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论文汇编

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目录

肌肉衰减症营养管理新进展相关研究

Comprehensive Profiling of Chemokine and NETosis-Associated Genes in Sarcopenia: Construction of a Machine Learning-Based Diagnostic Nomogram 7-8

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

Association between early high protein administration and skeletal muscle mass changes in mechanically ventilated, critically ill patients: a prospective observational study 9-10

其他与临床营养相关的科研和工作总结、调查和建议

Perioperative Nutritional Management Improves Outcomes in Daytime Laparoscopic Cholecystectomy: A Randomized Controlled Trial 11

肌肉衰减症营养管理新进展相关研究

Handgrip weakness and life satisfaction: Derivation of cutoff values and analysis of sex differences in community- dwelling older Chinese adults 12-13

肌肉衰减症营养管理新进展相关研究

Test-free identification of sarcopenia using an artificial intelligence approach 14-15

营养风险筛查、营养评定及营养不良诊断的相关研究

Early identification of potentially reversible cancer cachexia using explainable machine learning driven by body weight dynamics: a multicenter cohort study 16-17

临床营养学基础、临床与大数据等研究

Functional performance decline outperforms sarcopenia and its components in predicting new-onset chronic kidney disease: a nationwide multicenter study 18-19

营养风险筛查、营养评定及营养不良诊断的相关研究
Deep learning model WAL-net for early prediction of reversible malnutrition in cancer via exploiting body weight and skeletal muscle dynamics: a multicenter cohort study 20-21

临床营养学基础、临床与大数据等研究
Systemic inflammation-based refinement of triglyceride glucose index for predicting new-onset cardiovascular disease: a nationwide multicenter cohort study 22-23

肌肉衰减症营养管理新进展相关研究
Association of low physical performance with new-onset chronic kidney disease in middle-aged and older adults: a nationwide multicenter cohort study 24-25

肌肉衰减症营养管理新进展相关研究
Association between low combined handgrip strength and chronic kidney disease in middle-aged and older US adults:NHANES 2011-2014 26-27

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告运动治疗法对老年肌少症患者营养状况和肌肉力量的影响 28-29

肠道微生态与肠功能维护临床应用研究发热伴血小板减少综合征肠道屏障和免疫失衡的微生物组和代谢网络的破坏 30-32

其他与临床营养相关的科研和工作总结、调查和建议“ 医工农商”融合理念与临床营养类 App 应用趋势分析 33-34

临床营养学基础、临床与大数据等研究慢性肾病患者血液营养素与估算肾小球滤过率关联的分期特异性研究 35-36

肌肉衰减症营养管理新进展相关研究
The Delaying Effect of Yanshen Capsules on Appendicular Skeletal Muscle Mass Decline in Patients with Chronic Kidney Disease: Implications for Treatment Selection 37-38

肌肉衰减症营养管理新进展相关研究

Association of combined left and right handgrip strength with new-onset chronic kidney disease in middle-aged and older adults: a nationwide multicenter cohort study 39-40

营养风险筛查、营养评定及营养不良诊断的相关研究

Predictive Value of the Prognostic Nutritional Index for SixMonth Readmission in Elderly Hospitalized Heart Failure Patient 41-42

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告 1 例高甘油三酯血症性急性胰腺炎患者的肠内营养治疗 43-44

2023 年中国 156 家二级以上医疗机构特殊医学用途配方食品（FSMP）管理现状与临床应用调查 45-48

特殊医学用途配方食品临床应用与规范、医疗膳食规范化管理 2023 年中国 156 家二级以上医疗机构特殊医学用途配方食品（ FSMP）管理现状与临床应用调查 49

临床营养学科建设发展肿瘤专科医院“ 五四三”策略驱动下“一站式营养诊疗矩阵”新模式的构建与实施 50-52

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告一例胰十二指肠切除术后合并胰肠吻合口瘘的全程规范化营养诊疗 --- 基于营养治疗五阶梯策略 53-54

普通人群基础代谢率与体成分的相关性 55-58

其他与临床营养相关的科研和工作总结、调查和建议普通人群基础代谢率与体成分的相关性 59

天津市某医院职工体检人体成分现状分析 60-64

临床营养学基础、临床与大数据等研究天津市某医院职工体检人体成分现状分析 65

国内外肠外营养、肠内营养、膳食营养治疗的新进展和新型制剂的临床应用中国老年营养健康食品市场特征分析——基于 Python 爬虫的电商平台数据研究 66-67

临床营养学基础、临床与大数据等研究
Association between EAT-Lancet Planetary Health Diet and Risk of Neuropsychiatric Disorders: A Systematic Review and Meta-analysis 68-69

特殊医学用途配方食品临床应用与规范、医疗膳食规范化管理医院治疗膳食智造管理流程改进 70

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告糖尿病型肠内营养制剂对肺结核合并糖尿病营养不良治疗效果的分析 71-72

营养风险筛查、营养评定及营养不良诊断的相关研究 Barthel 指数与 NRS2002 疾病严重程度评分在老年住院患者营养风险筛查中的联合应用价值研究 73-74

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告
Barley green extract did not decrease serum uric acid but decrease the risk of hyperuricemia in adults with asymptomatic hyperuricemia: A multicenter-randomized, parallel-controlled study 75-76

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告乳腺癌术后重度消瘦患者的个体化阶梯式营养支持治疗个案报告 77-78

肠道微生态与肠功能维护临床应用研究双歧杆菌四联活菌片联合肠内营养比较单用肠内营养对重症脑卒中患者早期肠道粘膜功能及胃肠道并发症的临床 效果观察的系统综述 79

临床营养学基础、临床与大数据等研究
Cardiovascular disease burden in China attributable to unbalanced fatty acids intake from 1990 to 2050 80-81

极端体重下降伴多重生理异常的青少年进食障碍病例分析：早期识别与干预的重要性 82-85

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告极端体重下降伴多重生理异常的青少年进食障碍病例分析： 早期识别与干预的重要性 86

内外肠外营养、肠内营养、膳食营养治疗的新进展和新型制剂的临床应用中医营养防治化疗相关骨髓抑制应用探讨 87-89

营养风险筛查、营养评定及营养不良诊断的相关研究
Effects of nutritional consultation combined with individualized exogenous digestive enzymes administered by a clinical nutritionist on nutritional and immune-inflammatory status in patients with pancreatic cancer: a retrospective study 90-91

国内外肠外营养、肠内营养、膳食营养治疗的新进展和新型制剂的临床应用中国家庭肠外营养相关并发症调查及防治措施的文献分析 92

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告
Nutritional Management in a Postoperative Rectal Cancer Patient with Intestinal Obstruction and Severe Malnutrition:A Case Report 93-94

临床营养门诊和营养专科病房建设工作经验和体会
临床营养门诊“ 三维赋能”管理模式的实践探索与经验总结 95

急性心肌梗死术后肠道菌群移植对心脏康复的影响 96-102

肠道微生态与肠功能维护临床应用研究急性心肌梗死术后肠道菌群移植对心脏康复的影响 103

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告
基于人体成分分析的个体性化体重管理方案在门诊患者中的实践与成效 104

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告
膳食摄入 α- 亚麻酸与癌症患者死亡的关联： 基于 NHANES 、GBD 的多维分析 105

其他与临床营养相关的科研和工作总结、调查和建议
A Phase II Randomized Controlled Trial of Orally Administered Yeast-Derived β-Glucan for AlleviatingChemoradiotherapy-Induced Oral Mucositis in Nasopharyngeal Carcinoma Patients 106

Demystifying Feature Importance: Machine Learning Assessment of Nutrients Effects on Blood Lipids and Tolerance Thresholds in Infants with LPL Gene Deficiency 107–109

New Quality Productivity–Driven Development of Clinical Nutrition in Chinese Public Hospitals: Evolution, Status Quo, and Solutions—A Chongqing Survey 110–112

Comparison of Two Nutritional Risk Screening Tools in Hospitalized Children with Japanese Encephalitis: A Causal Inference of Clinical Outcomes and Implications for Optimized Management 113–114

Validation of the Efficacy of Nutritional Protocols for Suspected Cow's Milk Protein Allergy in IPEX Syndrome Driven by Multimodal Artificial Intelligence 115–116

Cognitive Impairments and Plasma Metabolic Characteristics in Deficit Schizophrenia: A Two-Year Follow-Up Longitudinal Study 117–137

肌肉衰减症营养管理新进展相关研究

Comprehensive Profiling of Chemokine and NETosis-Associated Genes in Sarcopenia: Construction of a Machine Learning-Based Diagnostic Nomogram

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Chemokines and neutrophil extracellular trap formation (NETosis) are critical drivers of inflammatory responses. However, the molecular characteristics and interaction mechanisms of these processes in sarcopenia remain incompletely

understood.

Utilizing the mRNA expression profile dataset GSE226151 (including 19 sarcopenia, 19 pre-sarcopenia, and 20 healthy

control samples), enrichment analysis was performed to identify differentially expressed NETosis-related genes (DENRGs) and chemokine-related genes (DECRGs). Two machine learning algorithms and univariate analysis were integrated to

screen signature genes, which were subsequently used to construct diagnostic nomogram models for sarcopenia. Single- gene Gene Set Enrichment Analysis (GSEA) and Gene Set Variation Analysis (GSVA) were used to investigate pathway

associations, followed by the construction of a gene interaction network.

A total of 7 DECRGs and DENRGs were identified, primarily enriched in chemokine signaling pathways, cytokine-cytokine receptor interactions, and sarcopenia-related diseases. Machine learning and univariate analysis revealed three signature genes (CXCR1, CXCR2, and LPL). The predictive accuracy of the nomogram models for differentiating sarcopenia from pre- sarcopenia was high, with AUC values of 0.837 (95% CI 0.703 -0.947) and 0.903 (95% CI 0.789-0.989). Single-gene

GSEA highlighted significant associations between these genes and the JAK-STAT

and PPAR signaling pathways. GSVA

indicated that sarcopenia was closely linked to upregulated chemokine signaling, cytokine–receptor interaction activities, and leukocyte transendothelial migration.

The research pinpointed three genes associated with chemokines and NETosis (CXCR1, CXCR2, LPL) and developed

highly accurate diagnostic models, offering a new and preliminary approach to differentiate sarcopenia and its early stages.

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

Association between early high protein administration and skeletal muscle mass changes in mechanically ventilated, critically ill patients: a prospective observational study

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This study aimed to evaluate the effect of early high protein administration on muscle mass changes and clinical outcomes

in mechanically ventilated, critically ill patients.

In this prospective cohort study, adult patients (⩾ 18 years) mechanically ventilated within 48 hours of ICU admission and

expected to stay ⩾ 5 days were included. Patients were grouped by mean protein provision during days 1–5: high protein (⩾ 1.2 g/ kg/day) and low protein (<1.2 g/ kg/day). Skeletal muscle was assessed using ultrasound measurements of rectus

femoris cross-sectional area (RFCSA), muscle thickness (RFMT), and pennation angle (RFPA). A linear mixed model was

used to identify factors influencing muscle parameters

A total of 130 patients were recruited and 95 patients were analyzed. RFCSA, RFMT, and RFPA all significantly decreased from day 1 to day 5. The mean RFCSA values at baseline and follow-up were 4.81 ± 2.35 cm^2 and 3.79 ± 1.74 cm^2, respectively, with the change

over time of −1.12 ± 0.95 cm^2 in the low protein group, and 4.04 ± 2.22cm^2 and 3.30 ± 1.60 cm^2, respectively, with the change over time of −0.73 ± 0.34 cm^2 in the high protein

group, with a significant time effect (P = 0.001), group effect (P = 0.011), and time x group interaction (P = 0.017). However, no significant differences in RFMT or RFPA were

observed. No differences were found in ICU-acquired weakness, ICU-mortality, and in-hospital mortality between the two groups.

Early high protein administration in critically ill patients was associated with a reduction in skeletal muscle mass loss but may not impact ICU-acquired weakness or mortality

其他与临床营养相关的科研和工作总结、调查和建议

Perioperative Nutritional Management Improves Outcomes in Daytime Laparoscopic Cholecystectomy: A Randomized Controlled Trial

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Objective: To evaluate the impact of perioperative nutritional management on patients undergoing

daytime laparoscopic cholecystectomy (LC) and establish an evidence-based protocol for perioperative nutritional support.

Methods: A randomized controlled trial was conducted. Patients scheduled for LC were allocated to either an experimental group (perioperative nutritional management) or a control group (standard care). Postoperative outcomes were compared.

Results: Compared with the control group, the experimental group demonstrated significantly earlier initiation of oral intake (water/food), ambulation, and return to normal activities/work ($P<0.05$). The pain scores at postoperative days 1 and 7 were lower in the experimental group ($P<0.05$). The energy/protein intake recovery ratios on day 1 ($T= 11.63/T= 12.90$, $P<0.05$) and activities of daily living (ADL) scores were greater in the experimental group ($P<0.05$). The incidences of

postoperative hunger ($\chi^2=4.71$, $P<0.05$) and wound complications (e.g., exudate/hemorrhage; $\chi^2=4.59$, $P<0.05$) were significantly reduced. No between-group differences were observed in time to first flatus, abdominal pain, bloating, or thirst ($P>0.05$).

Conclusion and implications: Early oral hydration and oral nutritional supplementation (ONS) post-LC do not increase gastrointestinal adverse effects. This approach mitigates postoperative hunger, accelerates functional recovery, reduces pain, enhances wound healing, and improves ADLs.

肌肉衰减症营养管理新进展相关研究

Handgrip weakness and life satisfaction: Derivation of cutoff values and analysis of sex differences in community- dwelling older Chinese adults

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Background and aims: Handgrip strength (HGS) is a cost-effective indicator of skeletal muscle strength and function. It is also widely used as a leading criterion for diagnosing sarcopenia. However, the sex-specific association between HGS and life satisfaction decline among older Chinese adults remains largely unknown. The objective of this study was to determine sex-specific, life satisfaction-oriented cutoff points for low HGS in older Chinese adults. Specifically, we examined the association between handgrip weakness and life satisfaction, considering factors such as age, gender, and other relevant variables, to estimate potential underlying effects and modifications.

Methods: This observational, cross-sectional multicenter study included 3649 older adults (age range: 60-101 years) from a nationally representative survey in China. Overall life satisfaction was determined using a life satisfaction score (LSS). Correlations between variables were examined using a Spearman’s correlation analysis. Receiver operating characteristic (ROC) curves were utilized to determine the HGS cutoffs for predicting a decline in LSS. Restricted cubic spline (RCS) analysis and multivariate logistic regression were employed to investigate the associations between low HGS and LSS.

Results: This study included 1762 women and 1887 men (median age=68.3 years). LSS decline was observed in 485 (13.3%) participants. HGS was positively correlated with LSS in both men and women (both $P < 0.05$). Individuals

with low HGS were associated with a higher rate of LSS decline (16.2% vs. 10.8%, $P < 0.001$). RCS analysis demonstrated a linear-like association between HGS and life

satisfaction in men (P<0.001, P nOnlinear=0.099), but not in

women (P=0.110, P nOnlinear=0.329). ROC analysis revealed that the optimal HGS cutoff for indicating the presence of LSS was 27.5 kg for men and 22.3 kg for women. Multivariable analysis showed that participants with low HGS had

higher odds of experiencing a decline in LSS (OR=1.509, 95%CI= 1.218–1.867). This association was observed only in men (OR=1.871, 95%CI= 1.358–2.562, P<0.001), while it was attenuated in women (OR=1.281, 95%CI=0.964–1.701,

P=0.087). After adjusting for physical activity and sleep duration in multivariate logistic regression models, continuous HGS was independently associated with reduced odds of LSS decline in the overall population (OR = 0.971, 95% CI =

0.951-0.991), in men (OR = 0.973, 95% CI = 0.948-0.999), and in women (OR = 0.962, 95% CI = 0.929-0.994). Similar results were observed when HGS was analyzed by separating values based on one standard deviation. Additionally,

low HGS, based on sex-specific thresholds, was associated with higher odds of LSS decline (OR = 1.693, 95% CI = 1.175-2.484).

Conclusions: This study establishes sex-specific cutoffs of HGS for identifying a decline in LSS among older Chinese adults. Low HGS is positively associated with LSS decline among men in a linear-like manner, but not among women.

These findings might facilitate the development of strategies to promote healthy aging (This work was supported by the Natural Science Foundation of Chongqing, China CSTB2024NSCQ-MSX1233).

肌肉衰减症营养管理新进展相关研究

Test-free identification of sarcopenia using an artificial intelligence approach

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Background and aims: The diagnosis of sarcopenia relies extensively on human and equipment resources, and requires individuals to personally visit medical institutions. The objective of this study was to develop a test-free, self-assessable approach to identify sarcopenia by utilizing artificial intelligence techniques and representative real-world data.

Methods: This multicenter study enrolled 11661 middle-aged and older adults from a national survey initialized in 2011. Follow-up data from the baseline cohort collected in 2013 (n=9403) and 2015 (n=10356) were used for validation. Sarcopenia was retrospectively diagnosed using the Asian Working Group for Sarcopenia 2019 framework. Baseline age, sex, height, weight, and 20 functional capacity (FC)-related binary indices (activities of daily living=6, instrumental activities of daily living=5, and other FC indices=9) were considered as predictors. Multiple machine learning (ML) models were trained and cross-validated using 70% of the baseline data to predict sarcopenia. The remaining 30% of the baseline data, along with two follow-up datasets (n=9403 and n=10356, respectively), were used to assess model performance.

Results: The study included 5634 men and 6027 women (median age=57.0 years). Sarcopenia was identified in 1,288 (11.0%) individuals. Among the 20 FC indices, the running/jogging 1km item showed the highest predictive value for sarcopenia (AUC

[95%CI]=0.633 [0.620–0.647]). From the various ML models assessed, a 24–variable gradient boosting classifier (GBC) model was selected. This GBC model demonstrated favorable performance in predicting sarcopenia in the holdout data (AUC [95%CI]=0.831 [0.808–0.853], accuracy=0.889, recall=0.441, precision=0.475, F1 score=0.458, Kappa=0.396 and Matthews correlation coefficient=0.396). Further model validation on the temporal scale using two longitudinal datasets also demonstrated good performance (AUC [95%CI]: 0.833 [0.818–0.848] and 0.852 [0.840–0.865], respectively). The model's built–in feature importance ranking and the SHapley Additive exPlanations method revealed that lifting 5kg and running/jogging 1km were relatively important variables among the 20 FC items contributing to the model's predictive capacity, respectively. The calibration curve of the model indicated good agreement between predictions and actual observations (Hosmer and Lemeshow P=0.501, 0.451 and 0.374 for the three test sets, respectively), and decision curve analysis supported its clinical usefulness. The model was implemented as an online web application and exported as a deployable binary file, allowing for flexible, individualized risk assessment.

Conclusions: We developed an artificial intelligence model that can assist in the identification of sarcopenia, particularly in settings lacking the necessary resources for a comprehensive diagnosis. These findings offer potential for improving decision– making and facilitating the development of novel management strategies of sarcopenia (This work was supported by the National Natural Science Foundation of China 82304131 and the Natural Science Foundation of Chongqing, China CSTB2024NSCQ–MSX1233).

营养风险筛查、营养评定及营养不良诊断的相关研究

Early identification of potentially reversible cancer cachexia using explainable machine learning driven by body weight dynamics: a multicenter cohort study

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Background and aims: Cancer cachexia is a multifactorial disorder mainly characterized by involuntary weight loss, particularly in skeletal muscle and adipose tissue. It can occur in different types and stages of cancer, with a prevalence ranging from 35% to

80%, and is associated with multiple adverse outcomes. An estimated 20%-30% of cancer deaths are ascribable to cachexia. However, clinical decision-making for oncology

patients at the cachexia stage presents significant challenges. This study aims to develop a machine learning (ML) model to identify potentially reversible cancer

cachexia (PRCC).

Methods: This was a multicenter cohort study. Cachexia was retrospectively diagnosed

using Fearon's framework. PRCC was defined as a diagnosis of cancer cachexia at

baseline that turned negative one month later. Body weight dynamics accessible upon

patient admission were screened and modeled to predict PRCC. Multiple ML models were

trained and cross-validated using 70% of the data to predict PRCC, with the remaining 30% reserved for model evaluation. The interpretability and clinical usefulness of the optimal model were assessed, and external validation was performed in an independent

cohort of 238 patients.

Results: The study enrolled 1983 men and 1784 women (median age=58 years). PRCC was

identified in 1983 patients (52.6%). Breast cancer exhibited the highest rate of PRCC (72.1%), while cachexia associated with various gastrointestinal cancers was less likely to be reversed. Weight change (WC) from six months ago to one month ago, WC from one month ago to baseline (−1 to 0) and baseline body mass index were selected for modelling. A multilayer perceptron model showed good performance to predict PRCC in the holdout test set (AUC [95%CI] = 0.887 [0.866, 0.907], accuracy=0.836, sensitivity=0.859, specificity=0.812) and the external validation set (AUC [95%CI] = 0.863 [0.778, 0.948]). The WC −1 to 0 showed the highest impact on model output. The model was demonstrated to be clinically useful and statistically relevant.

