65	45.20±5.55
Education		0.426	0.449	0.310	0.233
Junior high school and below	79 (19.65)	6.56±3.60	40.96±5.89	30.01±4.85	42.67±5.95

High school/technical secondary school	137 (34.08)	6.33±3.60	41.72±4.61	31.25±3.66	42.81±5.69
College	112 (27.86)	6.92±3.36	40.72±5.05	30.71±3.94	42.12±6.04
Bachelor’s degree	68 (16.92)	6.82±3.46	41.35±5.03	30.56±4.88	41.99±6.39
Postgraduate and above	6 (1.49)	4.67±3.27	43.33±3.33	31.67±2.25	37.33±9.61
Average monthly income, RMB		0.500	0.005	0.276	0.094
<2000	86 (21.39)	6.13±3.70	39.66±5.88	30.05±4.86	42.19±5.97
2000-5000	196 (48.76)	6.81±3.39	41.87±4.58	31.04±3.99	42.64±5.93
5001-10,000	83 (20.65)	6.52±3.64	40.90±5.39	30.69±4.20	42.98±5.89
10,001-20,000	23 (5.72)	6.30±3.50	41.87±3.86	30.22±3.69	39.26±6.88
>20,000	14 (3.48)	7.50±3.16	43.50±3.46	32.07±3.25	41.21±6.55
Types of health insurance					

Urban Employee Basic	134 (33.33)	6.94±3.37	41.70±4.90	30.93±4.11	42.82±5.96
Medical Insurance					
New Rural Cooperative	207 (51.49)	6.24±3.57	40.87±5.16	30.76±4.15	41.91±6.08
Medical Insurance					
Urban Resident Basic	53 (13.18)	7.11±3.46	42.06±4.72	30.75±3.95	43.66±5.73
Medical Insurance					
Commercial Insurance	6 (1.49)	6.33±4.56	40.33±6.25	29.67±5.75	38.17±7.11
Self-payment	2 (0.50)	8.00±1.41	33.00±1.41	20.00±8.49	38.00±4.24
GI Symptoms					
Loss of appetite	113 (28.11)	6.09±3.45	41.15±4.33	30.44±4.65	40.89±6.72
Nausea and vomiting	54 (13.43)	6.80±3.20	40.89±4.90	29.81±5.12	39.52±7.87
Constipation	53 (13.18)	6.25±3.59	40.72±5.26	29.70±4.22	40.13±6.30
Diarrhea	34 (8.46)	7.41±2.84	40.88±3.67	30.00±4.71	41.15±6.63

Oral ulcers	18 (4.48)	6.94±3.46	41.89±4.17	31.56±4.08	39.89±8.63	
Dry Mouth	45 (11.19)	6.11±3.49	41.07±4.86	30.24±4.78	41.91±6.78	
Altered taste perception	27 (6.72)	5.37±3.56	40.44±4.97	30.81±5.58	41.59±8.02	
Altered smell perception	8 (1.99)	4.75±3.45	41.13±3.72	29.13±6.13	41.00±8.64	
Swallowing Difficulties	13 (3.23)	6.38±3.64	40.08±6.49	29.31±5.99	41.38±7.09	
Feeling of fullness	48 (11.94)	5.65±3.44	41.65±4.35	31.40±4.34	43.33±6.57	
Pain	66 (16.42)	6.39±3.71	42.29±4.04	30.56±3.89	43.06±6.00	
None	198 (49.25)	6.80±3.52	40.98±5.45	30.88±4.07	43.28±5.18	
IrAEs			0.527	0.276	0.122	0.954
Yes	41 (10.20)	6.27±3.78	42.07±4.42	29.78±4.18	42.32±6.60	
No	361 (89.80)	6.63±3.48	41.16±5.13	30.85±4.20	42.37±5.98	
Symptoms you experienced						

Capillary Proliferation Syndrome	9 (2.24)	4.89±3.95	41.11±3.37	31.00±2.55	42.78±7.66
Other skin reactions (rash, papules, itching, vitiligo, etc.)	18 (4.48)	6.89±3.41	40.94±4.32	30.83±3.17	41.67±7.04
Gastrointestinal reactions (diarrhea, colitis, abdominal pain, nausea, vomiting, etc.)	16 (3.98)	6.75±3.24	41.75±4.30	30.00±4.76	40.25±6.22
Hepatic reactions	7 (1.74)	5.14±3.39	43.29±3.99	30.43±3.99	43.86±7.24
Endocrine reactions (hypothyroidism,	2 (0.50)	9.50±0.71	40.00±8.49	26.00±8.49	35.00±11.31