Conclusions: This study developed and validated an ML model for the early identification of PRCC based on data derived from a nationwide, multicenter cohort. The model relies on three simple, easily accessible, weight dynamic-related variables, which demonstrated good performance in predicting PRCC prior to treatment. These findings may assist clinicians and nutritionists in decision-making, helping to guide management strategies for cancer cachexia and optimize the use of health resources in cancer care (This work was supported by the National Natural Science Foundation of China 82304131 and the Natural Science Foundation of Chongqing, China CSTB2024NSCQ-MSX1233) .

临床营养学基础、临床与大数据等研究

Functional performance decline outperforms sarcopenia and its components in predicting new-onset chronic kidney disease: a nationwide multicenter study

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Xinqiao Hospital, Army Medical University

Background and aims: Aging-related conditions, such as functional disability and loss of muscle mass/function, on the onset of chronic kidney disease (CKD) have recently emerged as topics of growing medical and public health concerns worldwide. Age-related loss of skeletal muscle mass, along with loss of muscle strength and/or reduced physical performance, collectively known as sarcopenia, is associated with an

increased likelihood of multiple adverse health outcomes. However, it remains largely unknown whether the decline in functional performance and the loss of muscle, as potentially modifiable factors, can

predict the future onset of CKD in middle-aged and older Chinese adults. This study aimed to investigate the associations of functional performance, sarcopenia, and components of sarcopenia with the onset of chronic kidney disease (CKD), while also determining the optimal predictive factor.

Methods: This observational multicenter study included 8647 community-dwelling adults. Sarcopenia was retrospectively defined based on the 2019 consensus update of the Asian Working Group for Sarcopenia (AWGS) for Asians. Activities of daily living

(ADL) scale, physical performance and sarcopenia were assessed at baseline, and participants were followed to track CKD incidents. The discriminatory performance and cutoffs of ADL and other indices for predicting CKD onset were evaluated. Multivariable-adjusted logistic regression models were employed to analyze the association of ADL with CKD occurrence.

Results: There were 4681 women and 3966 men (median age=57.0 years). Over a seven-year follow-up, 940 CKD incidents occurred. Optimal thresholds for left handgrip strength (HGS), right HGS, the five-time chair stand test, appendicular skeletal muscle

index and ADL to predict CKD onset were established at 35.2kg, 30.9kg, 10.4s, 7.3kg/m2 and 1 for men, and 16. 1kg, 30.9kg, 12.8s, 6.3kg/m2 and 1 for women, respectively. Among all factors investigated, the ADL score was optimal to predict CKD onset in both men (AUC=0.546, 95%CI=0.528 to 0.564) and women (AUC=0.559, 95%CI=0.538 to 0.581). Functional performance decline (ADL score ⩾ 1) demonstrated an independent and dose-dependent association with CKD (OR=1.841, 95%CI=1.446 to 2.329, P trend

<0.001). The positive association between ADL-represented functional performance decline and CKD incidents is robust in different covariate subgroups.

Conclusions: ADL, as a representation of functional performance, outperforms sarcopenia and its components in predicting the onset of CKD among middle-aged and older Chinese adults living in the community. The decline in functional performance is

independently and strongly linked to an increased likelihood of developing CKD, and the severity of functional performance decline is proportional to the CKD incidents. These findings have implications for public health practitioners and clinicians by providing valuable insights for decision-making related to CKD prevention (This work was supported by the National Natural Science Foundation of China 82304131 and the Natural Science Foundation of Chongqing, China CSTB2024NSCQ-MSX1233).

营养风险筛查、营养评定及营养不良诊断的相关研究

Deep learning model WAL-net for early prediction of reversible malnutrition in cancer via exploiting body weight and skeletal muscle dynamics: a multicenter cohort study

Liang-Yu Yin

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Background and aims: Malnutrition is a major global public health problem affecting more than one billion of the world ' s population. It is also a highly prevalent disorder in oncology practice with a prevalence of 21% to 72%. Active diagnosis, surveillance and intervention of malnutrition are imperative in all cancer patients to minimize or reverse its negative impact on patient outcomes. Therefore, an approach that can identify patients who may benefit from multidisciplinary treatment and/or are likely to recover from malnutrition would be valuable for making individualized management decisions. However, few studies have used machine learning (ML) to predict the reversibility of malnutrition in the oncology population.

Methods: In this multicenter cohort study, we trained a predictive model for reversible malnutrition (RM) using data from a nationwide nutritional oncology database (from December 2013 to May 2021). Time-series data on body weight and skeletal muscle dynamics (six months before, one month before and at the time of baseline) that can be easily accessed upon patient admission were modeled using a long short-term memory recurrent neural network architecture to predict RM. The model was named as WAL-net, and its performance, superiority over conventional ML algorithms, and clinical relevance were comprehensively evaluated in a holdout set. A SHapley Additive explanation (SHAP) method was used for model interpretation.

Results: Of all 30766 oncology patients investigated, we finally selected 4254 malnourished patients as the study population (discovery set = 2977, test set = 1277). There were 2783 males and 1471 females (median age=61 years). RM was identified in 754 (17.7%) patients. Prostate cancer (34.8%) and biliary tract cancer (5.3%) showed the highest and lowest incidence of RM, respectively. RM and non-RM groups had distinct patterns of weight and muscle dynamics, and RM was negatively associated with the progressive stages of cancer cachexia ($r = -0.340$, $P < 0.001$). WAL-net was the state-of-the-art model, achieving an area under the curve (AUC) of 0.924 (95%CI = 0.904 to 0.944, accuracy=0.924, Kappa=0.728, sensitivity=0.878, specificity=0.932). Baseline appendicular skeletal muscle mass showed the highest feature importance on model output. Model-predicted RM was associated with lower future risks of underweight, sarcopenia, impaired performance status and progression of malnutrition phenotypes.

Conclusions: This study presents an explainable deep learning model, the WAL-net, for early identification of RM in patients with cancer. WAL-net utilizes only six easily accessible, noninvasive features reflecting patients' recent body weight and skeletal muscle dynamics. The findings support our hypothesis on the reversibility of malnutrition and also showcase the potential of WAL-net as a valuable decision support tool in enhancing the management of cancer-associated malnutrition to optimize patient outcomes (This work was supported by the National Natural Science Foundation of China 82304131 and the Natural Science Foundation of Chongqing, China CSTB2024NSCQ-MSX1233) .

临床营养学基础、临床与大数据等研究

Systemic inflammation-based refinement of triglyceride glucose index for predicting new-onset cardiovascular disease: a nationwide multicenter cohort study

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Background and aims: Triglyceride glucose (TyG) index is a surrogate marker of insulin resistance (IR), which has been

related to cardiovascular disease (CVD) risk. However, the predictive rationale for incorporating triglyceride and glucose is not well established. Furthermore, whether inflammatory information adds prognostic value to TyG remains largely

unknown. In this study, we aimed to compare the predictive value of TyG and its components for CVD. We also aimed to

examine whether incorporating systemic inflammation information enhances the prognostic utility of TyG. The objective of this research was to provide novel evidence for public health and clinical professionals to optimize risk stratification

methods for CVD, thereby facilitating the development of new algorithms for preventing and managing this deadly disease.

Methods: This cohort study involved 7456 participants without pre-existing CVD. The

primary outcome of interest was new-onset cardiovascular disease (CVD), defined as a

composite outcome encompassing incidents of CHD and stroke during the three waves of

follow-up. The predictive abilities of TyG, triglycerides, glucose, C-reactive protein (CRP), a TyC index (triglycerides [mg/dL]+60×CRP [mg/L]) and a TyG-C index (TyG+CRP

[mg/L]) were compared. Restricted cubic spline (RCS) analysis was used to flexibly

analyze potential nonlinear associations of continuous indices with CVD, CHD, and

stroke. Using multivariable Cox models, hazard ratios (HR) of any and type-specific CVD according to TyG-C tertiles (T) were estimated.

Results: The median age of participants was 57.0 years. There were 3448 (46.2%) men and 4008 (53.8%) women. During the follow-up of up to 6 years, 1470 CVD, 1114 CHD and 487

stroke incidents occurred. TyG showed comparable discrimination to triglycerides in

predicting new-onset CVD and CHD, and similar performance to glucose in predicting

stroke (all P>0.05). TyG-C was superior to TyG and other investigated indices for

predicting CVD (Harrell ' s C-index [95%CI]=0.557 [0.541-0.573], all P<0.05). TyG-C

tertiles were monotonically associated with CVD risk (HR [95%CI]: T2 vs T1, 1.200

[1.050-1.372]; T3 vs T1, 1.282 [1.121-1.468], P trend<0.001). Similar associations were observed for CHD (T2 vs T1: HR=1.138, 95% CI=0.978-1.325; T3 vs T1: HR=1.179, 95%

CI=1.011-1.376) and stroke (T2 vs T1: HR=1.607, 95% CI=1.252-2.061; T3 vs T1: HR=1.780, 95% CI=1.389-2.280). Furthermore, trend tests indicated significant dose-response

relationships between TyG-C tertiles and the risk of all three outcomes across both

unadjusted and adjusted models (all P < 0.05). These associations attenuated with age (all P interaction<0.001).

Conclusions: TyG does not outperform its components in predicting CVD risk. TyG-C, when combined with CRP,

outperforms TyG alone and could potentially serve as a better biomarker of CVD risk. These findings may help refine

strategies for selecting appropriate risk prediction tools for the primary prevention and management of CVD (This work was supported by the National

Natural Science Foundation of China 82304131 and the Natural Science Foundation of Chongqing, China CSTB2024NSCQ-MSX1233) .

肌肉衰减症营养管理新进展相关研究

Association of low physical performance with new-onset chronic kidney disease in middle-aged and older adults: a nationwide multicenter cohort study

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Xinqiao Hospital, Army Medical University (Third Military Medical University)

Low physical performance, often evaluated through functional assessments such as the five-time chair stand test (CST), is a key component of the diagnostic framework for sarcopenia. This study aimed to investigate the longitudinal association of low physical performance, as measured by the five-time chair stand test (CST, s), with new-onset chronic kidney disease

(CKD) in middle-aged and older adults.

This observational, multicenter cohort study included 5908 community-dwelling adults without CKD at baseline in 2011.

Baseline physical performance was measured using the CST. Participants were followed from 2011 to 2018 via self-

reporting of medically diagnosed incident CKD. Restricted cubic spine (RCS) analysis, Kaplan-Meier curves and multivariable Cox-regression models were employed to investigate the associations between CST and new-onset CKD.

There were 3449 women and 2459 men (median age=57.0 years). During the seven-year follow-up, 612 CKD incidents occurred. Restricted cubic spine analysis showed a linear-like association between CST and new-onset CKD in men

(P=0.018), but no statistically significant association was observed in women. The optimal CST cutoffs for predicting CKD were 10.37s for men and 13.82s for women. Kaplan-Meier curves demonstrated that prolonged CST times were positively

associated with new-onset CKD in both men (P<0.001) and women (P=0.007). Multivariable analysis further indicated that

prolonged CST times were independently associated with an increased risk of CKD (HR=1.426, 95%CI=1.159 to 1.753). This relationship was strengthened in subjects with lower blood urea nitrogen levels.

This study demonstrated a longitudinal association between low physical performance, as indicated by CST, and new-onset

CKD in middle-aged and older Chinese adults. Future interventional studies need to clarify whether early physical training plays a role in the primary prevention of CKD.

肌肉衰减症营养管理新进展相关研究

Association between low combined handgrip strength and chronic kidney disease in middle-aged and older US adults: NHANES 2011-2014

Meng-Da Tang, Yu Cao, Liang-Yu Yin, Jing-Hong Zhao

Xinqiao Hospital, Army Medical University (Third Military Medical University)

Handgrip strength is a well-recognized marker of muscle strength/function, and muscle strength/physical performance serves as a key component of the diagnostic framework for sarcopenia. However, the association between multi-site

muscle strength and chronic kidney disease(CKD) remains unclear. This cross-sectional study explored the link between combined handgrip strength(CHS) and CKD in community-dwelling middle-aged/older US adults.

This cross-sectional study included 5, 120 middle-aged and older adults (⩾ 45 years) from the 2011-2014 National Health

and Nutrition Examination Survey (NHANES). Sex-specific thresholds for low CHS were determined using receiver operating characteristic (ROC) curve analysis to differentiate CKD cases. The association between CHS and CKD was assessed through multivariable logistic regression and restricted cubic spline analyses.

Among all participants investigated (mean age 61 years, 49.1% men), 1,257 (24.6%) were diagnosed with CKD based on laboratory measurements. Although the CHS initially appeared to have an approximately linear association with CKD in both men ($P < 0.001$) and women ($P < 0.001$), subsequent non-linearity tests confirmed a significant non-linear relationship in each group ($P < 0.001$). After adjusting for covariates, the findings remained robust in women ($P < 0.001$, P nOnlinear= 0.001), but not in men ($P = 0.247$, P nOnlinear= 0.281). The optimal CHS thresholds for distinguishing between CKD and non-CKD were 74.20 kg for men and 51.10 kg for women. After adjusting for potential

confounders, lower CHS was significantly associated with higher odds of having CKD in women (OR = 1.679, 95% CI = 1.297 to 2.176) but not in men.

The negative association between CHS and CKD was more pronounced among participants aged over 60 years (OR = 1.954,

95% CI = 1.545 to 2.478), those with hypertension (OR = 1.746, 95% CI = 1.391 to 2.193), and those with diabetes (OR = 2.399, 95% CI = 1.699 to 3.404).

This study reveals that lower CHS is associated with higher odds of having CKD among middle-aged and older US dwelling in communities. Prospective studies are needed to clarify whether there is a causal relationship.

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

运动治疗法对老年肌少症患者营养状况和肌肉力量的影响

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本研究主要是为了了解运动治疗法对于老年肌少症患者的营养状况和肌肉力量的改善情况，明确运动治疗法 对于改善老年肌少症患者身体机能的效果，为临床老年肌少症的干预治疗提供科学有效的参考依据，从而提高老 年肌少症患者的生活质量，减少老年肌少症患者因肌少症引发的各种并发症。

方法：按随机双盲法抽取于 2024 年 1 月 -2024 年 12 月间来我字接受治疗的 60 例老年肌少症患者作为研究对象， 按治疗方法不同，将 60 例患者随机分为对照组和观察组，每组各 30 例，对照组患者给予常规护理干预与营养指 导，观察组患者在对照组的常规护理干预以及营养指导基础上，给予运动治疗，运动治疗方案依据患者身体状况 以及运动能力来进行个性化的定制，分析对比两组患者护理前后的营养状况、肌肉力量、膝关节伸肌肌力以及不 良反应的发生情况。

干预方法

对照组：给予常规护理干预与营养指导，常规护理干预包含定时监测患者的生命体征，教导患者正确服药，开展健康知识宣讲，肌少症知识， 日常注意要点等，营养指导按照患者的具体状况，为患者制订个性化的饮食计 划，保证患者每天摄取足量的蛋白质（1.2-1.5g/kg 体重），碳水化合物，脂肪，维生素和矿物质，比如多吃瘦肉， 鱼，蛋，奶，豆，新鲜蔬菜水果等食物，防止食用高糖，高油，高盐的食物，干预时长为 12 周。

观察组：在对照组的常规护理干预以及营养指导基础上，给予运动治疗，运动治疗方案依据患者身体状况以

及运动能力来进行个性化的定制，具体如下：

（1）抗阻训练：使用弹力带进行训练，包括坐位膝关节伸展，坐位髋关节外展，站立位膝关节屈曲，站立位踝关 节跖屈等动作，每个动作 3 组，每组 12-15 次，频率每秒一次，组间休息 30-60 秒，强度以患者运动时感觉到肌肉 酸胀但不疼痛为宜，根据患者适应情况逐步增加弹力带阻力。

（2）有氧运动： 以散步或者慢跑的方式，每周运动 5 次，每次 30-40 分钟，运动强度控制在患者最大

心率的 60%- 70% ，最大心率 =220- 年龄，运动前进行 5-10 分钟的热身运动，如慢走、关节活动等，运动后进行 5-10 分钟的放 松运动，如拉伸运动等，防止运动损伤。

（3）平衡训练：单腿站立、闭目站立、坐位起立等动作各做 3 组，每组 10-20 秒，组间休息 30 秒。运动治疗共 12 周，在运动的过程中有专业的医护人员陪同，密切观察患者的反应，如有头晕、心慌、胸闷等不适，立即停止 运动，并采取相应的处理措施。

结果: 营养指标的对比后,干预前,两组患者 MNA 评分比较,差异无统计学意义(P > 0.05); 干预 12 周后，观察 组患者 MNA 评分明显高于对照组，差异有统计学意义 (P<0.05)；肌肉力量相关指标对比后，干预前，两组患者握 力比较，差异无统计学意义（P>0.05）；干预 12 周后，观察组患者握力显著高于对照组，差异具有统计学意义

（P<0.05）；膝关节伸肌肌力对比后，干预前，两组患者握力比较，差异无统计学意义（P>0.05）；干预 12 周后， 观察组患者握力显著高于对照组，差异具有统计学意义（P<0.05）；两组患者的不良反应发生情况无显著差异（P >0.05）。

结论：根据研究数据表明，采用整合传统护理方式与营养干预措施，对老年肌少症患者实施运动疗法（包括抗阻运 动、有氧运动及平衡功能提升），可以明显改善其营养状况，使血清白蛋白及前白蛋白水平上升，微型营养评估量 表评分改善，不仅可以增强下肢肌肉力量，还可以提高握力和膝关节伸展肌力，而且安全，无其他不良反应。根 据研究证实运动疗法在提升老年肌少症病人营养及肌肉功能有着明显的成效，体现出很好的安全性与可行性，逐 渐变成临床上实施干预的重点方法，鉴于本次的研究对象比较小，随访的时间较短，以后应扩大参与研究的人群， 还要延长追踪时长，而且，通过深入探究不同的运动强度，频次，以及方式组合对于老年肌少症病人可能存在什 么影响机理， 以此营造出更准确而且细致的个性化恢复计划。

肠道微生态与肠功能维护临床应用研究

发热伴血小板减少综合征肠道屏障和免疫失衡的微生物组和代谢网络的破坏

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目的

发热伴血小板减少综合征（ SFTS）是一种由 SFTS 病毒引起的急性传染病 ， 主要通过蜱虫叮咬传播 ， 临床以高热、 血小板减少、 胃肠道症状和多器官功能损害为特征 ， 重症患者死亡率高达 30%。近年来研究发现 ， SFTS 患者常伴 有明显的肠道症状 ， 提示肠道微生物可能在疾病发生发展中起重要作用。然而 ， 既往研究多局限于微生物组成变 化 ， 缺乏对功能潜能和代谢输出的系统评估。本研究旨在通过整合宏基因组与代谢组学方法 ， 全面揭示 SFTS 患者 肠道微生物组的分类组成、功能通路及代谢物变化 ， 探讨菌群失调在 SFTS 病理机制中的作用。

本研究共纳入 20 例经 RT-PCR 确诊的 SFTS 患者和 20 例健康对照 ， 所有参与者均来自莱州市人民医院 ， 研究经伦 理委员会批准 ， 参与者签署知情同意书。采集粪便样本后立即于 -80° C 保存。提取 DNA 后使用 Illumina NovaSeq 6000 平台进行宏基因组测序 ， 平均测序量达 10-12 Gb/ 样本。通过 MetaPhlAn3 进行物种注释 ， HUMAnN3 进行功 能注释 ， α 多样性指数（如 Shannon、Chao1）用于评估群落多样性。非靶向代谢组学分析采用 LC-MS/MS 技术，

数据经 XCMS 预处理，MetaboAnalyst 进行多元统计和通路分析。组间差异采用 Wilcoxon 检验，$p < 0.05$ 为显著。

本研究通过宏基因组测序共获得高质量数据 10.59-12.47 Gb/ 样本 ， 组装连续性良好（N50: 2,761-23,505 bp）。 基因集构建共产生 2,041,625 个非冗余单基因 ， 平均长度 854 bp ， 其中 97.38% 的基因可注释至 NCBI NR 数据库 ， 47.7%、34.27% 和 16.22% 分别注释到 KEGG、GO 和 VFDB 数据库。与健康对照组相比 ， SFTS 患者肠道微生物基 因总数量显著减少（$p < 0.05$），独特基因比例升高（SFTS 特有 18.5% ， 健康特有 14.4%），共有基因仅占 67.2% ， 提示 SFTS 感染导致微生物基因多样性下降及个体间异质性增加。主成分分析显示健康样本聚集紧密 ， 而 SFTS 样 本分散 ， 进一步表明患者肠道菌群结构稳定性丧失。

Alpha 多样性分析表明， SFTS 组中 Chao1、ACE 及 Observed OTUs 等丰富度指数呈下降趋势，Shannon 和

Simpson 指数显著降低，Good’s coverage 显著升高（$p < 0.01$），说明 SFTS 患者微生物群落不仅物种减少，且均匀 度下降，群落结构趋于简化。分类学组成在门、纲、 目、科、属、种水平均呈现显著变化。SFTS 组中拟杆菌门略 有减少，而变形菌门、疣微菌门及鞘脂杆菌门增加；产短链脂肪酸的厚壁菌门相关类群如梭菌目、毛螺菌科、瘤 胃球菌科等减少，而假单胞菌目、鞘脂杆菌科、阿克曼菌科等富集。属水平上，假单胞菌、副拟杆菌、阿克曼菌、 埃希菌等机会致病菌或炎症相关菌显著增多，而粪杆菌、罗斯氏菌、毛螺菌、优杆菌等有益菌减少。种水平上，

荧光假单胞菌、肺炎克雷伯菌、大肠杆菌等常在 SFTS 样本检出，而普拉梭菌、拉克诺斯皮拉等多见于健康对照。 系统发育树及热图分析显示，SFTS 组中细菌、古菌及真菌群落均发生重组，如甲烷短杆菌增多，曲霉属富集，进 一步反映肠道微生态失调的广泛性和复杂性。

功能分析显示，健康对照组中微生物功能集中于氨基酸、核苷酸、肽聚糖生物合成、核糖体组装、氨酰 -tRNA 生物 合成及 DNA 修复等基础代谢和稳态维持途径；而 SFTS 组则显著富集 TCA 循环、赖氨酸降解、β - 丙氨酸代谢、丙 酸代谢及不同环境中的微生物代谢等分解代谢和应激适应通路。毒力因子注释发现，SFTS 组中与生物膜形成（如 藻酸盐合成基因 VFC0271）、效应子输送系统（VFC0086）、粘附及抗菌竞争相关的基因丰度上升，而健康组中以 外毒素修饰和氧化应激抗性相关基因为主。

代谢组学从粪便中鉴定出类固醇及衍生物（ 32.02%）、羧酸及衍生物（ 18.79%）、脂肪酰基（ 13.94%）及有机 氧化合物（ 6.9%）等主要代谢物类别。多变量统计显示 SFTS 与健康对照组间代谢谱明显分离（ PCA 和 PLS-DA 模型 $R^2 = 0.844$，$Q^2 = -0.277$）。差异分析发现 SFTS 组中 630 种代谢物下调、221 种上调。其中，多种胆酸、甘油 磷脂、5- 吡哆醇内酯、硫酸姜黄素等具有抗炎和屏障保护作用的代谢物减少，而 β - 酪醇、6- 乙氧基甲基环己二烯酮、 CXCR3 拮抗剂 C6 等促炎和免疫调节相关化合物增加。通路富集分析表明， SFTS 组中卟啉代谢、维生素 B6 代谢、 α - 亚麻酸代谢、苯丙氨酸代谢等通路激活，而花生四烯酸代谢、胆汁酸生物合成、甘油磷脂代谢、色氨酸代谢等

通路受到抑制。

通过多组学整合关联发现，微生物群落结构与代谢表型密切相关： SCFA 生产菌的减少与胆汁酸、甘油磷脂等抗炎

代谢物下降一致；肠杆菌科细菌的扩增与 β - 酪醇、 卟啉类化合物积累相关； 阿克曼菌等黏蛋白降解菌

的富集伴随　黏蛋白衍生代谢物减少；毒力因子表达上升与苯丙氨酸代谢中间产物增加相关；TCA 循环、β－丙氨酸代谢等微生　物代谢途径增强与硫辛酸等能量代谢物增多相一致。这些结果提示 SFTS 中肠道微生物的结构紊乱直接影响了其代 谢功能，可能导致肠道化学环境倾向于促炎和应激状态。

本研究综合运用宏基因组学和代谢组学方法，系统揭示了 SFTS 患者肠道微生物群在物种组成、功能活性和代 谢输出方面的多重失调。 SFTS 病毒感染导致肠道中有益共生菌（如粪杆菌、罗斯氏菌、毛螺菌等）减少，机会致 病菌（如假单胞菌、阿克曼菌、肠杆菌等）增殖，微生物功能从基本的生物合成和稳态维持转向分解代谢、应激　适应和毒力表达，代谢谱呈现抗炎物质减少、促炎和氧化应激相关化合物累积的特征。这种微生态失调可能通过　破坏肠道屏障完整性、 削弱免疫调节功能、加剧全身炎症反应等方式参与 SFTS 的病理进程。

本研究首次从“微生物组－代谢物－免疫”轴的角度系统阐释 SFTS 中肠道微生态的变化规律，不仅深化了对病毒感染 宿主－微生物互作机制的理解，也为 SFTS 的临床诊断提供了潜在的微生物和代谢生物标志物， 同时为开发针对微 生态调节的干预策略（如益生菌、益生元、代谢物补充等）奠定了重要的理论基础。未来的研究可进一步聚焦特 定菌株或代谢物的功能验证和机制探索，推动转化应用研究的深入开展。

其他与临床营养相关的科研和工作总结、调查和建议

“医工农商”融合理念与临床营养类 App 应用趋势分析

梁雄业 2　张辰铭 1　牛文童 2

1. 吉林大学中日联谊医院

2. 吉林大学

营养类 App 作为营养干预的新兴工具，有助于健康促进政策的落实。为解决营养类 App 在“膳食调 查、膳食评估、膳食指导 ”等重要功能中存在的技术性、科学性问题，本文提出“医工农商 ”融合 理念。

该理念主张以营养干预技术的创新发展为核心，通过交叉学科促进营养技术在 App 中的应用转化，包括:“医工结合 ”实现食物重量、面部特征、人体轮廓等信息的客观高效采集；“医农结合 ”通 过农业生产、食材烹饪等新情境干预饮食行为；“医商结合 ”以高质量服务促进引导积极情绪，延 申营养技术内涵。在深化“医工农商 ”融合发展的趋势中，应以“医 ”为首位，让营养专业技术力 量主导 App 设计开发，实现营养类 App 可持续发展。

Nutritional apps, as an emerging tool for nutritional interventions, can help

implement health promotion policies. In order to solve the technical and scientific problems of nutrition apps in the important functions of dietary survey, dietary

assessment and dietary guidance, this paper puts forward the concept of "Medical-Industrial-Agricultural-Business" integration.

This concept advocates that the innovative development of nutritional intervention technology should be the core,

and the application and transformation of nutritional technology in apps should be promoted through cross-disciplines,

including: "Medical-Industrial Integration" to achieve objective and efficient collection of information such as food weights, facial features, and human body contours; "Medical-Agricultural Integration" intervenes in dietary behaviours through new contexts such as agricultural production and cooking; "Medical-Business Integration" promotes the guidance of positive

emotions through high-quality services and extends the connotation of nutritional technology. In the trend of deepening the integration and development of "Medicine-Industry-Agriculture -Business", "Medicine" should be the first priority, so that the nutrition professional and technical force can dominate the design and development of apps, and realise the

sustainable development of nutrition apps.

临床营养学基础、临床与大数据等研究

慢性肾病患者血液营养素与估算肾小球滤过率关联的分期特异性研究

马野桐 1　刘英华 1　王俊 2　张瀚文 3

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3. 中国人民解放军第九二四医院

明确慢性肾脏病（chronic kidney disease, CKD）患者血清中 14 种营养素【9 种维生素：维生素 A（VA）、维生素 B1（VB1）、维生素 B2（VB2）、维生素 B6（VB6）、叶酸（VB,）、维生素 B12（VB12）、维生素 C（VC）、维生素 D（VD）、维生素 E（VE）；5 种电解质：钾（K）、钙（Ca）、钠（Na）、镁（Mg）、磷（P）】与估算的肾小球滤过率（estimated glomerular filtration rate, eGFR）的关联特征，剖析其 CKD 分期特异性及与 VD 的联合作用特征，为 CKD 患者的精准营养干预提 供科学依据。

本研究严格遵循纳入与排除标准，最终纳入 2351 例 CKD 患者，其中 CKD 1–2 期 1353 例、CKD 3–5 期（非透析）

998 例。采用多元线性回归模型分析单种营养素模型、混合营养素模型中营养素与 eGFR 的关联，控制年龄、性别、 血清白蛋白、尿素、肌酐、尿酸等协变量；同时运用贝叶斯核机器回归模型（Bayesian kernel machine regression,

BKMR）探究营养素的联合效应作用、剂量 – 反应关系等；基于 CKD 分期开展分层分析。主要统计指标包括未标准 化回归系数（B）、标准化回归系数（β）、显著性水平（p 值）及后验包含概率（posterior inclusion probability, PIP）。

①多元线性回归分析显示，在单种营养素模型中，VB 、VB 、VB 、VC 、VD 及磷与 eGFR 呈显著正向关联（p <

0.01），其中 VD 的关联强度最高（β = 0.123）；钙、钾、镁与 eGFR 呈显著负向关联（p < 0.01），镁的负向关联强 度最高（β = −0.104）。在混合营养素模型中，VB 、VD 、磷（正向关联）及钙、钾、镁（负向关联）的显著关联仍 稳定存在，且钠与 eGFR 的负向关联亦显现（p = 0.029）。② BKMR 分析表明，VB （lnVB ）、磷（lnP）、钾（lnK）、 镁（lnMg）、VD（lnVD）为与 eGFR 关联最核心的营养

素（PIP > 0.75）；部分营养素（如磷）对 eGFR 的效应随暴露 分位数的升高呈现由正向向负向的转变，而 VD 、VB_9 在较高暴露分位数下仍维持正向关联，镁在高暴露分位数时 负向关联进一步增强。③分层分析显示，CKD 1-2 期患者以电解质与 eGFR 的关联为主: 磷与 eGFR 呈正向显著关 联（β = 0.076），钙、钠与 eGFR 呈负向显著关联（β 均为 - 0.052），维生素类与 eGFR 无显著关联；CKD 3-5 期患 者以维生素与 eGFR 的关联为主：VB_2 、VB_6 、VB_9 、VD 与 eGFR 呈正向显著关联，镁与 eGFR 呈负向显著关联

（β = −0.039），磷与 eGFR 转为负向关联（p = 0.027）；磷、钙与 eGFR 的关联在各分期均存在，但磷与 eGFR 的关联 方向随 CKD 分期进展由正向转为负向。

CKD 患者血清营养素与 eGFR 的关联存在显著的 CKD 分期特异性。磷和钙为跨 CKD 分期的核心关联营养素，但其

作用模式随疾病进展发生变化；维生素类与 eGFR 的关联在 CKD 中晚期凸显， 电解质与 eGFR 的关联呈现阶段转换 特征。临床实践中需遵循分期精准干预原则：CKD 早期（1-2 期）以维持电解质平衡（控制钠摄入、调节钙磷代谢）

为核心，CKD 中晚期（3-5 期）需强化 VB_2 、VB_6 、VB_9 、VD 的补充，并针对性控制磷和镁水平，以延缓肾功能下 降；对 CKD 患者开展营养素水平的分期动态监测，对 CKD 全程管理具有重要意义。

肌肉衰减症营养管理新进展相关研究

The Delaying Effect of Yanshen Capsules on Appendicular Skeletal Muscle Mass Decline in Patients with Chronic Kidney Disease: Implications for Treatment Selection

yu cao, Meng-Da Tang, 景宏 赵 , Liang-Yu Yin Army Medical University Xinqiao Hospital

Protein-energy wasting (PEW) and sarcopenia are common yet easily overlooked complications in patients with chronic kidney disease (CKD) . Currently, the compliance with intervention strategies mainly based on nutritional support and

exercise intervention is relatively poor . Although Yanshen Capsule has been proven to improve renal function in CKD patients, no studies have explored its effect on delaying muscle mass loss .

This study enrolled patients with CKD who received regular follow-up at our hospital from January 2016 to May 2025.

Based on the predefined inclusion and exclusion criteria, a total of 68 patients treated with Yanshen Capsules and 76 patients treated with other conventional kidney-protective and toxin-removing drugs were finally included, and the

patients were divided into two groups according to the treatment regimen. A multi-model linear regression analysis was

used to compare the changes in appendicular skeletal muscle mass (ASM) between the two groups, and to explore whether different treatment methods have a delaying effect on the decline in muscle mass.

A total of 144 patients were included in this study, with a median age of 49.50 (40.00, 58.00) years. After a period of

regular treatment, there was no significant difference in estimated glomerular filtration rate (eGFR) levels between

patients treated with Yanshen Capsules and those treated with other kidney-protective and toxin-removing drugs.

However, the change rate of appendicular skeletal muscle mass in patients treated with Yanshen Capsules was significantly lower than that in patients treated with other kidney-protective and toxin-removing drugs (p=0.017). Multiple linear

regression analysis showed that treatment with Yanshen Capsules was an independent protective factor for delaying muscle mass decline in patients with CKD ($\beta = -0.017$, 95% CI: −0.033 to −0.001, p = 0.038). This negative association

remained significant after stepwise adjustment for demographic characteristics, clinical complications, and medication use, indicating the robustness of the association.

Compared with patients treated with other kidney-protective and toxin-removing drugs, those treated with Yanshen

Capsules had a smaller change rate of ASM. These findings are of great significance, as they provide valuable references for clinicians and patients with CKD to select treatment regimens.

肌肉衰减症营养管理新进展相关研究

Association of combined left and right handgrip strength with new-onset chronic kidney disease in middle-aged and older adults: a nationwide multicenter cohort study

yu cao, Meng-Da Tang, Jing-Hong Zhao, Liang-Yu Yin Army Medical University Xinqiao Hospital

Low muscle strength is a key component of the diagnostic framework for sarcopenia, yet the role of multi-site muscle strength in the incidence of chronic kidney disease (CKD) remains largely unknown. This study aims to investigate the association of combined left and right handgrip strength (CHS) with new-onset CKD in middle-aged and older adults.

This observational multicenter study included 4618 community-dwelling adults without CKD at baseline in 2011. CHS (kg)

was assessed at baseline and participants were followed in 2013, 2015, and 2018 to track CKD incidents. Sex-specific

thresholds for low CHS were determined using receiver operating characteristic (ROC) analysis. Restricted cubic spline analysis, survival analysis and multivariable-adjusted Cox regression models were used to analyze the association between

CHS and new-onset CKD.

The study included 2526 women and 2092 men (median age=58.87 years). During the seven-year follow-up, 503 (10.89%)

new CKD cases occurred. CHS was associated with new-onset CKD in both men (P=0.021) and women (P=0.009) in a linear- like manner (both P nonlinearity > 0.05). The optimal thresholds for CHS to predict CKD incidents were 96.15 kg for men

and 57.90 kg for women. Kaplan-Meier curves demonstrated that prolonged CHS were positively associated with new-

onset CKD in both men (P<0.001) and women (P=0.001). Low CHS, defined using the optimal thresholds, was independently associated with an increased risk of CKD (HR = 1.824, 95% CI = 1.379 to 2.413). This relationship was

strengthened in participants with a BMI classification of normal (HR=2.878, 95%CI=1.732 to 4.782, P interaction = 0.032) at baseline, as well as those without diabetes (HR=2.048, 95%CI=1.514 to 2.771, P interaction = 0.019).

This study demonstrated a longitudinal association between CHS and new-onset CKD in middle-aged and older Chinese

adults. These findings highlight the potential of early-life multi-site muscle strength interventions for the prevention of CKD.

营养风险筛查、营养评定及营养不良诊断的相关研究

Predictive Value of the Prognostic Nutritional Index for Six-Month Readmission in Elderly Hospitalized Heart Failure Patient

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Purpose:

The objective of this study was to employ the Prognostic Nutritional Index (PNI) to assess nutritional status and explore its predictive value for six-month readmission in elderly hospitalized heart failure patients, a population with a high incidence of nutritional risk.

Patients and methods:

We recruited 328 elderly heart failure patients from the Department of Cardiology from January to August 2024. We prospectively collected data on age, sex, clinical characteristics, smoking history, comorbidities, and laboratory findings. The Prognostic Nutritional Index (PNI) was used to evaluate nutritional status. Factors associated with six-month readmission were identified through multivariate logistic regression analysis.

Results:

According to PNI assessment, 199 subjects (60.67%) were identified as malnourished (PNI < 40). Univariate logistic regression analysis revealed that low PNI, body mass index (BMI), length of hospital stay, self-care ability, albumin level, smoking status, and NYHA class were significantly associated with six-month readmission ($p < 0.05$).

Multivariate analysis further identified the following independent risk factors for

readmission: low PNI (OR = 2.319), current smoking (OR = 8.308), NYHA II (OR = 3.267), NYHA III (OR = 4.911), and NYHA IV (OR = 16.364).

Conclusion:

Malnutrition is highly prevalent among elderly patients with heart failure, and a low Prognostic Nutritional Index (PNI < 40) is an independent risk factor for readmission within six months.

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

1 例高甘油三酯血症性急性胰腺炎患者的肠内营养治疗

付佳佳 张艳黎 王海生 李昕 刘丽波 武警特色医学中心

急性胰腺炎（SAP）是临床常见的消化系统急症，可累及全身器官、系统并有进展为病情凶险、病死 率高的特点。近年来，高脂血症已超过酒精成为 AP 的第二大病因，因此又被称为高甘油三酯血症性 急性胰腺炎（HTG-AP）。指南推荐 HTG-AP 患者的营养支持方法首选肠内营养，若对 EN 耐受性差，

则应启动肠外营养。

本文总结了一例 HTG-AP 患者，住院期间给予肠内营养治疗并取得满意疗效。患者于入院前 1 天无明显诱因出现上腹部疼痛，呈持续性，程度较重，伴后背部放射痛，伴恶心、呕吐、心悸、出汗等不 适，呕吐物为胃内容物，无呕吐咖啡色胃内容物、黑便，无反酸、烧心，无寒战、高热等不适，胰 腺炎监测：淀粉酶 259 U/L, 脂肪酶 4901U/L。血常规：白细胞 19.7x109/L, 中性粒细胞百分比 84.6%, 中性粒细胞绝对值 16.66 x109/L, 红细胞 5.89x1012/L, 血红蛋白 181g/L, 红细胞压积 51.1%;C- 反应 蛋白（定量）264.57 mg/L; 糖化血红蛋白 10.6%: 生化：尿酸 647 umol/L, 钠 135.3 mmol/L, 总胆固醇

10.17 mmol/L，甘油三脂 19.59mmol/L, 高密度脂蛋白胆固醇 0.75 mmol/L; 前降钙素测定（定

量）0.93ng/ml; 入院后，消化科给予抑酸、抑制胰酶分泌及胰酶活性、补液、降糖等治疗。入院后完 善腹部 CT 检查可见胰腺周围渗出，急性胰腺炎诊断明确，BISAP 评分 1 分，予禁食水、留置胃管，

胃肠减压。入院后随机指血血糖测不出，尿常规提示酮体 1+，血气分析 PH 值正常，予以糖盐 + 胰岛 素降糖治疗。患者未排气考虑急性胰腺炎合并胃肠功能障碍，给予灌肠后可自行排气。

2025 年 4 月 15 日在内镜室行胃镜下鼻 - 空肠营养管置入术。为协助早期肠内营养支持请营养科 会诊。经营养评估将目标能量定在 1800-2100kcal，蛋白质在 1.0-1.2g/kg.d，前期采用完全肠内营 养，后面根据患者胃肠恢复情况逐渐过渡至经口进食。4.15 首日小剂量启动，250ml 以 25mi/h 的滴 速慢滴，耐受良好，逐步上调，严密监测血糖、电解质、并动态调整营养素供给。第 5 天达到了

1250ml，热量 1518kcal，同时逐渐增加经口进食，由流食到半流食顺利过渡，无特殊不适，患者治 疗期间生命体征趋于平稳，食欲及精神好转，血浆白蛋白出院前 48.5g/L，甘油三酯降至

4.36mmol/L，血脂情况较入院前有明显改善，整体治疗有效。

经过个体化营养治疗，患者治疗期间生命体征趋于平稳，食欲及精神好转，血浆白蛋白水平正常， 电解质正常，血脂情况较入院前有明显改善，整体治疗有效。

“唤醒肠道 ”对患者的作用优于“肠道休息 ”。

2023 年中国 156 家二级以上医疗机构特殊医学用途配方食品（FSMP）管理现状与临床应用调查

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摘要

目的： 全面调查我国二级以上医疗机构特殊医学用途配方食品（FSMP）的管理模式、临床应用现状及面临的核心障碍，为制定针对性的改进策略提供实证依据。方法： 于 2023 年采用横断面调查方法，通过在线问卷对全国 156 家二级及以上医疗机构进行普查。问卷内容涵盖管理体系、采购招标、信息化建设、临床应用及收费支付等维度。结果： 共回收有效问卷 156 份。管理体系方面，仅 39.1% 的医院设立了 FSMP 管理委员会；51.92% 的省份尚未制定任何地方性规范文件。采购与使用方面，FSMP 采购决策部门分散，招标办（19.23%）、物资科（17.95%）、总务科（17.31%）为主；68.59% 的医院使用 FSMP，但使用量最大的品类却是“固体饮料型制剂”（44.23%）。信息化与收费方面，仅 51.92% 的医院实现了 FSMP 信息化闭环管理；41.03% 的医院能将 FSMP 纳入 HIS 系统收费；高达 91.03% 的省份未将 FSMP 纳入医保。临床实践方面，营养风险筛查率较高（89.1%），但住院费用清单纳入率（33.97%）和不良反应监测率（66.03%）仍不理想。结论： 我国医疗机构 FSMP 应用普遍但管理混乱，面临 “管理组织缺位、招标采购不规范、医保支付缺失、信息化建设滞后、‘固体饮料’滥用风险” 五大核心挑战。建议从加强统一招标采购流程、推动医保准入、建设信息化平台及强化临床应用监管等方面系统推进 FSMP 的规范化进程。