hyperthyroidism, adrenal					
insufficiency, etc.)					
Pneumonia	1 (0.25)	9.00	40	29	30
Cardiac reactions	0	0	0	0	0
Renal toxicity (nephritis)	0	0	0	0	0
Muscle or joint pain,	13 (3.23)	5.85±3.74	41.92±4.82	30.08±5.85	44.92±2.99
muscle weakness					
Other	4 (1.00)	7.50±4.36	39.75±5.06	27.75±5.44	41.00±9.56
Number	of		0.736	0.529	0.620
immunotherapy					
medication					
1	218 (54.23)	6.65±3.50	41.11±5.04	30.84±3.71	41.45±5.88
>1	184 (45.77)	6.53±3.52	41.43±5.09	30.63±4.73	43.46±6.06

Familiar with the specific names of the immunotherapy drugs			0.990	0.724	0.806	0.884
Yes	140 (34.83)	6.60±3.62	41.38±5.03	30.81±4.34	42.43±6.71	
No	262 (65.17)	6.60±3.45	41.19±5.09	30.71±4.13	42.34±5.66	

RMB: renminbi, the official currency in China.

Table S2. Knowledge, attitudes, and practices

Statement	Accuracy, n (%)
K1. Adverse reactions can occur during immunotherapy, but they are normal occurrences that do not require excessive attention.	204 (50.75)
K2. Skin toxicities (rashes, dermatitis, capillary proliferation), endocrine toxicities (hypothyroidism, hyperthyroidism, adrenal insufficiency), hepatic toxicities, cardiac toxicities, gastrointestinal toxicities (abdominal pain, diarrhea), pneumonia, renal toxicity (immune nephritis leading to proteinuria), etc., might emerge during the immunotherapy process.	247 (61.44)
K3. The liver is engaged in digestion, synthesis, and metabolic processes of various nutrients; impaired liver function significantly elevates the incidence of malnutrition in liver cancer patients.	245 (60.95)
K4. Tumor progression and immunotherapy can exacerbate malnutrition due to deteriorating liver function, which, in turn, affects the prognosis of liver cancer patients, leading to a vicious cycle.	231 (57.46)

- K5. Liver cancer patients undergoing treatment should undergo nutritional screening and assessment, followed by personalized nutritional interventions based on their nutritional status.

281 (69.90)
- K6. Nutritional risk screening and assessment include disease status, dietary surveys, weight changes, anthropometric measurements, laboratory examinations, etc.

290 (72.14)
- K7. Nutritional support encompasses dietary guidance, oral supplements, enteral nutrition, and parenteral nutrition.

283 (70.40)
- K8. Appropriate and effective nutritional interventions can optimize the intake structure and quantity of nutrients, improve nutritional status and liver function, enhance tolerance to surgery or other treatments, enhance immune conditions, reduce complications during treatment, elevate quality of life, and extend survival time.

290 (72.14)
- K9. Prompt identification and timely reporting of symptoms of malnutrition and immune-related events to healthcare professionals are not only beneficial for immunotherapy and ameliorating immune-related adverse symptoms and nutritional status but also increase the likelihood of continuing immunotherapy.

291 (72.39)

K10. Liver cancer patients receiving immunotherapy should be managed comprehensively throughout the cycle, from 290 (72.14) screening and assessment to diagnosis, supportive treatment, monitoring, and follow-up, focusing on nutritional and adverse event management.

Attitude	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A1. I consider nutritional support highly significant throughout the entire course of immunotherapy.	230 (27.21)	150 (37.31)	16 (3.98)	2 (0.50)	4 (1.00)
A2. I believe that targeted nutritional interventions can enhance the efficacy of immunotherapy.	196 (48.76)	175 (43.53)	25 (6.22)	2 (0.50)	4 (1.00)
A3. I deem continuous monitoring of adverse immune events to be essential.	208 (51.74)	160 (39.80)	32 (7.96)	0	2 (0.50)
A4. I would be concerned about adverse reactions following immunotherapy.	169 (42.04)	183 (45.52)	36 (8.96)	6 (1.49)	8 (1.99)

A5. I find it necessary to monitor nutrition-related indicators comprehensively.	188 (46.77)	172 (42.79)	30 (7.46)	6 (1.49)	6 (1.49)
A6. I think consuming high-quality proteins, abundant dietary fiber, and appropriate carbohydrates is crucial.	216 (53.73)	158 (39.30)	23 (5.72)	3 (0.75)	2 (0.50)
A7. I wish to acquire further knowledge about nutritional support through professional channels.	200 (49.75)	163 (40.55)	32 (7.96)	2 (0.50)	5 (1.24)
A8. I desire to gain more insights through professional channels regarding self-management, emergency responses, and precautions for managing adverse events during immunotherapy.	193 (48.01)	175 (43.53)	27 (6.72)	4 (1.00)	3 (0.75)
A9. I am confident in maintaining a relatively favorable nutritional status.	179 (44.53)	165 (41.04)	45 (11.19)	7 (1.74)	6 (1.49)

A10. I believe that maintaining a positive mindset and quality sleep are important during immunotherapy.