关键词： 特殊医学用途配方食品；医疗机构管理；信息化建设；固体饮料

1. 引言

特殊医学用途配方食品（FSMP）作为患者营养支持的重要工具，其规范化管理是临床营养治疗有效性的关键保障 [1]。国家相继出台多项法规标准以推动行业发展 [2, 3]，然而，FSMP 从注册审批到临床终端的“最后一公里”仍存在诸多障碍。既往全国性调查多集中于临床应用率等宏观描述 [4, 5]，对深层次的管理机制、采购流程、支付方式等系统性问题的挖掘尚不深入。为精准识别当前 FSMP 在医院落地过程中的痛点和难点，本研究于 2023 年对全国 156 家二级以上医疗机构开展专项调查，旨在从多维度剖析现状，为破解 FSMP 临床应用困境提供精准的数据支持和政策参考。

2. 对象与方法

2.1 调查对象

以全国设有营养科的二级及以上医疗机构作为调查对象。

2.2 调查方法

经查阅既往文献及小组讨论等方式初步制定调查问卷，参考特殊医学用途配方食品（FSMP）临床管理专家共识（2021 版）内容，在天津市临床营养质量控制中心的讨论和监督下制定了《关于医疗机构特殊医学用途配方食品使用情况的调研问卷》，以在线问卷的形式，通过天津市临床营养质量控制中心为平台，对全国各个省 / 直辖市的医疗机构进行普查，由各院营养科负责人进行填写和提交。问卷内容主要包括：（1）FSMP 管理组织与政策环境；（2）FSMP 采购招标与供应模式；（3）FSMP 信息化与收费管理；（4）FSMP 临床应用与质量监控；（5）存在的主要问题与发展需求。

2.3 统计学分析

采用描述性统计分析，后续数据处理使用 Excel 进行例数及构成比的计算，计数资料以频数（n）和构成比（%）表示。

3. 结果

2023 年 7 月底至 9 月，共回收问卷 157 份，除去 1 份内容不完整问卷后得到有效问卷 156 份。其中三级医院 148 家（94.87%），二级医院 8 家（5.12%）。

3.1 FSMP 管理体系与政策环境 管理组织建设：仅 39.1%（61/156）的医院设立了 FSMP 管理委员会或专门管理组织。政策环境：超过一半的省份（51.92%，81/156）尚未制定任何 FSMP 地方标准、使用规范或指南。仅 27.56%（43/156）的医院参与了本省市相关文件的制定。医院内部制度：在无上级规范的省份，仍有 46.15%（72/156）的医院自行制定了本院的 FSMP 临床使用管理制度。

3.2 FSMP 采购招标与品类使用 采购方式：采购方式多样且分散。最常见的是“营养科提需求，医院招标决定”（35.26%，55/156），而由“FSMP 管理委员会讨论决定”的比例极低（5.77%，9/156）。采购部门：负责采购的部门多元，主要包括招标办（19.23%，30/156）、物资科（17.95%，28/156）和总务科（17.31%，27/156），由营养科直接采购的仅占 15.38%（24/156）。产品品类与使用：68.59%（107/156）的医院在使用 FSMP。然而，问及使用量最大的品类时，“固体饮料型制剂”占比最高（44.23%，69/156），高于“药品”（26.92%，42/156）和“FSMP”（25.64%，40/156）。

3.3 FSMP 信息化建设与收费医保现状 信息化管理：仅略超半数（51.92%，81/156）的医院建立了 FSMP 信息化管理系统，实现处方、医嘱、收费、仓储管理的全流程闭环管理。医嘱开具与收费：52.56%

（82/156）的医院可在信息系统医嘱上直接开具 FSMP。收费方式以“纳入医院 HIS 系统”为主（41.03%，64/156），但仍有 22.44%（35/156） 通过营养科饭卡系统等非正规途径收费。医保支付：FSMP 的医保支付问题极为突出，高达 91.03%（142/156） 的省份未将其纳入医保收费编码，这是被调查者认为最亟待解决的问题（86.54%，135/156）。

3.4 FSMP 临床应用与质量监控 营养筛查与记录：绝大多数医院（89.1%，139/156）在使用 FSMP 前对患者进行营养风险筛查。73.08%（114/156） 的医院对使用情况有医疗文书（纸质或电子）记录。不良反应监测: 66.03%（103/156）的医院对使用 FSMP 后的不良反应进行监测，但监测深度和规范性可能不一。处方人员：开具人员以营养科医师（89.1%，139/156） 和临床医生（66.67%，104/156） 为主。住院收费清单: 仅 33.97%（53/156）的医院将住院患者使用的 FSMP 费用纳入住院费用清单，多数收费流程不规范。

3.5 面临的主要问题 调查显示，FSMP 管理面临多重问题，按选择比例排序前四位依次为：医保编码问题（86.54%）、定价收费问题（84.62%）、信息化管理问题（69.87%）和招标形式管理规范问题（59.62%）。

4. 讨论

本研究结果描绘了一幅充满矛盾的图景：一方面，FSMP 在临床的应用需求巨大且日益普及；另一方面，从管理到应用的全链条都存在显著的不规范现象，严重制约了其营养治疗价值的发挥。

4.1 管理体系涣散与采购流程异化 FSMP 管理委员会的低设立率（39.1%）表明大多数医院缺乏多部门协同管理机制。这直接导致采购决策权分散至招标办、物资科等非业务部门，而作为使用主体的营养科话语权薄弱（仅 15.38% 直接采购）。这种采购与使用的分离模式，极易导致采购决策与临床实际需求脱节，也为不符合标准的产品流入临床打开了方便之门 [6]。本调查中“固体饮料”成为使用量最大品类的现象，可能涉及价格、利润、招标规则等多种复杂因素。

4.2 医保支付缺失与收费乱象并存 医保收费编码未进行营养制剂的录入（91.03% 未纳入）是 FSMP 推广的核心瓶颈。它直接导致医院收费困难，进而催生了通过营养科饭卡收费、现金支付等种种不规范操作，使得 FSMP 的使用无法纳入正规医疗行为和费用监管体系，也使得营养科正规的医疗行为没有合理的官方背书，极易造成患者的误解与质疑。

4.3 信息化水平不足制约精细化管理 超半数医院未实现信息化闭环管理，意味着无法对 FSMP 的处方合理性、库存流转、患者使用效果进行有效追踪和质控。这与《FSMP 临床管理专家共识》[7] 的要求相去甚远，是实现 FSMP 科学化、精细化管理的技术短板。

4.4 临床应用环节仍有提升空间 虽然营养筛查率较高，但不良反应监测（66.03%）和住院费用清单纳入

率（33.97%）仍有较大提升空间，反映出临床应用环节的末端管理仍较为松散。

5. 对策建议 强组织：强制要求二级以上医院设立 FSMP 管理委员会，由医务部门牵头，营养、临床、药学、采购等多部门参与，统一履行管理职责。明目录：各省应加快制定 FSMP 临床应用规范和推荐目录，明确“固体饮料”等非 FSMP 产品在临床营养治疗中能否使用及使用方法。建平台：推动医院将 FSMP 全流程管理模块嵌入 HIS 系统，实现从处方、配制、配送、收费到疗效评价的智慧化管理。严监管：加强对医疗机构 FSMP 的招标采购、临床使用和收费行为的监督检查，确保合规产品应用于适宜人群。

本次调查深刻揭示了我国医疗机构 FSMP 领域存在的 “管理缺位、采购失范、支付障碍、信息孤岛和产品乱象” 等系统性问题。FSMP 的规范化应用绝非单一环节的修补，而是一项需要政策制定者、医院管理者、临床专家和产业界共同推进的系统工程。未来应聚焦于构建权责清晰的管理体系、建立规范透明的采购流程、加快建设信息一体化平台，并严厉打击临床使用中的不规范行为，提高患者对营养于疾病的认识，提高就医率，方能真正让 FSMP 的科学价值惠及广大患者。

利益冲突： 无

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特殊医学用途配方食品临床应用与规范、医疗膳食规范化管理

2023 年中国 156 家二级以上医疗机构特殊医学用途配方食品（FSMP）管理现状与临床应用调查

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目的： 全面调查我国二级以上医疗机构特殊医学用途配方食品（FSMP）的管理模式、临床应用现状及面临的核心 障碍，为制定针对性的改进策略提供实证依据。

方法： 于 2023 年采用横断面调查方法，通过在线问卷对全国 156 家二级及以上医疗机构进行普查。问卷内容涵盖 管理体系、采购招标、信息化建设、临床应用及收费支付等维度。

结果： 共回收有效问卷 156 份。管理体系方面，仅 39.1% 的医院设立了 FSMP 管理委员会；51.92% 的省份尚未制定 任何地方性规范文件。采购与使用方面，FSMP 采购决策部门分散，招标办（19.23%）、物资科（17.95%）、总务科（17.31%）为主；68.59% 的医院使用 FSMP ，但使用量最大的品类却是“固体饮料型制剂”（44.23%）。信息化与收

费方面，仅 51.92% 的医院实现了 FSMP 信息化闭环管理；41.03% 的医院能将 FSMP 纳入 HIS 系统收费；高达 91.03% 的省份未将 FSMP 纳入医保。临床实践方面，营养风险筛查率较高（89.1%），但住院费用清单纳入率 （33.97%）和不良反应监测率（66.03%）仍不理想。

结论： 我国医疗机构 FSMP 应用普遍但管理混乱，面临“管理组织缺位、招标采购不规范、医保支付缺失、信息化 建设滞后、‘固体饮料’滥用风险”五大核心挑战。建议从加强统一招标采购流程、推动医保准入、建设信息化平台 及强化临床应用监管等方面系统推进 FSMP 的规范化进程。

关键词： 特殊医学用途配方食品；医疗机构管理；信息化建设；固体饮料

临床营养学科建设发展

肿瘤专科医院“ 五四三”策略驱动下“一站式营养诊疗矩阵”新模式的构建与实施

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天津市肿瘤医院（天津医科大学肿瘤医院）

目的：恶性肿瘤是中国面临的重要公共卫生问题之一，约有 40%–80% 恶性肿瘤患者存在营养不良，其中 20% 直接死于营养不良。我院自 2022 年起，创新性地探索并实施 了基于“五四三 ”策略构建“一站式营养诊疗矩阵 ”的新模式，旨在为临床营养科的高质量发展提供新的思路与方向，从而进一步提升患者的营养诊疗就医体验。

方法：我院采用“五四三 ”策略即：1、“五个环节 ”：营养诊疗参与“防 – 筛 – 诊 – 治 – 康 ”，该策略构建营养诊疗五环节闭环。“防 ”通过宣教和饮食指导提升认知，预防疾病；“筛 ”用专业工具筛 评营养状态；“诊 ”下达准确诊断；“治 ”实施针对性治疗方案；“康 ”提供营养支持促进全面康复。五环节衔接形成高效诊疗链条。2、“ 四个场景 ”：营养诊疗覆盖“ 门诊 – 日间 – 住院 – 居家 ”，现 有营养医疗服务形式难以满足非长期住院患者的全面营养诊疗需求。为解决短板，我院将日间营养诊疗纳入医疗管理体系，开展临床价值显著的日间营养诊疗。2024 年获批国家卫健委医院管理研究 所日间医疗规范化研究项目，建立了日间营养诊疗的相关标准及制度。3、“三个领域 ”：营养诊疗融合“医疗 – 互联网 –AI ”。在当前数智化时代，我们积极通过深度融合医疗资源、互联网技术以及 人工智能算法，打造一个高效、便捷、精准的营养诊疗新平台。基于“五四三 ”策略我们构建了“一站式营养诊疗矩阵 ”模式。该模式整合多部门资源，实现了营养诊疗服务的无缝对接。为患者节省 就诊时间，提高诊疗质量。1、服务一站式：我院以智能化系统建设为抓手，构建覆盖院前 – 院中 – 院后的全周期营养诊疗生态。通过三大智慧平台联动，确保患者从首诊到居家均能享受连贯性服务，

真正实现“诊疗零距离，健康全程护 ”的医疗服务目标。（1）互联网医院（2022 年启用）：突破时空限制，让患者足不出户即可获得三甲医院专业指导。支持在线复诊、检查预约，开药配送等，形 成医疗闭环，为肿瘤患者提供全流程营养诊疗支持。（2）辅助决策系统（2024 年升级）：基于 HIS 系统的深度开发，构建四大智能模块营养风险提示、营养会诊弹窗、智能监测用药、疗效指标抓取。 为医院运营提质增效，为患者服务更优更强。（3）营养云管理（2024 年部署）：由营养科与信息中心联合打造集五大核心功能：营养数据看板、膳食调查日记、AI 体重管理、营养风险预警、精准科 普推送。通过移动端实现云端营养诊疗服务，

将三甲医院专业能力延伸至全生命周期管理。2、场地一站式：我院创新构建营养诊疗全流程集成服务体系，依托信息化平台整合营养筛查、评估、诊断、 治疗闭环服务。通过智能化系统实现三项核心服务：营养专家全程跟进制；床旁代谢检测即时化；医用营养制剂精准配送。该模式突破传统科室壁垒，打造“营养诊疗零位移 ”服务体系，使患者在固 定诊疗单元即可完成营养诊疗全流程。显著提升诊疗效率，优化患者就医体验。3、管理一站式：为规范该模式的规范化运行，我院制定并实施了一系列标准和制度，依托信息化平台实现质量数据的 统一归集与跨部门共享。(1)信息化建设实现了上游对下游多部门的垂直管理: 2023 年我院率先出台《天津市肿瘤医院营养筛查制度》，系统推进营养筛查工作全院覆盖；2024 年我院颁布《天津市 肿瘤医院住院患者营养状况评估制度》建立临床营养闭环管理体系；2025 年我院发布《天津市肿瘤医院规范化营养诊疗示范病房建设标准》，系统构建营养治疗标准化应用体系，诊疗质量实现标准 化提升。从制度、流程、考核三方面进行临床营养医疗质量的监督。（2）信息化建设实现了各部门质控数据横向监督。营养诊疗质控数据科通过信息平台查询。医务处、护理部、营养科、信息处、

病案室、医疗保险办公室及药学部等对全营养诊疗流程及质量进行互相监督和管理。

结果：该模式实施后，我院取得了一定成效。1. 医院层面：该模式实施后我院医疗运行稳步增长，2022 年出院人次为 118471，2024 年增长为 161140 人次。良好的营养状态对接受四级手术的患者具

有积极影响，2022 年我院接受四级手术患者为 22307 人，2024 年增长至 26285 人，其中术后平均住院日缩短至 4.63 天。医疗收入结构持续优化，形成医疗质量与运营效率双提升的良性发展格局。2.

科室层面：（1）营养科诊疗质效双提升：营养风险筛查率稳步提升，由 2022 年的 78.5%，提升为 2024 年的 93.6%。营养状况评估量稳步增加，由 2022 年的 1700 人次增加至 2024 年的 6270 人次。

肠内 / 肠外营养治疗量稳步增加，营养科诊疗工作量稳步提升。（2）科研产出：获国家自然科学基金青年项目 1 项；天津医科大学管理创新项目 1 项；天津市卫生健康委项目 1 项；天津市肿瘤医院院

级课题 5 项；研究者发起临床试验 5 项 。营养科以第一作者发表中、英文论文 10 余篇。2023 年作为参与单位完成了“临床营养诊疗体系的创建及应用 ”科技成果鉴定。专利 3 项，计算机软著 1 项。

参与起草《天津市医疗机构临床营养科肠内营养诊疗技术质量规范》（津卫医政 [2023] 67 号）。3. 患者层面：（1）降低患者医疗成本：从患者医疗成本的角度来看，通过规范化的营养诊疗服务，

患者能够获得更为精准和有效的营养治疗，降低整体的医疗费用。2022 年我院住院均次费用为 22533.77 元，而 2024 年为 21855.22 元。营养诊疗的早期介入和持续管理，也有助于减少患者住院天数，

进一步降低了患者的医疗成本。2022 年我院患者平均住院天数为 4.62 天，而 2024 年平均住院天数为 4.29 天。（2）提高患者满意度：在该创新实践模式下，患者满意度得到提升。国家公立医院

绩效监测指标中门诊患者满意度由 2021 年的 84.6% 提升至 2023 年的 94%，住院患者满意度由 2021 年的 95.26% 提升至 2023 年的 99%。通过优化服务流程以及提供个性化的营养诊疗方案，患者感受到了更加贴心和专业的医疗服务，从而进一步改善患者就医感受。

结论: “五四三 ”策略驱动下“一站式营养诊疗矩阵 ”新模式的构建与实施，实现了营养诊疗“ 四大升级 ”: 营养筛查由“被动式 ”转变为“主动预警式 ” 、膳食指导由“通用型 " 转变为“个体化定 制 ” 、营养支持时机由“滞后性 ” 转变为“治疗同步化 ” 、营养管理流程由“碎片化 ” 转变为“全周期闭环 ” 。医院实现医疗质效双提升，扩大影响力。营养科实现诊疗延申，获多项科研、专利及软 著成果。患者降低医疗成本，改善生活质量，提升满意度。

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

一例胰十二指肠切除术后合并胰肠吻合口瘘的全程规范化营养诊疗 ---基于营养治疗五阶梯策略

孙学丽 周素宏 杨连营 陈常红 王艳军

天津宝坻人民医院

探讨基于营养治疗五阶梯策略的规范化营养诊疗方案在胰腺癌患者胰十二指肠切除术术前及术后营养支持治疗中 的应用，为胰十二指肠切除术术后患者的临床营养支持治疗实践提供参考。

回顾分析一例 62 岁、女性胰腺癌患者，行开腹探查：胰十二指肠切除术，术后合并胰肠吻合口瘘的围手术期 营养支持治疗经过，包括营养风险筛查、营养治疗方案的调整、营养支持手段的转换、术后血糖控制及术后合并 吻合口瘘时总能量及蛋白质的供给量，评价患者的预后，总结营养诊疗经验， 以指导胰腺癌患者围手术期的临床 营养诊疗工作，更好的促进疾病康复。

患者于入院 24 小时由主管医师完成营养风险筛表（NRS-2002），评分不足 3 分，拟进行手术治疗，患者腹痛、食欲欠佳，给予经口进食流食联合氨基酸、脂肪乳、葡萄糖静脉输注补液支持治疗。明确手术方案后，于术前 1

天再次完善营养评估，术中保留鼻空肠营养管、胆肠吻合口后 + 胰肠吻合口后 + 胰肠吻合口前引流管。患者术后第 一天禁食水经中心静脉予全合一胃肠外营养支持治疗，术后 3 天患者排气，未排便，肠鸣音正常，经鼻空肠管持 续滴入适量温水启用空肠营养联合部分肠外营养支持治疗，肠内营养耐受可，予短肽型肠内营养剂经鼻空肠营养 管滴入，逐渐减少肠外营养供给量。术后 10 天因胰肠吻合口瘘停止空肠营养，予全胃肠外营养支持治疗至术后 16 天再次启用空肠营养联合部分肠外营养治疗，患者肠内营养耐受可，营养支持方式由肠外营养治疗为主逐渐过渡 至空肠营养治疗为主，术后 22 天患者夹闭胃管，经口试饮水未诉不适，术后 23 天拔除胃管，顺利过渡至经口进 食联合短肽型肠内营养剂治疗，停止肠外营养支持治疗。营养支持治疗过程中定期检测生化指标评估营养治疗效 果，指导调整治疗方案。营养治疗过程中总能量系数 20-33kcal/kg.d（1174-1815 kcal/d）；保证充足的氨基酸供 给量（1.1-1.6g/kg.d），结合肝肾功能及血糖水调整

糖脂比，患者病情逐渐好转，恢复经口进食流食联合口服短 肽型肠内营养剂后，顺利出院。

规范化的营养诊疗流程是包含营养风险筛查、营养评价、营养诊断和营养治疗及监测在内的一套连续性的诊疗 模式，营养治疗五阶梯策略提倡优先口服营养、逐步升级支持的治疗方案，基于营养治疗五阶梯策略的胰十二指 肠切除患者围手术期的规范化营养诊疗是通过术前早期营养风险筛查与评估将营养治疗前置，为手术奠定基础。

术后动态调整营养支持方式，实现肠外营养治疗逐渐向肠内营养治疗的阶梯过渡，营养治疗过程中保证足量能量 与蛋白质供给及严格的血糖控制，可有效促进患者术后恢复，最终改善预后与生存质量。

普通人群基础代谢率与体成分的相关性

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摘要：目的 分析普通人群基础代谢率（Basal Metabolic Rate，BMR）与人体成分的相关性。方法 选取 509 例普通人群，其中男性 127 例，女性 382 例，平均年龄（39.66±8.01）岁，收集基本信息，并采用 inbodyS10 人体成分分析仪进行人体成分测定。结果 BMR 在自身 BMR 正常范围内者 162 例，低于自身 BMR 正常范围下限者 345 例，高于自身 BMR 正常范围上限者 2 例。相关性分析显示，BMR 与去脂体重（ Fat Free Mass，FFM）、骨骼肌（Skeletal Muscle Mass，SMM）、身体总水分（Total Body Water，TBW）、身体细胞量（Body Cell Mass，BCM）、蛋白质高度正相关，与去脂体重指数（Fat Free Mass Index，FFMI）、骨骼肌指数（Skeletal Muscle Index，SMI）、体重、男性中度正相关，与体质指数（Body Mass Index，BMI）、内脏脂肪面积（Visceral Fat Area，VFA）、体脂肪（Body Fat Mass，BFM）弱相关，与体脂百分比（Percent Body Fat，PBF）负相关。结论 肌肉相关指标是影响基础代谢率的最主要因素，提示力量训练对提升基础代谢率的重要性。脂肪相关指标对基础代谢率的影响存在复杂性，体脂肪与基础代谢率呈弱正相关，但体脂百分比与基础代谢率呈负相关；内脏脂肪面积＞ 100cm2 的例数占 42.8%，但仅与基础代谢率弱相关，提示内脏脂肪更可能通过炎症因子间接影响基础代谢率。肌肉量、去脂体重、身体总水分的 VIF 值＞ 1000，不可作为独立预测变量，体成分综合评分比单一指标更具预测力。

关键词：基础代谢率 体成分 相关性

基础代谢率（Basal Metabolic Rate，BMR）是指人体在清醒而又极端安静的状态下，不受肌肉活动、环境温度、食物及精神紧张等影响时的能量代谢率。它反映了人体维持基本生命活动所需要的能量消耗，是评估人体能量代谢的重要指标之一[1]。体成分则是指人体各组成部分的含量，包括脂肪组织、瘦体重（肌肉、骨骼、内脏等）等 [2], 体成分在能量消耗过程中会发生动态变化，影响 BMR[3]。了解普通人群基础代谢率与体成分的相关性，对于深入认识人体能量代谢机制、制定合理的饮食和运动计划以及预防肥胖、糖尿病等慢性疾病具有重要意义。

目的

探究普通人群基础代谢率与体成分之间的相关性，明确各项体成分指标对基础代谢率的影响程度，为进一步研究人体能量代谢规律和制定个性化的健康管理策略提供科学依据。

1 研究方法

1.1 研究对象

选取年龄在 23-61 岁之间的普通人群作为研究对象，共纳入 509 名参与者。所有参与者身体健康，无重大疾病史，近期未服用影响代谢的药物。

1.2 研究内容

（1）患者基本信息：包括年龄、性别、体重、既往病史。（2）基础代谢率测量：采用间接测热法，使用专业的代谢测量仪对参与者进行基础代谢率测量。测量前要求参与者禁食 12 小时，保持安静状态 30 分钟以上，测量过程中参与者需安静平卧，呼吸平稳。（3）人体成分测定：采用 InbodyS10 型人体成分分析仪。测定指标包括：去脂体重（ Fat Free Mass，FFM）、骨骼肌（Skeletal Muscle Mass，SMM）、身体总水分（Total Body Water，TBW）、身体细胞量（Body Cell Mass，BCM）、蛋白质、去脂体重指数（Fat Free Mass Index，FFMI）、骨骼肌指数（Skeletal Muscle Index，SMI）体质指数（Body Mass Index，BMI）、内脏脂肪面积（Visceral Fat Area，VFA）、体脂肪（Body Fat Mass，BFM）、体脂百分比（Percent Body Fat，PBF）。

1.3 统计学分析

将测量得到的数据录入统计学软件进行分析。首先对数据进行正态性检验，若数据符合正态分布，则采用 Pearson 相关分析来探讨基础代谢率与各体成分指标之间的相关性；若数据不符合正态分布，则采用 Spearman 相关分析。以 $P < 0.05$ 为差异有统计学意义。

2 研究结果

2.1 参与者基本特征

参与者的平均年龄为（39.66±8.01）岁，其中男性 127 名，女性 382 名，平均体重为（66.64±13.58）kg。

2.2 基础代谢率与体成分的相关性分析

（1）基础代谢率与去脂体重的相关性：分析结果显示，基础代谢率与去脂体重呈显著正相关（$r=0.999994$，$p < 0.05$）。这表明去脂体重越高，基础代谢率也越高，说明去脂体重是影响基础代谢率的重要因素之一，有研究认为，去脂体重，即 LBM 的质量是影响 BMR 的唯一预测指标 [4]。（2）基础代谢率与脂肪含量的

相关性：基础代谢率与去脂百分比呈负相关（r= − 0.299314，p < 0.05）。这意味着体脂肪比例越高，基础代谢率越低，提示过多的脂肪组织可能会降低人体的基础代谢水平。（3）基础代谢率与其他体成分指标的相关性：基础代谢率与体质指数也存在一定的正相关关系（r=0.558644，p < 0.05），但相关性相对较弱。

2.3 不同性别组基础代谢率与体成分的相关性比较

进一步分析发现，在男性组和女性组中，基础代谢率与体成分的相关性存在一定差异。在男性组中，基础代谢率与体重的相关性更为显著（r=0.81，p < 0.05）[5]；而在女性组中，基础代谢率与体脂肪的相关性相对更明显（r=0.48，p < 0.05）。

3 讨论

3.1 基础代谢率与体成分相关性的生理机制

本研究结果显示基础代谢率与去脂体重呈正相关，这是因为去脂体重中的肌肉组织是代谢活跃的组织，肌肉量越多，身体在静息状态下消耗的能力就越多，从而导致基础代谢率升高。而脂肪组织的代谢活性相对较低，过多的脂肪堆积会降低身体的整体代谢效率，导致基础代谢率下降。

3.2 研究结果的临床意义

本研究结果对于临床实践具有重要的指导意义。在制定体重管理和健康管理方案时，可以根据个体的体成分情况来调整策略。对于去脂体重较低的人群，可以通过增加力量训练来提高瘦去脂体重，从而提高基础代谢率，促进能量消耗；对于脂肪含量较高的人群，则需要控制饮食和增加有氧运动，以减少脂肪堆积，提高基础代谢水平。

3.3 研究的局限性

本研究也存在一定的局限性。首先，研究样本仅选取了 23–61 岁的普通人群，可能无法完全代表所有年龄段和不同健康状况的人群。其次，本研究仅测量了有限的体成分指标，可能还有其他未考虑到的因素影响基础代谢率与体成分的关系。未来的研究可以扩大样本范围，增加测量指标，以更全面地探讨基础代谢率与体成分的相关性。

4 结论

本研究通过对普通人群基础代谢率和体成分的测量和分析，发现基础代谢率与去脂体重呈显著正相关，与体脂百分比呈负相关。不同性别组中基础代谢率与体成分的相关性存在差异。以上结果提示，体成分指标高者，BMR 显著增高，这与其他相关研究结果一致 [6]。由此可以提示，通过加强身体素质，增加肌肉量，提高身

体代谢水平，可以有效提高机体 BMR 水平，维持机体健康 [7]。

这些结果为深入了解人体能量代谢机制以及制定个性化的健康管理方案提供了重要依据。未来还需要进一步开展大规模、多中心的研究，以更深入地探讨基础代谢率与体成分的关系及其影响因素。

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其他与临床营养相关的科研和工作总结、调查和建议

普通人群基础代谢率与体成分的相关性

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分析普通人群基础代谢率（Basal Metabolic Rate，BMR）与人体成分的相关性。

选取 509 例普通人群，其中男性 127 例，女性 382 例，平均年龄（39.66±8.01）岁，收集基本信息，并采用 inbodyS10 人体成分分析仪进行人体成分测定。

BMR 在自身 BMR 正常范围内者 162 例，低于自身 BMR 正常范围下限者 345 例，高于自身 BMR 正常范围上限者 2 例。相关性分析显示，BMR 与去脂体重（ Fat Free Mass，FFM）、骨骼肌（Skeletal Muscle Mass，SMM）、身体总水分（Total Body Water，TBW）、身体细胞量（Body Cell Mass，BCM）、蛋白质高度正相关，与去脂体重指数（Fat

Free Mass Index，FFMI）、骨骼肌指数（Skeletal Muscle Index，SMI）、体重、男性中度正相关，与体质指数 （Body Mass Index，BMI）、内脏脂肪面积（Visceral Fat Area，VFA）、体脂肪（Body Fat Mass，BFM）弱相关， 与体脂百分比（Percent Body Fat，PBF）负相关。

肌肉相关指标是影响基础代谢率的最主要因素，提示力量训练对提升基础代谢率的重要性。脂肪相关指标对基础 代谢率的影响存在复杂性，体脂肪与基础代谢率呈弱正相关，但体脂百分比与基础代谢率呈负相关；内脏脂肪面 积＞ 100cm2 的例数占 42.8%，但仅与基础代谢率弱相关，提示内脏脂肪更可能通过炎症因子间接影响基础代谢率。 肌肉量、去脂体重、身体总水分的 VIF 值＞ 1000，不可作为独立预测变量，体成分综合评分比单一指标更具预测 力。

天津市某医院职工体检人体成分现状分析

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摘要

目的 测量医院职工体成分状况，分析不同性别、年龄职工体成分差异及体质指数的影响因素，为制定针对性的健康管理策略提供依据。方法 选取 2025 年 8 月天津市安定医院体检职工为研究对象，采用生物电阻抗分析法进行人体成分分析，测定体质指数、体脂量、肌肉量、体脂率、内脏脂肪面积等指标。采用独立样本 t 检验比较不同性别、年龄组（青年组：23–39 岁；中青年组：40–61 岁）体成分指标差异。通过多元线性回归分析探究 BMI 的影响因素。结果 本研究共纳入 509 名职工，包括男性 127 人（24.95%），女性 382 人（75.05%）；年龄范围 23–61 岁，平均年龄为（39.7±8.0）岁。男性职工超重及肥胖总检出率为 71.65%，显著高于女性的 38.22%（P<0.05）。比较不同性别间体成分指标，结果显示女性体脂率高于男性，两者均值超正常标准（分别为 33.53%、26.49%）；男性在 BMI、肌肉量、去脂体重及基础代谢率等指标上均高于女性，差异具有统计学意义（P<0.05）；在体脂量、内脏脂肪面积上无性别差异（P>0.05），男女职工内脏脂肪面积均值分别为 95.32cm 、100.99cm 。不同年龄组间比较显示，中老年组的基础代谢率、身体总含水量、蛋白质、无机盐、肌肉量及去脂体重均显著低于青年组（P<0.05）。多元线性回归表明，年龄、蛋白质、体脂量与 BMI 呈正相关，无机盐与 BMI 呈负相关（P 均 <0.05）。结论 男性职工的超重及肥胖率显著高于女性，应作为体重管理的重点人群。同时，全体职工体脂率普遍偏高，存在内脏脂肪蓄积风险。建议通过实施个性化营养指导、组织体育锻炼活动及优化食堂膳食结构（如增设减脂餐供应窗口）等综合措施，有效控制职工体脂水平，改善整体营养状况，从而为患者提供更优质的医疗服务。

1 目的

职工健康是医疗机构维持高效运转、保障医疗服务质量的基石 [1]。医院职工，尤其是临床一线人员，常面临着工作强度大、长期轮值夜班、持续心理高压等问题，加上缺乏锻炼、膳食结构不均衡等因素，易出现体脂过度蓄积、骨骼肌量流失、基础代谢速率下降等体成分异常，进而增加超重及肥胖风险 [2]。研究表明，超重和肥胖不仅是独立的健康问题，更是冠心病、高血压、2 型糖尿病等慢性病的重要危险因素 [3]。因此，对职工群体进行早期健康监测与风险识别尤为重要。人体成分分析仪可精准量化脂肪量、肌肉量、身体水分等指标，为营养评估提供客观依据，有助于营养医师早期识别营养风险并制定个体化饮食与运动干预方案 [4]。本研究基于 2025 年 8 月天津市某医院职工体成分检测数据，采用横断面研究方法，分析不同性别与年龄组的

体成分差异及体质指数 (BMI) 的影响因素，为医院优化职工健康管理策略提供科学依据。

2 方法

2.1 研究对象

选取 2025 年 8 月于天津市安定医院营养与体重管理中心接受人体成分分析的全院职工作为研究对象。排除数据缺失或明显异常者后，最终共纳入 509 人，其中男性 127 人（24.95%），女性 382 人（75.05%）；年龄范围为 23–61 岁，平均年龄为（39.7±8.0）岁。

2.2 研究方法

使用韩国 Biospace 公司生产的 InBody S10 型人体成分分析仪进行体成分检测。该设备基于直接节段多频率生物电阻抗测量（DSM–BIA 法）原理收集数据。测量前录入受试者基本信息（姓名、性别、出生日期、身高、体重），嘱受试者赤足保持静止状态，将相应电极与受试者足踝、拇中指紧密接触。检测项目包括：身体总水分、蛋白质、无机盐、体脂肪、身体质量指数、体脂率、骨骼肌、基础代谢率、内脏脂肪面积等。

将 509 例研究对象按年龄分层，分为青年组（23–39 岁，n=283，55.60%）与中老年组（40–61 岁，n=226，44.40%）。参照中国肥胖工作组 2022 年发布的《中国居民肥胖防治专家共识》评定超重 / 肥胖标准：BMI<18.5 kg/m 为消瘦，18.5 ≤ BMI<24.0 kg/m 为正常，24.0 ≤ BMI<28.0 kg/m 为超重，BMI ≥ 28.0 kg/m 为肥胖 [5]。按照 Biospace 公司推荐标准：男性，体脂率≥ 20% 为超标准；女性，体脂率≥ 28% 为超标准；内脏脂肪面积≥ 100 cm 为超标准。

2.3 统计学方法

数据经 Excel 2025 双人核对录入，采用 SPSS 27.0 统计学软件进行处理分析。符合正态分布的计量资料用均值 ± 标准差（ ）表示，组间比较采用独立样本 t 检验；计数资料以频数（n）和百分比（%）描述，组内比较采用卡方检验。通过多重线性回归分析 BMI 与体成分指标的相关性，以 $P < 0.05$ 为差异具有统计学意义。

3 结果

3.1 研究对象超重及肥胖情况

全院 509 名职工中超重 161 人（31.6%），肥胖 76 人（14.9%）。男性职工中，低体重、体重正常、超重及肥胖的占比分别为 0.78%、27.56%、42.52% 和 29.13%；女性职工中，相应指标分别为 3.40%、58.38%、28.01% 和 10.21%。男性超重及肥胖合计占比为 71.65%，远高于女性的 38.22%。在超重与肥胖组内比较，男性占比显著高于女性（$P < 0.05$）。相反，女性职工以体重正常者为主，占比为

58.38%，远高于男性的 27.56%。

3.2 不同性别人体成分差异分析

通过独立样本 t 检验，结果表明女性体脂率高于男性 (P < 0.05)；女职工在内脏脂肪面积、体脂量方面，与男性相比无显著统计学差异（P=0.161，P=0.449）；女性的体质指数、基础代谢率、身体含水量、蛋白质、无机盐、肌肉量、去脂体重等指标，均显著低于男性（P 均 <0.05）。男女职工体脂率均值分别为 26.49%、33.53%；男女职工内脏脂肪面积均值分别为 95.32cm 、100.99cm 。

3.3 不同年龄组人体成分比较分析

采用独立样本 t 检验对不同年龄组的人体成分指标进行比较。结果显示，在体质指数、体脂率、内脏脂肪面积及体脂量方面，不同年龄组间差异均无统计学意义（P=0.964，P=0.119，P=0.867，P=0.588）。然而，中老年组在基础代谢率、身体总含水量、蛋白质、无机盐、肌肉量及去脂体重方面均显著低于青年组，差异具有统计学意义（P 均< 0.05）。

3.4 体质指数的多重线性回归分析

以体质指数（BMI）为因变量，将年龄、身体总含水量、蛋白质、无机盐、体脂量、肌肉量、去脂体重和体脂率纳入多元线性回归模型进行分析。结果表明，年龄、蛋白质、无机盐和体肪量是影响体质指数的主要因素（P 均 < 0.05）。

4 结论

近年来，超重与肥胖已成为日益突出的公共卫生挑战，其作为 2 型糖尿病、癌症等多种慢性疾病的独立危险因素，显著增加了人群患病风险。在这一背景下，医院职工作为维护公众健康的关键群体，其自身健康状态更应受到重视。开展规律的人体成分测量，对于早期筛查超重与肥胖、动态监测营养状况、评估慢性疾病进展及相关干预措施效果具有重要价值。目前常用的人体成分测定方法包括计算机断层扫描、磁共振成像、双能 X 射线吸收法以及生物电阻抗分析法（BIA）等。其中，BIA 技术凭借其无辐射暴露、操作便捷、成本较低等优势，更适用于医院、健身中心等场所，为实现常态化的职工健康监测与动态干预提供实用高效的解决方案 [7]。

本研究结果显示，男性职工超重及肥胖率远高于女性（分别为 71.65% 和 38.22%），该结果与乔永涛等 [6] 于 2022 年报告的数据存在一定差异，后者中男性与女性超重 / 肥胖发生率均高于本研究（分别为 73.4% 和 39.6%）。这种差异可能与以下因素有关：一是地域生活方式的不同；二是研究样本的特异性——本研究样本量有限且集中于健康意识较强的医院职工群体，这些都可能导致超重 / 肥胖检出率略低。卡方检验进一步表明，在超重与肥胖组中，男性比例均显著高于女性（P < 0.05），该结论与范蜀滨等 [8] 的研究结果一致。因此，建议将男性职工作为体重管理的重点干预对象。

不同性别间经独立样本 t 检验发现，体脂率、体质指数、基础代谢率、身体含水量、蛋白质、无机盐、肌肉量、去脂体重等指标在男女之间均存在差异，且女性体脂率显著高于男性（P < 0.05）；而在内脏脂肪面积和体脂量指标上无显著差别。由于体脂率界定标准存在性别差异（体脂率超标准：男性≥ 20%；女性≥ 28%），男女职工体脂率均值分别为 26.49%、33.53%，均超过正常范围；男女职工内脏脂肪面积均值分别为 95.32cm 、100.99cm ，均接近正常参考上限，提示职工整体体脂率超标，且内脏脂肪堆积风险较高，脂肪肝发病率增加。因此，针对全体职工开展减脂干预刻不容缓。

不同年龄组别经独立样本 t 检验显示，中老年职工的基础代谢率、身体总含水量、蛋白质、无机盐、肌肉量及去脂体重均显著低于青年职工（P < 0.05），与乔永涛等 [9] 研究结果一致。这一差异提示，随着年龄增长，人体可能出现蛋白质合成减少、骨骼肌流失、骨矿物质（无机盐）下降及基础代谢功能减退等生理变化。结合临床研究证据 [10]，中老年人群若出现以肌肉量减少、肌肉力量下降为核心特征的肌少症，需及时通过营养补充、抗阻运动等方式干预，以改善身体功能与生活质量，降低跌倒、营养不良及死亡风险。

本研究进一步开展多元线性回归分析，以探究体重指数（BMI）与其他体成分指标及年龄的关联，结果显示年龄、蛋白质、体脂量与 BMI 呈正相关，无机盐与 BMI 呈负相关。该结果表明，体脂量是影响 BMI 的重要正向因素，通过饮食调控（如控制总热量摄入、优化膳食结构）与运动干预（如结合有氧运动与抗阻运动）实现“适当减脂”，可有效降低 BMI、改善超重 / 肥胖状态。

综上所述，本院职工超重 / 肥胖问题存在显著性别与年龄差异，男性职工是超重及肥胖干预的重中之重。同时，全院职工体脂率普遍偏高，存在内脏脂肪蓄积风险，亟需全员减脂干预。建议从三方面推进：一是提供个性化营养指导并加强随访，开展全院营养宣教，提升肥胖相关疾病风险认知；二是组织工间操等集体锻炼活动，营造运动氛围；三是优化食堂膳食，增设低脂、低热量窗口，引导健康饮食。通过综合措施，控制职工超重 / 肥胖率，提升整体健康水平，保障医疗服务质量。

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临床营养学基础、临床与大数据等研究

天津市某医院职工体检人体成分现状分析

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测量医院职工体成分状况，分析不同性别、年龄职工体成分差异及体质指数的影响因素，为制定针对性的健康管 理策略提供依据。

选取 2025 年 8 月天津市安定医院体检职工为研究对象，采用生物电阻抗分析法进行人体成分分析，测定体质指数、体脂量、肌肉量、体脂率、内脏脂肪面积等指标。采用独立样本 t 检验比较不同性别、年龄组（青年组：23-39 岁； 中青年组：40-61 岁）体成分指标差异。通过多元线性回归分析探究 BMI 的影响因素。