Practice	Always	Frequently	Sometimes	Occasionally	Never
P1. I can cooperate with medical personnel for comprehensive treatment monitoring and follow-up.	216 (53.73)	130 (32.34)	43 (10.70)	6 (1.49)	7 (1.74)
P2. I will regularly monitor nutrition-related indicators such as body weight, body mass index, grip strength, albumin, and prognostic nutritional index.	177 (44.03)	140 (34.83)	55 (13.68)	22 (5.47)	8 (1.99)
P3. If a physician recommends it, I will take medication to enhance appetite, digestion, and absorption.	192 (47.76)	132 (32.84)	53 (13.18)	18 (4.48)	7 (1.74)
P4. I will proactively seek relevant knowledge about immunotherapy nutrition and adverse reactions through	172 (42.79)	126 (31.34)	64 (15.92)	27 (6.72)	13 (3.23)

professional channels such as healthcare providers,					
health promotion columns, books, and television.					
P5. I will undergo oral nutritional supplementation,	162 (40.30)	118 (29.35)	60 (14.93)	31 (7.71)	31 (7.71)
including branched-chain amino acids, omega-3 fatty					
acids, and vitamin D if necessary.					
P6. If required, I am prepared to receive enteral feeding	133 (33.08)	38 (6.45)	46 (11.44)	36 (8.96)	149 (37.06)
through nasogastric/nasoenteric tubes.					
P7. If necessary, I am open to receiving parenteral	123 (30.60)	43 (10.70)	52 (12.94)	56 (13.93)	128 (31.84)
nutrition support (intravenous administration).					
P8. I will maintain moderate physical exercise to	176 (43.78)	122 (30.35)	55 (13.68)	34 (8.46)	15 (3.73)
improve my overall physical condition.					
Lifestyle	Never	Occasionally	Sometimes	Frequently	Always

In your daily lifestyle habits, what is your eating

frequency for the following types:

L1. Smoking	272 (67.66)	38 (9.45)	27 (63.72)	35 (8.71)	30 (7.46)
L2. Alcohol consumption	285 (70.90)	52 (12.94)	27 (6.72)	21 (5.22)	17 (4.23)
L3. Cooking methods involving frying, smoking, baking, pickling, etc.	223 (55.47)	100 (24.88)	47 (11.69)	19 (4.73)	13 (3.23)
L4. High-fat, high-salt, spicy foods (such as chili peppers, onions, ginger, raw garlic, and pepper)	212 (52.74)	100 (24.88)	50 (12.44)	27 (6.72)	13 (3.23)
L5. High-quality protein sources (legumes, eggs, meat, fish, shellfish, dairy products, etc.)	22 (5.47)	21 (5.22)	37 (9.20)	224 (55.72)	98 (24.38)
L6. Light and easily digestible foods (egg custard, millet porridge, lotus root powder, Chinese yam)	15 (3.73)	42 (10.45)	61 (15.17)	213 (52.99)	71 (17.66)

L7. Foods rich in vitamins (fresh vegetables and fruits, such as spinach, cabbage, kiwi, tomatoes, etc.)	8 (1.99)	34 (8.46)	42 (10.45)	217 (53.98)	101 (25.12)
L8. Stimulants like coffee, chocolate, and strong tea	247 (61.44)	70 (17.41)	30 (7.46)	38 (9.45)	17 (4.23)
L9. Probiotics	202 (50.25)	90 (22.39)	51 (12.69)	37 (9.20)	22 (5.47)
L10. Sugary beverages	215 (53.48)	114 (28.36)	45 (11.19)	20 (4.98)	8 (1.99)
L11. Citrus fruits (grapefruit, pomelo, honey pomelo, etc.)	93 (23.13)	112 (27.86)	75 (18.66)	92 (22.89)	30 (7.46)

Table S3. SEM model fit

Indicators	Reference	Results
CMIN/DF	1-3 Excellent, 3-5 Good	1.610
RMSEA	<0.08 Good	0.039
IFI	>0.8 Good	0.939
TLI	>0.8 Good	0.893
CFI	>0.8 Good	0.935