本研究共纳入 509 名职工，包括男性 127 人（24.95%），女性 382 人（75.05%）；年龄范围 23-61 岁，平均年龄为 （39.7±8.0）岁。男性职工超重及肥胖总检出率为 71.65%，显著高于女性的 38.22%（P<0.05）。比较不同性别间 体成分指标，结果显示女性体脂率高于男性，两者均值超正常标准（分别为 33.53%、26.49%）；男性在 BMI、肌肉 量、去脂体重及基础代谢率等指标上均高于女性，差异具有统计学意义（P<0.05）；在体脂量、 内脏脂肪面积上无 性别差异（P>0.05），男女职工内脏脂肪面积均值分别为 95.32cm 、100.99cm 。不同年龄组间比较显示，中老年 组的基础代谢率、身体总含水量、蛋白质、无机盐、肌肉量及去脂体重均显著低于青年组（P<0.05）。多元线性回 归表明，年龄、蛋白质、体脂量与 BMI 呈正相关，无机盐与 BMI 呈负相关（P 均 <0.05）。

男性职工的超重及肥胖率显著高于女性，应作为体重管理的重点人群。同时，全体职工体脂率普遍偏高，存在内 脏脂肪蓄积风险。建议通过实施个性化营养指导、组织体育锻炼活动及优化食堂膳食结构（如增设减脂餐供应窗 口）等综合措施，有效控制职工体脂水平，改善整体营养状况，从而为患者提供更优质的医疗服务。

国内外肠外营养、肠内营养、膳食营养治疗的新进展和新型制剂的临床应用

中国老年营养健康食品市场特征分析——基于 Python 爬虫的电商平台数据研究

张 淇
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系统剖析中国老年营养健康食品市场的产品属性特征，量化分析用户喜好度与产品价格、功能成分、商家宣传的 关联关系，为市场发展动态把控、产品研发创新及行业监管提供科学参考。

以京东电商平台为数据来源，采用 Python 3.10 编程语言构建爬虫系统，以 “老年食品 ” “营养健康食品 ” 为核 心关键词，爬取截至 2025 年 6 月的 10768 款产品数据，涵盖产品类型、原料成分、功能宣称、价格及用户评 论等核心属性。通过 Python 完成数据清洗与整合，利用 PyEcharts 实现统计可视化，结合 SnowNLP 库开展用户 情感分析，采用 Pearson 相关性分析（双侧检验）量化用户喜好度。

10768 款产品中，老年营养健康食品 5905 款（55.26%）、保健食品 4571 款（42.80%）、特殊医学用途配方食品 209 款（1.96%）。老年营养健康食品核心特征：①产品形态以固态为主，蛋白型固体饮料占固态产品的 58.42%； ②慢性病专用产品占比仅 9.21% ，以糖尿病专用食品为主，高血压专用食品较少；③原料以谷物、植物蛋白、乳 制品为主，药食同源原料应用不足；④功能成分中钙、维生素、铁添加普遍，益生菌添加受限；⑤价格以低端产 品为主，与原料及功能成分质量正相关；⑥功能宣称集中于 “增强免疫力 ” 与 “补钙 ” ，20.28% 产品存在 “宣 称 – 成分 ” 不匹配。

Pearson 相关性分析结果显示：①用户喜好度与功能成分添加量：用户评分与益生菌添加量呈强正相关（r=0.73，

P<0.001），与钙添加量呈显著正相关（r=0.62 ，P<0.01），与维生素添加量呈中度正相关（r=0.48 ，P<0.01）； ②用户 喜好度与价格：用户评分与价格呈弱正相关（r=0.23 ，P<0.05），正面评论占比与价格分层呈梯度上升,但复购意 愿提及频次与 “单价 – 功效比 ”(功效宣称数量 / 单价)呈中度正相关(r=0.38 ，P<0.01），中端产品复购意愿最 高；③用户喜好度与商家宣传：正面评论占比与 “宣称 – 成分 ” 匹配度呈强正相关(r=0.68 ，P<0.001），匹配度 ⩾ 90% 的产品正面评论占比显著高于匹配度 < 60% 的产品；商家引用临床研究文献的产品，用户评分高于无文献 支撑的产品（r=0.43 ，P<0.01）。

多维度情感分析显示：用户整体情感偏向正面，“补钙类 ”“益生菌类 ” 产品正面情感热力值≥ 0.8 ；用户关注点以 “效果 ”、“成分 ”为主，“价格 ” 提及频次仅占 15% ，进一步印证功能实效对喜好度的主导作用。

中国老年营养健康食品市场存在产品结构不均衡、功能成分应用局限等问题；用户喜好度主要受功能成分（尤其 是益生菌、钙）添加量、“宣称 – 成分 ” 匹配度驱动，价格影响较弱但 “单价 – 功效比 ” 显著影响复购意愿。需通过强化功能成分技术创新、规范商家宣传、优化中端产品性价比，推动市场高质量发展。

临床营养学基础、临床与大数据等研究

Association between EAT-Lancet Planetary Health Diet and Risk of Neuropsychiatric Disorders: A Systematic Review and Meta-analysis

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In 2019, the EAT-Lancet Commission introduced the Planetary Health Diet, a predominantly plant-based dietary pattern designed to promote both human and environmental health. Although some studies suggest that adherence to the EAT- Lancet diet may confer benefits against neuropsychiatric disorders (NPDs), stronger statistical evidence is still needed to substantiate this association. This meta-analysis aims to comprehensively evaluate the associations between the EAT-

Lancet dietary pattern and the risk of NPDs, including depression, anxiety, stroke, cognitive impairment, dementia, and related outcomes.

A systematic review and meta-analysis were conducted using data from PubMed, Web of Science, Embase, Cochrane

Central, Scopus, and ProQuest Dissertations & Theses Global, from database inception to September 4, 2025. We included all observational studies examining the association between adherence to the EAT-Lancet diet and neuropsychiatric

disorders, including depression, anxiety, stroke, dementia, cognitive impairment, and related outcomes. Summary effect sizes were reported as hazard ratios (HRs), odds ratios (ORs), or standardized regression coefficients (β). Study

heterogeneity was assessed using Q and I statistics and visualized with Galbraith plots. Subgroup analyses were

performed to explore potential sources of variability, publication bias was evaluated with funnel plots and statistical tests, and sensitivity analyses were conducted to assess robustness. The quality of included studies was assessed, and the

certainty of evidence was graded using the GRADE framework.

We identified 23 studies including over 1.8 million participants. Adherence to the EAT–Lancet dietary pattern was associated with lower risks of depression (six studies; OR = 0.76; 95% CI: 0.71–0.81; $p < 0.001$; I = 0.00%), anxiety (three studies; OR = 0.82; 95% CI: 0.76–0.89; $p < 0.001$; I = 0.00%), stroke (eight studies; HR = 0.88; 95% CI: 0.83– 0.93; $p < 0.001$; I = 0.00%), and dementia (two studies; HR = 0.96; 95% CI: 0.93–1.00; $p = 0.04$; I = 0.00%). No significant association was observed for overall cognitive

function (four studies; $\beta = 0.02$; 95% CI: −0.01 to 0.06; $p = 0.23$; I = 95.49%).

Anxiety and depression outcomes were predominantly reported in cross-sectional studies and as odds ratios, so these results should be interpreted with caution. Sensitivity

analyses and Galbraith plots confirmed the robustness of these results. Funnel plot analyses suggested minor potential publication bias, which did not materially affect the overall conclusions.

Higher adherence to the EAT–Lancet diet was associated with lower risks of anxiety,

depression, and stroke, with modest benefits for dementia. These findings highlight the potential of predominantly plant-based dietary patterns in promoting neuropsychiatric

health and support their use as a strategy for NPDs prevention.

特殊医学用途配方食品临床应用与规范、医疗膳食规范化管理
医院治疗膳食智造管理流程改进

左思璐 程懿 王艳 胡雯 四川大学华西医院

随着中国社会与经济快速发展，居民生活及医疗卫生服务水平持续提升，人均预期寿命 不断延长，慢性病患病率呈逐年上升趋势，疾病负担日益加重。治疗膳食作为疾病综合治疗不可或 缺的一部分，有助于降低其并发症和死亡率，减轻疾病负担。 目前国内医院的膳食质量仍处于相对 较低水平，对治疗膳食的管理建设仍有极大的改进空间。通过对治疗膳食标准化流程建设及信息化 智能制造的改进，有助于优化资源配置、提升膳食的生产效率及生产服务质量、保障医疗的安全性， 提高患者的满意度及减轻疾病负担，适应医院未来的精细化运营管理及高质量发展。

本研究通过实地问卷调查及深入访谈等方式，对四川大学华西医院治疗膳食智造的流程、 供应链及运营管理进行了深度剖析，聚焦膳食研发、生产计划、采购库存及质量控制四个部分，运 用 PEST 宏观环境分析工具、SWOT 战略分析模型及鱼骨图因果分析方法等，对目前医院治疗膳食智

造存在的问题进行全面诊断及成因分析，运用平衡记分卡、需求预测、PDCA 循环、六西格玛等管理 模型工具给出对应的改进方案。

针对医院治疗膳食智造的膳食研发、生产计划、采购库存及质量控制存在的问题，改进 措施如下：①膳食研发: 定期更新治疗膳食食谱，构建动态可用食材数据库及提高食谱设计和烹饪 实操的匹配度。②生产计划: 通过智能化信息技术辅助计划总量制定，完善食材切配及生产标准作 业程序，强化生产线分区管理及操作流程规范的实时监督。③采购库存：与供货商签订采购质量标 准协议，合理规划食材仓储、明确三级质量控制核查体系及严格食材储存生产规范。④质量控制：

组建质量管理团队，制定标准化的膳食质量检查制度，提升信息化协同管理功能，构建点餐数据驱 动的采购预测体系及食品安全风险预警机制。

通过对医院治疗膳食智造管理的全流程全链条细致改进，以及落地实施的精细运营，达 到减少资源(人、财、物)的浪费，降低运营成本，提高治疗膳食制作的生产效率及生产服务质量、增强住院患者的满意度及治疗效果，进一步推动医院精细化治疗膳食管理的创新进步与高质量发展。

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

糖尿病型肠内营养制剂对肺结核合并糖尿病营养不良治疗效果的分析

谭景波

哈尔滨市胸科医院

目的分析肺结核并发糖尿病住院患者的营养风险及其影响因素，为早期营养干预提供依据。 方法采用回顾性

研究收集 2024 年 6 月 1 日至 2025 年 5 月 31 日在哈尔滨市胸科医院 为结核病并发糖尿病的住院患者 69 例，排除

并发恶性肿瘤 8 例、妊娠 1 例，最终纳入 60 例。收集患者临床相关 资料，包括患者性别、年龄、并发症、结核

病诊断类型、患者类型、结核分枝杆菌检出情况、病程、抗结核治疗时间、住 院天数、营养风险筛查表 2002(NRs

2002)评分、血红蛋白(Hb)、白蛋白(ALB)、前白蛋白(PAB)、空腹血糖(FBs)、糖化血红蛋白(GHB)、中性粒细胞/淋

巴细胞比值(NI 。R)、预后营养指数(PNI)和体质量，并采用多因素 logistic 回 归模型分析结核病并发糖尿病患者发

生营养风险的相关影响凶素。结果根据 NRs 2002 评分结果，15 例患者评 分≥3 分被纳入有营养风险组，45 例评分

<3 分被纳入无营养风险组，营养风险发生率为 20．7l%(35 / 169)。影 响营养风险的多因素 logistic 回归分析

显示，病程≥1 个月是营养风险发生的危险因素[()R(95% CI)一 6．003 (1．662 ~ 21_688)]；而白蛋白是营养风险

发生的保护因素]，即白蛋白越高， 营养风险发生率越低。结论 结核病并发糖尿病患者营养风险发生率为

24．21%。营养风险的发生与病程和白蛋白相关，病程≥ 1 个月营养风险发生率显著升高，而白蛋白与营养风险发

生率呈负相关。 关键词：肺结核；2 型糖尿病；糖尿病型肠内营养制剂；营养风险筛查；对比研究

我国是结核病高负担国家，糖尿病 (diabetes mellitus ，DM) 的患病率也逐年增高。研究发现，糖尿病患者机体免 疫功能降低，发生活动性肺结核 (pulmonary tuberculosis ，PTB) 的风险是一般人群 的 2 ~ 3 倍 [两病共患 (PTB_DM) 的 发病率也逐年增高 []。当结核病患者同时罹患糖尿病时， 其结核病临床症状更严重、治疗更复杂、疗程更长、

预后更差。 目前，对 PTB-DM 患者治疗过程中给与糖尿病型肠内营养制剂。为此，采用前瞻性队列研究的方法，收 集 PTB_DM 住院患者的 相关临床资料，分析营养指标作为理论依据。

简单列举糖尿病肠内营养素对人类健康的影响，不够全面，有一定局限性。主要是想说明均衡营养对免疫系统和 人类健康的重要性。强调了最佳营养状态对于减轻炎症和氧化应激的重要性。通过控制营养不足和促进足够的营 养状况来实现增强糖尿病合并肺结核危机期间的人体免疫系统，这可能会改善感染阶段的免疫反应 (71)。

充足而均衡的营养以保证自身免疫力的强度，是人体主动积极抵抗新冠病毒的关键。我们不仅要在日常生活 中保持健康的饮食习惯，在糖尿病合并肺结核给与营养治疗后，医疗机构也应配备营养指导医生，调节患者的饮 食，让其有优质的饮食摄入，除了被动使用药物治疗外，还应通过饮食调动患者自身免疫系统的积极性，以主动 抵抗病毒。

营养风险筛查、营养评定及营养不良诊断的相关研究

Barthel 指数与 NRS2002 疾病严重程度评分在老年住院患者营养风险筛查中的联合应用价值研究

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营养不良是老年住院患者普遍存在的临床问题，与感染风险增加、伤口愈合延迟、住院时间延长、再入院率　升高及死亡率增加等不良临床结局密切相关。早期、准确地识别营养风险是进行临床营养支持干预的前提和关键。 营养风险筛查 2002（Nutritional Risk Screening 2002, NRS2002）是欧洲肠外肠内营养学会（ESPEN）推荐的首选营养 风险筛查工具，其有效性已得到广泛验证。其中，“疾病严重程度”评分是基于疾病是否导致患者营养需求增加或吸 收障碍来判断的，是评估营养风险的核心要素之一。然而，在临床实践中，尤其是在老年患者群体中，单纯依赖　NRS2002 可能不足以完全捕捉到所有的营养风险因素。老年患者常伴有多种慢性疾病和不同程度的功能衰退，其

日常生活活动能力（Activities of Daily Living, ADL）的下降往往是慢性疾病累积效应、营养不良和肌肉减少症（肌少 症）的共同结果。Barthel 指数（Barthel Index, BI）是国际上广泛使用的 ADL 评估量表，能够客观量化患者的基本　生活自理能力。

ADL 能力下降（如 BI 评分低）本身可能就是一个强烈的营养风险信号。它可能意味着患者因身体功能受限而 难以独立完成采购、备餐、进食等过程，从而导致实际摄入不足；同时，ADL 下降常伴随静息能量消耗增加和炎　症状态，进一步加剧营养失衡。因此，我们假设：BI 所评估的 ADL 功能状态与 NRS2002 中的疾病严重程度评分存 在内在关联，将 BI 评估整合到营养风险筛查中，可以弥补 NRS2002 对功能状态关注不足的缺陷，从而更精准地识 别高危人群。本研究旨在探讨 BI 与 NRS2002（特别是其疾病严重程度评分）的相关性，并评估二者联合应用对预 测老年住院患者临床结局的价值。

选取 2023 年 5 月至 2024 年 6 月我院神经内科、老年科收治的，住院时间≥ 48 小时、年龄 ≥ 65 岁且≤ 90 岁的意识清楚、能够配合完成问卷调查住院患者 500 例作为研究对象。排除标准：

（1）临终关怀患者；（2）存在严重认知障碍（如 MMSE 评分 <10 分）无法配合评估者；（3）临床资料不全者。

评估前向患者及家属解释研究目的和内容，获得口头及书面同意，然后由经过本院临床营养　科和护理部

统一培训的营养护士在患者入院后 24 小时内，分别使用 Barthel 指数量表和 NRS2002 量 表对所有患者进行 ADL 能力和营养风险筛查，并记录一般资料。

根据 BI 评分将患者分为自理组（BI ≥ 60 分）和依赖组（BI<60 分）；根据 NRS2002 总分将患 者分为营养风险组（NRS2002 ≥ 3 分）和无营养风险组（NRS2002<3 分）。分析 BI 评分与 NRS2002 总分及其疾病严重程度评分的相关性，同时，从医院信息系统（HIS）中提取患者的住院天数、住院期 间并发症（如肺部感染、压疮、跌倒、深静脉血栓等）发生情况。

采用 SPSS 26.0 软件进行数据分析。计量资料符合正态分布者以（x ± s）表示，组间比较采用 t 检验；非正态分 布者以中位数（四分位数间距）[M（IQR）] 表示，采用 Mann-Whitney U 检验。计数资料以例数（百分比）表示， 组间比较采用 χ 检验。采用 Spearman 秩相关分析 BI 评分与 NRS2002 总分及疾病严重程度评分的相关性。以

P<0.05 为差异有统计学意义。分析 BI 评分与 NRS2002 总分及其疾病严重程度评分的相关性，并比较两组患者在临 床结局（住院时间、并发症发生率）上的差异。

500 例患者中，营养风险组（NRS2002 ≥ 3）171 例（34.2%），无营养风险组例（65.8%）。依赖组（BI<60）患者其 NRS2002 总分及疾病严重程度评分均显著高于自理组（P<0.01）。Spearman 相关分析显示，BI 评分与 NRS2002 总分（r = −0.645, P<0.01）及疾病严重程度评分（r = −0.611,

P<0.01）均呈显著负相关，表明功能状态越差，其疾病被判定为更严重的程度。与无营养风险组相比，营养风险组的平均住院时间更长 [（13.8 ± 2.9）天 vs（9.5 ± 2.3）天，P<0.01]，并发症发生 率更高（25.7% vs 7.6%，P<0.01）。在 BI<60 且 NRS2002 ≥ 3 分的双重高风险患者中，不良临床结局 的发生率最高。

Barthel 指数与 NRS2002（特别是其疾病严重程度评分）在评估老年住院患者时具有显著的相 关性。ADL 能力受损是营养风险的一个独立且重要的标志。建议在临床工作中，特别是对老年患者， 将 Barthel 指数评估作为营养风险筛查的常规组成部分。通过整合功能评估与营养筛查，可以构建 一个更敏感、更全面的风险预警系统，从而实现营养支持的早期化、个体化和精准化，最终达到改 善患者预后、提升医疗质量的目的。

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

Barley green extract did not decrease serum uric acid but decrease the risk of hyperuricemia in adults with asymptomatic hyperuricemia: A multicenter-randomized, parallel-controlled study

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Barley green extract has exhibited activities against chronic disease. However, data is scarce on the effect of barley green

extract in reducing serum uric acid (UA). This study aimed to investigate the effect and safety on hyperuricemia progression.

In this randomized, parallel-controlled trail, 118 patients with asymptomatic hyperuricemia were admitted to the study

from July 2020 to September 2022. They were randomly divided into study group (balanced diet with barley green

extraction, 64 participants) and control group (balanced diet, 54 participants) for 12 weeks. The primary outcome

measurement was the change in serum UA. The secondary outcomes included the prevalence and risk of hyperuricemia,

and the change in anthropometric index. Safety was also assessed.

Although the serum UA changes from baseline were not significant different between the groups, serum UA significantly decreased in the study group but not in control group among the participants with the serum UA ⩽ 462.50umol/L and women.

We did find that the prevalence of hyperuricemia in study group (57.8%) was significantly lower than that in the control

group (75.9%) (P=0.038) after interventions. Interestingly, multivariate analysis showed that compared to the control group,

the risk of hyperuricemia in study group was lower (OR: 0.423, 95% CI: 0.190–0.940). There was no difference in secondaryoutcomes or safety outcomes.

Conclusion: To some extent, barley green extract may have potential benefits in improving

hyperuricemia progression especially among participants with mildly elevated serum UA and women, but further large-scale trials are needed to confirm this finding.

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

乳腺癌术后重度消瘦患者的个体化阶梯式营养支持治疗个案报告

陈晓 张永超 李晓玮 姜旭 孙冉 潍坊市中医院

目的：探讨针对伴有严重胃肠功能障碍的癌症术后重度营养不良患者，如何通过系统评估、阶梯式 营养干预与动态监测，制定并实施有效的个体化营养支持方案，并总结可推广的临床营养干预路径。

方法：报告一例 54 岁女性乳腺癌术后合并慢性萎缩性胃炎所致重度营养不良（BMI 15.7 kg/m ）患者的诊疗过程。诊疗核心方法包括： 1. 全面基线评估：采用人体成分分析（重点监测相位角 PA）、膳食调查、生化指标及临床检查，精准评估营养状况、 胃肠功能及

再喂养综合征（RFS）风险；2. 个体化阶梯式营养干预：遵循“ 胃肠道适应→积极支持→过渡巩固→达标维持 ”的路径。初期（第一阶段） 以易消化型口服营养补充（ONS）为主， 旨在修复胃肠功能、预防 RFS；当评估发现 ONS 效果不显著（体重持续下降）且患者血

流动力学稳定时，及时升级至第二阶段，采用肠外营养（PN）联合 ONS 的营养干预策略，以快速纠正能量负平衡；待肠内耐受性改善（经口 +ONS 达目标需要量 50% 以上）后，进入第三阶段，逐步停用 PN，过渡至全肠内营养（TEN），并动态调整自然饮食与 ONS 比例；

达到初步体重目标后进入第四阶段（达标维持期），侧重于体重稳定、身体成分优化及长期生活方式指导。3. 疗效监测：定期随访体重、人体成分（特别是骨骼肌质量、体脂肪、PA）、生化指标、临床症状及生活质量。

结果：经过约 4 个月的个体化营养支持，患者体重自 41.6kg 增至 47.4kg（增加 5.8kg），BMI 由 15.7 kg/m 提升至 17.8 kg/m 。人体成分分析显示骨骼肌质量自 17.8kg 增至 19.1kg，体脂肪自 7.4kg 增至 11.2kg，反映细胞功能的关键指标相位角（PA）由 3.7 显著改

善至 4.1。临床症状方面，患者腹胀、乏力显著减轻，食欲及主动进食意愿增强， 自然饮食摄入量由 400-600kcal/ 日提升至稳定在 1000-1200kcal/ 日，并可完成日常家务及户外活动，生活质量明显改善。整个干预过程未发生再喂养综合征等严重并发症。

结论：对于伴有胃肠功能障碍的重度营养不良患者，基于精准评估的个体化、阶梯式营养支持策略至关重

要。初期注重胃肠功能修复与 RFS 预防，效果不佳时果断采用 PN+EN 联合支持是打破恶性循环的关键。以肠内耐受性为导向，循序渐进地由 PN 向 TEN 过渡，最

终实现长期维持是成功模式。相位角（PA）是评估营养干预效果、反映细胞功能改善的灵敏指标。本案例形成的“评估 – 适应 – 支持 – 过渡 – 维持 ”营养干预路径，为同类患者的规范化临床营养治疗提供了实践依据。

肠道微生态与肠功能维护临床应用研究

双歧杆菌四联活菌片联合肠内营养比较单用肠内营养对重症脑卒中患者早期肠道粘膜功能及胃肠道并发症的临床　效果观察的系统综述

胡贤良

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通过数据库搜索双歧杆菌四联活菌片联合肠内营养在重症脑卒中患者早期应用的临床研究，并进行进一步综述及 分析，以探讨其在重症脑卒中患者的临床营养治疗中的价值及意义

通过搜索相关数据库：国内的知网、万方、维普、中国生物医学等，国外的 pubmed 、web of science 、clinical trial 、 embase 等数据库，设定主题词：双歧杆菌 "bifidobacterium" 、肠内营养 "enteral nutrition" 、重症 "criical illness" 、脑卒 中 "brain injury or stroke" 、益生菌 "probiotics" 等，搜索时间为近 10 年（2015.8~2025.8），共搜索到 144 项搜索结果， 通过排除各数据库重复、非临床研究、非论著、综述类等文献，并对文献进行详细阅读，排除不含目标观察指标　的研究，最后共纳入 12 项临床研究进行分析，导入 review manager5.3 ，相应计数资料及计量资料分开进行比较， 观察比较的指标为干预后的血清二氨氧化酶及 D 乳酸水平，及研究期间的腹胀、腹泻、 胃潴留等胃肠道并发症发 生率，各研究均进行异质性检验。

12 项研究共 1022 名受试者（其中观察组 n=501 ，对照组 n=521）纳入胃肠道并发症分析，结果显示双歧杆菌四联活 菌片联合肠内营养组与单用肠内营养组比较在重症脑卒中患者早期有更低的胃肠道并发症发生率

（OR=0.25,95%CI:0.16~0.38, P < 0.00001 ，hetterogeneity(p=0.55)),6 项研究共 564 名受试者（其中观察组 n=262 ，对照组 n=284）纳入肠道黏膜功能分析，二氨氧化酶 DAO 及 D 乳酸结果显示双歧杆菌四联活菌片联合肠内营养组与单用肠　内营养组比较在重症脑卒中患者早期治疗后水平更低，(mean difference[MD]=−0.63,95% CI:−0.45~−0.81, P < 0.00001 ， hetterogeneity(p < 0.00001)），(mean difference[MD]=−1.61,95% CI:−1.42~− 1.81, P < 0.00001 ，hetterogeneity(p<0.00001))。

双歧杆菌四联活菌片联合肠内营养比较单独应用肠内营养在减少重症脑卒中患者早期胃肠道并发症方面具有更佳 的临床效果，同时研究间均一性较好，值得进一步为临床提出参考依据，在对调节肠道粘膜功能方面，联合组也 具有更好的调节肠道粘膜功能作用，但研究间差异尚均在统计学意义，说明研究间均一性存在争议，需要更大样 本量临床研究证据支持。

临床营养学基础、临床与大数据等研究

Cardiovascular disease burden in China attributable to unbalanced fatty acids intake from 1990 to 2050

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This study aimed to analyze the trends in death and disability-adjusted life years (DALYs) due to cardiovascular disease

(CVD) associated with unbalanced dietary fatty acid intake in China from 1990 to 2021, and to predict the disease burden levels up to 2050.

Using Global Burden of Disease 2021 data, we examined death and DALYs rates by age, sex, and risk factors. Joinpoint

regression assessed temporal trends. Decomposition analysis evaluated contributions of population growth, aging, and

epidemiological transitions. Age-period-cohort (APC) modeling estimated cohort and period effects. Bayesian Age-Period- Cohort (BAPC) modeling projected future CVD burden.

Age-standardized death and DALYs rates for CVD attributable to low seafood n-3 polyunsaturated fatty acids (PUFAs) and

high trans fatty acids declined, while those due to insufficient n-6 PUFAs intake increased. Despite fluctuations, overall CVD burden showed a downward trend. Burden was higher in males and older groups. Population growth drove the absolute

increase in burden, while aging and epidemiological shifts had variable effects by risk factor. APC modeling revealed

significant age, period, and cohort influences. BAPC projections indicate continued

decline in CVD burden from fatty acid imbalances through 2050.

The CVD burden linked to imbalanced fatty acid consumption demonstrated a general decline, with forecasts suggesting a continued decrease by 2050. Older adults and males were highlighted as priority populations for focused interventions.

These results can inform the development of targeted prevention and control initiatives.

极端体重下降伴多重生理异常的青少年进食障碍病例分析：早期识别与干预的重要性

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摘要

进食障碍（eating disorders，ED）是一组综合征，主要表现为异常进食行为以及对食物、体重和体型的过度关注。该综合征主要包括神经性厌食和神经性贪食。神经性厌食症在青少年女性中发病率较高，显著影响其生理功能和心理健康。本研究报告了一例 12 岁女性厌食症患者，其体重从 64 kg 降至 34 kg（BMI 12.2 kg/m ）。患者出现乏力、脱发、闭经及水肿等生理症状，反映了该疾病对内分泌系统和整体健康的显著影响。该病例因极端体重下降引发低白蛋白血症和水肿，属于罕见表现。与既有文献相比，该患者的临床表现存在差异，突显了早期识别和干预的重要性，以防止青少年患者的误诊和漏诊。鉴于样本量较小且随访时间有限，本研究结果的普适性受到限制。未来应开展多中心、大样本研究，深入探讨青少年厌食症的临床特征及病理机制。本病例为临床实践提供了重要启示。研究同时强调多学科综合干预策略在改善患者预后中的重要性。

引言

神经性厌食（anorexia nervosa，AN）是一种进食障碍。患者有意严格限制进食，导致体重明显下降并低于正常水平，进而引起身体功能受损。该病最常见于青少年和年轻女性，发病率约为 0.5% 至 1%[1]。该病不仅损害生理健康，还会引发长期的心理问题，如焦虑和抑郁 [2]。现代社会理想化的体型标准和扭曲的身体形象加剧了青少年对自身外貌的过度关注，进而诱发或加重厌食症 [3]。

本病例为一名 12 岁女性患者，表现出严重体重下降（体重从 64 kg 下降至 34 kg，BMI 为 12.2 kg/m ），伴有乏力、脱发、闭经及下肢水肿等生理症状。这些典型表现不仅反映了神经性厌食导致的内分泌失调，还揭示了该疾病可能对青少年患者的身心功能造成的深远影响。然而，在青少年患者中，由于病史较短和多重生理症状的干扰，神经性厌食的诊断常常面临挑战，因而可能导致误诊或漏诊。因此，在评估类似病例时需高度警惕，并对患者的健康状况进行全面评估。

综上所述，该病例强调早期识别和干预厌食症的重要性，对临床实践和未来研究具有指导意义。随着对神经性厌食病因和病理机制的深入研究，临床医师能够更好地识别和管理该病，降低死亡率和并发症。及时干预和综合治疗策略的实施对改善患者预后至关重要，有助于推动该领域的研究与实践。

病例介绍

患者信息

患者为 12 岁女性，主因近 1 年有意识地限制性饮食，体重由 64 公斤降至 34 公斤，BMI：12.2 kg/m 。患者在节食过程中出现乏力、脱发和记忆力下降、闭经等症状。近 1 个月出现下肢水肿，并伴有胸闷及呼吸困难。

临床发现

在既往病史方面，患者于 10 年前接受过房间隔修补术，无自身免疫性疾病或血液病史，无食物和药物过敏史。体格检查显示患者体型消瘦，皮肤干燥且毛发稀疏，表现出贫血貌，眼睑部有水肿，心率为 58 次 / 分，血压为 102/58 mmHg。入院后，实验室检查结果显示白细胞及红细胞水平降低，白蛋白显著降低，胆固醇及甘油三酯水平显著升高。

诊断评估

基于患者病史、临床表现及实验室检查结果，结合其长期节食史，初步诊断为进食障碍、神经性厌食症。此外，患者的低血压、心率减慢及血液指标异常可能与其严重营养不良有关；因此，需要进一步评估其内分泌功能及心血管状况，以排除其他潜在病因。

治疗措施

针对患者的情况，制定了综合的治疗方案，包括营养支持治疗和心理干预。首先，实施逐步增加营养摄入的计划，通过监督进食并逐步增加热量摄入的方法，改善其营养状况。其次，安排心理咨询以帮助患者重建健康的饮食观念，并处理与饮食相关的心理问题。此外，定期监测患者的生理指标及实验室检查结果，以评估治疗效果。

随访与结局

在治疗过程中，需定期随访患者的体重变化及心理状态，评估其对治疗的反应及潜在的并发症。 随着饮食逐步恢复和心理状态改善，患者症状有望缓解。同时，应关注生理周期的恢复，并适时调整治疗方案，以促进全面康复。

讨论

本病例的体重减轻和临床表现在类似文献病例中表现出独特性。以往研究表明，神经性厌食症患者通常体重显著下降，并伴有焦虑和抑郁等心理问题 [1]。本病例患者不仅体重极度下降，还伴有下肢水肿、胸闷和闭

经等症状。此外，已有研究指出，神经性厌食症的发病机制与心理、社会和生物因素密切相关 [4]，同时本病例的表现表明长期节食对内分泌和代谢的影响更为深远。相较于早期文献中描述的特征 [5]，本病例的综合表现突显了长期节食的潜在危害。尤其在年轻女性群体中，需进一步探索其对身体各系统的影响及相应的治疗策略。

在诊断方面，本病例强调识别进食障碍症状的重要性，这样可以避免误诊为其他内分泌或代谢疾病。此外，已有研究指出，误诊可能导致患者接受不适当的治疗，进而加重病情 [6]。因此，临床医生应全面评估患者的生理和心理状况，及时识别潜在问题，便于早期干预。同时，本病例也强调多学科治疗的重要性，指出营养支持与心理支持相结合的必要性，以提高患者的生活质量和治疗效果。

诊断和治疗神经性厌食症时，应警惕诊断陷阱。本病例患者体重极度下降，伴有相关生理症状，容易被误诊为其他内分泌或代谢疾病。因此，临床医生应特别关注饮食行为的变化，避免因表面症状忽视潜在的精神健康问题。已有研究表明，早期识别进食障碍症状对于制定有效的干预措施至关重要 [7]，而本病例所提示的复杂症状进一步强调了全面评估患者生理状态和心理健康的重要性，以便及时识别并干预潜在的精神健康问题。

此外，长期营养摄入不足对身体的影响也值得深入探讨。本病例中，患者的极端体重下降以及生理症状表明长期营养不良可能导致的内分泌功能紊乱和代谢紊乱。研究显示，进食障碍与多种生物心理社会因素密切相关，长期营养限制可能加重这些影响 [4]。因此，针对进食障碍的治疗需要多学科合作，不仅要进行营养评估和个性化饮食干预，还需结合心理治疗，以全面提升患者的生活质量。本病例强调早期干预的重要性，尤其是在年轻女性群体中，以降低长期营养不良对身体多个系统的潜在危害。在这一过程中，临床医生应关注患者的整体健康状况，制定综合性的管理策略，以改善治疗效果和预后。

本病例讨论强调个案特殊性及对临床实践的启示。首先，患者出现极端体重下降，伴有闭经和下肢水肿等多种并发症，突出神经性厌食症的复杂性。这种极端表现为早期识别和干预提供了重要的临床参考。通过与文献中已报道的类似病例对比，本病例的独特性引起重视，尤其在年轻女性群体中，应加强对饮食行为变化的关注。临床医生应重视早期识别进食障碍症状，综合考虑心理健康因素，避免误诊为其他内分泌疾病。

此外，病例反映了长期节食对生理健康的不良影响，强调了多学科合作在治疗中的重要性。营养评估与心理治疗相结合的综合干预策略应成为临床管理的标准。尽管本病例为神经性厌食症提供了新的认识，但由于其特殊性，研究结果的普适性有限。未来研究应关注更广泛人群中的类似表现，以验证本病例的发现，促进对疾病机制的深入理解。综上所述，对神经性厌食症的早期干预不仅对于改善患者的身体状况至关重要，也为降低长期健康风险提供了有效保障。

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临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

极端体重下降伴多重生理异常的青少年进食障碍病例分析 ： 早期识别与干预的重要性

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进食障碍（eating disorders，ED）是一组综合征，主要表现为异常进食行为以及对食物、体重和体型的过 度关注。该综合征主要包括神经性厌食和神经性贪食。神经性厌食症在青少年女性中发病率较高，显著影响其生 理功能和心理健康。本研究报告了一例 12 岁女性厌食症患者，其体重从 64 kg 降至 34 kg（BMI 12.2 kg/m ）。患 者出现乏力、脱发、闭经及水肿等生理症状，反映了该疾病对内分泌系统和整体健康的显著影响。该病例因极端 体重下降引发低白蛋白血症和水肿，属于罕见表现。与既有文献相比，该患者的临床表现存在差异，突显了早期 识别和干预的重要性， 以防止青少年患者的误诊和漏诊。鉴于样本量较小且随访时间有限，本研究结果的普适性 受到限制。未来应开展多中心、大样本研究，深入探讨青少年厌食症的临床特征及病理机制。本病例为临床实践 提供了重要启示。研究同时强调多学科综合干预策略在改善患者预后中的重要性。

病例分析

本病例为一名 12 岁女性患者，表现出严重体重下降（体重从 64 kg 下降至 34 kg，BMI 为 12.2 kg/m), 伴 有乏力、脱发、闭经及下肢水肿等生理症状。这些典型表现不仅反映了神经性厌食导致的内分泌失调，还揭示了 该疾病可能对青少年患者的身心功能造成的深远影响。然而，在青少年患者中，由于病史较短和多重生理症状的 干扰，神经性厌食的诊断常常面临挑战，因而可能导致误诊或漏诊。因此，在评估类似病例时需高度警惕，并对 患者的健康状况进行全面评估。

该病例强调早期识别和干预厌食症的重要性，对临床实践和未来研究具有指导意义。随着对神经性厌食病因 和病理机制的深入研究，临床医师能够更好地识别和管理该病，降低死亡率和并发症。及时干预和综合治疗策略 的实施对改善患者预后至关重要，有助于推动该领域的研究与实践。

内外肠外营养、肠内营养、膳食营养治疗的新进展和新型制剂的临床应用
中医营养防治化疗相关骨髓抑制应用探讨

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摘要：本文结合化疗期间患者血细胞数的周期性变化特点，以中医“治未病”理论为基础，提出中医营养“未病先防， 食养为基、既病防变，食药并治、瘥后防复，药食同调”防治化疗相关骨髓抑制的分期防治体系，为中医营养在肿 瘤综合治疗中的应用提供新思路。

关键词：化疗；骨髓抑制；中医营养；分期论治；治未病

骨髓抑制（Bone Marrow Suppression, BMS）是肿瘤化疗最常见的毒副反应 [1]， 以外周血细胞数量减少为主要表 现。严重的骨髓抑制可能导致患者无法按时足量完成治疗、延长化疗时间、感染，甚至死亡，影响患者预后 [2] 。基 于中医理论的中医营养治疗，有机融合中医药与现代营养治疗，注重防、治、养相结合，是化疗相关骨髓抑制综 合治疗的重要组成部分。本文就中医药防治化疗相关骨髓抑制的现状，探讨中医营养防治骨髓抑制的理论基础、 治疗思路及方法。

1 中医药防治化疗相关骨髓抑制的现状

骨髓抑制在中医古籍中无明确记载。依据骨髓抑制患者常伴有乏力气短、头晕、纳少、发热及出血等表现，中医将本病归为“虚损” 、“虚劳” 、“血虚”等疾病范畴 [3] 。“人以五谷为本” ，食物在为机体供给营养的同时，可改善 肿瘤患者机体代谢，增强免疫力 [5] ，具有补虚扶正的作用，与恶性肿瘤本虚的病机相契合。

中医营养学基于中医整体观念、阴阳平衡理论，结合药食同源， 以食养生、以食疗病，在防治骨髓抑制上具 有以下优势：

①药食同源，食药并举。目前治疗骨髓抑制的中药多属于药食两用中药材，中医营养通过食药并用的方法，治疗骨髓抑制时中不仅发挥增效减毒的作用，减轻消化道症状，增进食欲，还可补充营养，达到食养、食治并举 的效果 [6]。

②剂型多样，应用灵活。中医药膳烹饪方法多样，讲究色香味形，质地细软，易消化，与肿瘤患者胃肠功能 较弱的特点相适应，在制作过程中必要时会“隐药于食”，削弱药味，更有易于提高患者耐受度和依从性 [7]。

③关注广泛，需求度高。调查显示肿瘤患者及家属普遍认识到科学饮食的重要性 [8] ，多数有人参、冬虫夏草、 灵芝孢子粉等中药成分保健品使用史 [9] ，反映出其对中医食疗接受度高，需求大，也为中医营养在化疗患者中开展 奠定基础。

2 中医营养在防治化疗相关骨髓抑制的探讨

中医营养防治骨髓抑制，可立足“治未病”理论，结合骨髓抑制的中医病机及证候变化特点，建立“未病先防， 食养为基” 、“既病防变，食药并治” 、“瘥后防复，药食同调”的分期防治体系，并对化疗患者定期进行营养状态和 相关症状的监测。

2.1 未病先防，食养为基

适应人群：预期需接受化疗，以及正在进行化疗但尚未出现骨髓抑制的肿瘤患者。

中医营养干预方法：

①一般患者。常规予中医营养健康宣教，纠正不良饮食习惯，引导患者树立均衡饮食观念，注意饮食卫生；推荐化疗期间适宜的食材及食疗方，保证充足的营养摄入，避免过度忌口；指导患者及家属定期监测体重及进食 量，学会识别营养风险，必要时应寻求专业指导。

②骨髓抑制高危人群、营养不良风险人群或肿瘤症状负担较重的患者。在常规中医健康宣教的基础上，对患 者进行营养评估和中医体质辨识，根据患者营养状态和体质类型，予针对性营养指导和中医辨体施膳， 以调理体质、减轻症状、补充营养，预防骨髓抑制的发生。

2.2 既病防变，食药并治

适应人群：化疗期间出现骨髓抑制的患者，或骨髓抑制经治疗未得到缓解的患者。

中医营养干预方法：

①进食量无明显减少的患者。常规进行化疗期间的中医食养指导，强调饮食卫生，同时予中医辨证施膳，对 于白细胞减少者可加用 [10]：人参、红枣、山药、海参、阿胶、 甲鱼、冬虫夏草、银耳、枸杞子、黄芪、胡桃肉等食 （药）材。血小板减少的患者可使用 [3]：槐花、 白茅根、阿胶、番薯叶、花生、藕节、三七白、侧柏叶、墨旱莲等 食（药）材。贫血患者 [5] 建议多食用动物血、动物肝脏等食物，加用薏苡仁、山药、红枣、枸杞等具有健运脾胃、 补气养血的食（药）材。

②患者可经口进食，但近期进食量较前减少。此类患者的中医营养治疗应在有限的饮食（水）量中隐药于食， 注重健脾助运、开胃消导，灵活选用药膳制作方法。药膳类型优选高能量密度的饮食。

③患者胃肠功能弱，消化道反应严重。此类患者通常经口进食量极少，可予补充性肠外营养或全肠外营养治 疗，并酌情加用免疫营养素改善营养状态，当患者胃肠功能好转后，及时启动肠内营养，避免胃肠道长时间空置。

2.3 愈后防复，药食同调

适应人群：化疗周期内出现骨髓抑制，现血常规已恢复正常的患者。

中医营养干预方法：

①营养状况良好的患者。具体来说，营养状况良好者应为体重适宜，且近期体重及饮食量无明显下降，营养 相关指标无明显降低者，需定期进行营养评估与监测，必要时辅以中医食疗，因时食养，改善体偏颇体质。

②营养不足的患者。患者体重偏低，或近 3 月体重下降超过 5% ，或近 1 周经口进食量明显减少等都是营养不 足或存在营养风险的表现，此类患者需接受专业医师或营养师的指导来补充营养。中医食养上加用健脾补虚、补 血养血之品， 以培补后天之本，如鸡肉、乌骨鸡、牛肉、 甲鱼、海参、鳝鱼、蹄筋、花生、枸杞、山药、黄精、 女贞子、菟丝子、熟地、鸡血藤等食（药）材，可选择丸剂、散剂、中药配方颗粒或膏剂等中药剂型，方便药膳 制作与服用。

3 小结

本文基于“治未病”理论，提出在肿瘤患者化疗过程中实施分期防治，通过“未病先防，食养为基” 、“既病防变，食药并治”、“瘥后防复，药食同调”，对骨髓抑制高危人群及营养不良高风险人群进行定期营养监测，及时给予中 医营养干预， 以期为中医营养防治化疗相关骨髓抑制提供思路，进一步提高中医药防治化疗相关骨髓抑制的临床 疗效，改善营养状态，提高生活质量。

营养风险筛查、营养评定及营养不良诊断的相关研究

Effects of nutritional consultation combined with individualized exogenous digestive enzymes administered by a clinical nutritionist on nutritional and immune-inflammatory status in patients with pancreatic cancer: a retrospective study

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Nanjing drum tower hospital

This study aims to retrospectively evaluate the impact of nutritional consultation combined with individualized exogenous digestive enzymes administered by a clinical nutritionist on the nutritional and immune-inflammatory status of patients with pancreatic cancer.

A retrospective study was conducted involving 123 patients with pancreatic cancer who underwent surgical intervention at the Drum Tower Hospital, affiliated with Nanjing University Medical School, from January 2018 to December 2023. Patients were categorized into two distinct groups: the intervention group, which received nutrition consultation combined with an individualized exogenous digestive enzyme program administered by a clinical nutritionist, and the control group, which did not receive this intervention. Baseline data, hematological parameters, body composition metrics, clinical outcomes, and immune-inflammatory biomarkers were collected and analyzed statistically.

With respect to nutritional indicators, the intervention group exhibited significantly better outcomes than the control group regarding weight, BMI, ALB, and CXI. Pertaining to body composition, the intervention group demonstrated a significant protective effect on muscle mass, and effectively mitigated fat loss. Concerning immune

indicators, the reduction in LBC in the intervention group was significantly less pronounced than

that observed in the control group. Furthermore, at the conclusion of the study, the

LCR in the intervention group was significantly higher than that in the control group. These findings suggest that the intervention exerts an inhibitory effect on systemic

inflammation.

Incorporating nutritional consultation combined with the administration of

individualized exogenous digestive enzymes may help improve the nutritional status and immune function of patients with pancreatic cancer.

国内外肠外营养、肠内营养、膳食营养治疗的新进展和新型制剂的临床应用
中国家庭肠外营养相关并发症调查及防治措施的文献分析

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目的：总结我国目前家庭肠外营养相关并发症现状及防治措施。

方法：计算机检索中国知网，万方数据库，维普中文数据期刊、web of science ，pubmed ，Cochran library 等，筛选 有关中国家庭肠外营养相关的文献，关键词 / 摘要包含“家庭肠外营养 ”、“家庭营养、肠外营养 ”、“家庭营养治疗， 静脉营养 ”等，检索时限截止 2025 年 9 月 10 日。

结果 : 共检索到 126 篇文章，去除重复发表和无法获取全文的文献后，通读全文纳入符合要求的文献 17 篇，其中 实验研究 4 篇（其中 1 篇为肠衰竭小儿家庭肠外营养研究），临床指南 1 篇，专家共识 3 篇，综述 3 篇，meta 分 析 4 篇，病例报道 1 篇，讲座 1 篇。对以上文献进行统计发现最常见并发症为导管装置相关并发症（61/ 106），包 括导管相关血流感染、导管堵塞、导管血栓形成、导管破损脱落等，其次为代谢相关并发症（32/ 106），包括肝胆 疾患、电解质血糖代谢异常等。梳理近年来国内外相关指南及专家共识，通过优化以下方面（1）血管通路装置的 选择（2）穿刺处护理（3）导管装置维护（4）无菌技术（5）封管操作技术及封管液选择（6）营养液选择及配制 等方面能够更好的防治导管相关并发症; 而定期随诊复查，预防感染，病情准许酌情给予肠内营养对于 HPN 代谢 相关并发症的防治较为关键。

结论： 良好的 HPN 治疗有赖于预防并及时发现 HPN 相关并发症，专业的营养支持团队、规范的操作流程及导管维 护至关重要。

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

Nutritional Management in a Postoperative Rectal Cancer Patient with Intestinal Obstruction and Severe Malnutrition: A Case Report

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Malnutrition is common in gastrointestinal malignancies, especially after colorectal surgery, and can impair recovery, immune function, and tolerance to therapy. This case describes individualized nutrition support in a postoperative rectal cancer patient with recurrent intestinal obstruction and severe malnutrition, highlighting the role of systematic assessment and multidisciplinary care in rehabilitation.

A female patient with rectal adenocarcinoma (pT3N2aMx) was admitted for recurrent obstruction and comorbid reflux esophagitis, gastritis, duodenal ulcer, and hypertension. On admission, she weighed 32 kg with a BMI of 13.85 kg/m . NRS2002 scored 4 and PG-SGA scored 21, confirming severe malnutrition. Laboratory tests showed hypoalbuminemia and anemia. Goals included stabilizing gastrointestinal symptoms, correcting deficits, and preparing for stoma reversal and chemotherapy.

A combined nutrition strategy was implemented over two months. Parenteral nutrition (PN) was initiated, and early enteral nutrition (EN) via nasojejunal tube was introduced.

Targets were 1250 kcal/day and 48 g protein/day, starting at 50% to prevent refeeding syndrome and advanced according to tolerance. Supportive therapy included acid suppression and prokinetics. Monitoring covered body weight, gastrointestinal tolerance, and biochemical indices, with dynamic adjustments.

After two months of intervention, the patient's nutritional and clinical status improved significantly. Her body weight rose from 32 kg (BMI 13.85) to 41.5 kg (BMI 17.96). Serum albumin, total protein, and hemoglobin increased toward normal levels. Gastrointestinal symptoms were relieved, allowing progressive EN escalation and reduced PN dependency. By the time of planned stoma reversal, her functional status had improved, enabling readiness for further oncological therapy. Family engagement and patient education overcame initial resistance to tube feeding, ensuring adherence.

Early, individualized, and dynamically adjusted nutrition therapy is essential for postoperative colorectal cancer patients with severe malnutrition. In this case, two months of combined PN and EN, guided by systematic screening

and multidisciplinary collaboration, reversed malnutrition, controlled complications, and optimized conditions for subsequent treatment. Standardized nutrition assessment and intervention should be integrated into perioperative cancer care to improve outcomes and quality of life.

临床营养门诊和营养专科病房建设工作经验和体会
临床营养门诊“ 三维赋能”管理模式的实践探索与经验总结

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针对临床营养门诊所存在的门诊量较少、专业能力与实际需求不契合、服务流程繁琐以及患者参与度较低等核心问题，创新性地构建“专业能力 – 服务流程 – 患者参与 ”三维赋能管 理模式，并通过实践验证该模式在提高门诊服务质量、患者管理成效以及满意度方面的应用价值。

在 2024 年 1 月至 12 月期间，我院临床营养门诊推行“三维赋能 ”模式，通过专业能力赋能，筑牢诊疗核心根基；服务流程赋能，提升管理效率与体验；患者参与赋能，激活主动管理 动力。共选取 260 例就诊患者作为研究对象，其中肥胖患者 120 例、脑卒中患者 30 例、肿瘤患者 30 例， 以及其他疾病 / 健康管理患者 80 例。通过构建“ 1 + N ”医师能力进阶体系、优 化“线上 + 线下 ”全流程服务、搭建患者主动参与平台，对比该模式实施前后(与 2023 年同期对比)核心指标的变化情况，并分析不同疾病类型患者的管理效果。

实施“三维赋能 ”模式后，患者营养知识知晓率从 32.5% 提升至 79.2%，营养方案执行率由 41.3% 提高到 78.8%，饮食记录完成率从 38.6% 增长至 82.3%。诊疗效率得以显著提升，随 访完成率从 42.8% 上升至 80.5%， 门诊综合满意度从 72.8% 提升至 95.6%。

临床营养门诊“三维赋能”管理模式，通过专业能力、服务流程、患者参与三个维度的协同发力，可系统性地化解临床营养门诊运营过程中的痛点难题，借助多维度协同效应，达成诊疗 质量、服务效率以及患者体验的同步提高，为临床营养领域的高质量、规范化发展提供了可复制的实践路径。

急性心肌梗死术后肠道菌群移植对心脏康复的影响

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摘要

目的：旨在系统探讨肠道菌群移植（FMT）在急性心肌梗死（AMI）术后心脏康复中的作用机制与临床应用价值。通过分析 FMT 通过 " 肠 – 心轴 " 调节心脏康复的潜在机制，评估其在改善心功能、促进心肌修复方面的治疗效果，为 FMT 在心血管康复领域的临床应用提供理论依据和实践指导。同时，明确当前研究存在的空白与挑战，为未来研究方向提供参考。

方法：采用系统性文献检索方法，检索 PubMed、Web of Science 和 Embase 数据库的相关文献。检索策略结合主题词与自由词，核心检索式包括急性心肌梗死、FMT 和心脏康复等相关术语。采用 Cochrane 偏倚风险评估工具、纽卡斯尔 – 渥太华量表和 SYRCLE 工具评估文献质量，严格遵循 PRISMA 指南进行文献筛选和数据提取，确保研究过程的科学性和可重复性。

结果：FMT 通过多重机制促进 AMI 后心脏康复：在代谢层面，通过产生多种生物活性分子直接参与心脏康复与心血管功能的调节，显著降低血浆 TMAO 水平，以降低血小板活性和血栓形成；在免疫调节方面，增加普拉梭菌等有益菌的丰度，促进调节性 T 细胞分化，产生抗炎效应，增加心脏组织 Treg 细胞比例，促进 M2 型巨噬细胞极化；在肠道屏障功能方面，FMT 防止肠道屏障损伤并抑制白细胞介素 8（IL–8）和单核细胞趋化蛋白 1（MCP–1）的分泌，全身炎症反应显著改善。这些机制协同作用，共同改善心肌炎症反应、促进组织修复和改善心功能。

结论: FMT 通过调节 " 肠 – 心轴 " 在 AMI 后心脏康复中展现出多靶点治疗优势。尽管目前仍处于研究阶段，但其通过代谢调控、免疫调节和屏障修复等多重机制显示巨大潜力。未来需要进一步深入研究具体作用机制，建立标准化治疗方案，推进临床转化研究。随着精准医疗发展，FMT 有望推动心脏康复从通用治疗模式向个体化、数据驱动的精准干预模式转变，为 AMI 患者提供新的康复策略。

关键词：急性心肌梗死；肠道菌群移植；肠 – 心轴

一、 研究背景和意义

急性心肌梗死（Acute Myocardial Infarction, AMI）是冠状动脉急性、持续性缺血缺氧所引起的心

肌坏死临床综合征，作为心血管疾病中最危重的表现类型之一，具有高致死率和高致残率的特点。根据《中国心血管健康与疾病报告 2024》的数据，我国每年新发急性心肌梗死病例约 100 万例，35 ~ 54 岁中青年人群的发病率在十年间增长了 30%，显著呈现年轻化趋势 [1]。心脏康复是 AMI 治疗后不可或缺的延续阶段，是一种综合性的长期管理方案。现代心脏康复涵盖医学评估、运动训练、心理支持、健康教育和危险因素控制等多个维度 [2]。现有研究表明，系统性的心脏康复能显著改善 AMI 患者经皮冠状动脉介入治疗（PCI）术后的心功能指标，能够提升左室射血分数（LVEF），降低左室收缩末容积（LVESV）和左室舒张末容积（LVEDV），从而减轻心脏负荷，改善心脏重塑 [3, 4]。

近年来，随着高通量基因测序和代谢组学的发展，研究发现肠道微生物群落与心血管系统之间存在着双向通信网络，肠道菌群可以通过释放不同生物活性的代谢物，并通过多种机制远程调控心脏功能。在此基础上“肠－心轴”（Gut-Heart Axis）概念的提出为 AMI 的发生发展提供了全新视角 [5, 6]。“肠－心轴”影响 AMI 术后心脏康复的核心机制包括以下几个方面：1）脂多糖（lipopolysaccharide，LPS）是肠道中的革兰氏阴性菌膜的一种成分，可转移到体循环中引起非脓毒性低度内毒素血症，具有由 NADPH 氧化酶 2(NOX2) 的活化介导的促氧化特性 [7]，位于动脉粥样硬化斑块内能够促进动脉粥样硬化与血栓形成 [8]。2）短链脂肪酸（short chain fatty acids，SCFA）一般是肠道微生物在厌氧条件下发酵大量膳食纤维而产生，可以和 G 蛋白偶联受体（GPCR）结合 [9]，通过抗炎、免疫调节、促进胆固醇代谢等方式抑制体内斑块的形成，参与 AMI 术后稳定血压、修复心肌和炎症的改变。3）氧化三甲胺（TMAO）在长期胆碱饮食激活肠道菌群时水平升高，通过诱导胆固醇代谢改变、炎症反应、内皮功能障碍和血小板活化等机制促进 AMI 的发生发展 [10]。此外有研究发现 TMAO 可促进心肌肥大，加剧梗死后的纤维化进程，从而影响 AMI 术后心脏康复 [11]。

在这一背景下，肠道菌群移植（FMT）作为一种能够快速、全面重塑肠道微生态的干预手段，展现出独特的治疗价值 [12]。通过将健康供体的功能菌群移植到患者肠道内，不仅能够恢复菌群多样性，更重要的是可以重建正常的菌群代谢功能和免疫调节功能。因此，本综述将探讨肠道菌群及 FMT 在 AMI 中的作用机制，总结目前以肠－心轴为新的靶点从而辅助术后心脏康复的研究现状与临床应用前景。

二、文献综述方法论

为了提供全面而可靠的文献基础，我们采用了系统性的文献检索与分析方法，旨在全面评估 AMI 术 FMT 对心脏康复影响的作用机制与临床价值。我们选择了三个核心数据库作为文献来源：PubMed、Web of Science 和 Embase，这些数据库在生物医学领域，特别是在心血管疾病与微生物组研究方面具有权威性和广泛的覆盖范围。检索策略采用主题词与自由词相结合的方式，核心检索式包括：（"acute myocardial infarction" OR "myocardial infarction" OR "AMI"）AND（"fecal microbiota transplantation" OR "FMT" OR "intestinal flora transplantation"）AND（"cardiac rehabilitation" OR "heart function recovery" OR "ventricular remodeling"）。同时扩展检索了与肠－心轴机制相关的术语，如

"gut-heart axis"、"TMAO"、"short-chain fatty acids"、"intestinal barrier function" 等。考虑到概念演变，我们还纳入了 "microbiota-gut-heart axis"、"dysbiosis" 等衍生术语，以确保检索的全面性。

在研究方法学质量评估方面，我们采用多种评估工具确保文献质量。对于随机对照试验，使用 Cochrane 偏倚风险评估工具，从随机序列生成、分配隐藏、盲法实施、数据完整性、选择性报告等方面进行评估。对于观察性研究，采用纽卡斯尔 - 渥太华量表（NOS）进行质量评分。动物实验研究则使用 SYRCLE 偏倚风险评估工具。通过这种多层次的质量评估体系，确保纳入文献的方法学严谨性。在数据分析过程中，我们特别关注研究间的异质性问题。这种异质性主要体现在：动物模型差异（永久性结扎与缺血再灌注模型）、FMT 干预时机（预防性移植与治疗性移植）、移植物制备标准（供体筛选、保存方法）以及结局测量时点的不一致性。为此，我们采用亚组分析思路，根据不同研究特征对结果进行分层解读，确保结论的可靠性。在整个文献筛选和数据分析过程中，我们严格遵循 PRISMA 系统评价指南，确保研究过程的可重复性和透明度。

三、主要理论与结果

目前，针对肠道微生态以帮助心脏康复的研究主要集中在饮食调控[13]、药物治疗[14]和肠道菌群移植[12]三大领域。这些干预策略的共同目标是恢复肠道微生态平衡，通过多种途径改善心脏功能 [15]：一是减少有害代谢产物如 TMAO 的产生；二是增加有益代谢物如 SCFAs 的水平；三是强化肠道屏障功能，减少细菌脂多糖易位；四是调节免疫炎症反应，创造有利于心肌修复的微环境。其中，FMT 作为一种能够直接、快速重塑肠道菌群生态的治疗策略，通过将健康供体的功能菌群移植到患者肠道内，以重建正常肠道微生态的治疗方法，近年来在 AMI 术后心脏康复领域展现出了巨大潜力 [12, 16]。Yang 研究团队 [17] 利用 FMT 来平衡心肌炎小鼠的平衡肠道微生物群，发现其心脏组织中的 IFN-γ 基因表达和脾脏中的 CD4 IFN-γ 细胞表达降低，减轻了心肌损伤程度而改善心功能。TANG 等 [18] 通过 CX3CR1-GFP 报告发现 FMT 能够补充小鼠免疫系统，恢复梗死周围区域的免疫活性，并提高心肌梗死后的生存率。

在代谢产物调控层面，FMT 通过产生多种生物活性分子直接参与 AMI 术后心脏康复与心血管功能的调节。AMI 患者血浆 TMAO 水平较健康人群显著升高，可达正常值的 2-3 倍，且其浓度与主要不良心血管事件风险呈正相关 [19]。Zhu 团队的研究发现 [20]，利用 FMT 将 TMAO 水平升高的供体肠道微生物群移植到无菌小鼠体内后，可显著增强受体小鼠的血小板活性和血栓形成倾向。此外，一些肠道共生菌中的胆碱 TMA 裂解酶及其激活酶（cutC/D）基因的表达水平与 TMAO 产生有关，提示可能是潜在的治疗靶点 [21]。

在免疫炎症调节方面，FMT 通过多种机制缓解全身炎症状态和加速心肌修复过程。AMI 术后肠道菌群失调导致促炎 / 抗炎平衡破坏，表现为促炎细胞因子如肿瘤坏死因子 -α（TNF-α）、白细胞介素 -6（IL-6）和白介素 -1β（IL-1β）水平显著升高 [22]。研究发现，FMT 可以增加普拉梭菌等有益菌的丰度 [23]，这些菌株能够促进调节性 T 细胞分化，产生抗炎效应。动物实验表明，接受 FMT 处理的 AMI 小鼠心脏组织中

Treg 细胞比例显著增加 [24]，同时 IL-10 等抗炎因子表达上调，心肌炎症浸润程度显著减轻。此外，来自健康供体的 FMT 可促进梗死心脏中 M2 型巨噬细胞的极化 [25]，这种巨噬细胞表型与组织修复和炎症消退密切相关。

实验数据显示 [26]，FMT 调节的微生物代谢物可防止肠道屏障损伤并抑制白细胞介素 8（IL-8）和单核细胞趋化蛋白 1（MCP-1）的分泌，全身炎症反应显著改善。值得注意的是，FMT 所补充的 SCFAs 特别是丁酸盐，在维持肠道屏障功能中发挥关键作用，它不仅是肠道上皮细胞的重要能量来源，还能通过激活 GPR109a 受体增强紧密连接蛋白表达 [27]，从而加速 AMI 术后心脏康复。

综上所述，FMT 通过代谢产物调控、免疫炎症调节、肠道屏障修复等多重机制的相互关联、协同作用，形成一个复杂的调控网络，共同构成了促进 AMI 术后心脏康复的理论基础。

四、结论与未来展望

本综述系统阐述了肠道菌群移植在急性心肌梗死术后心脏康复中的作用机制与研究进展。通过对现有文献的系统分析，我们证实 FMT 通过调节 " 肠 - 心轴 " 在 AMI 后心脏康复中利用多靶点、多层次的作用机制显示出独特优势。将 FMT 移植整合于急性心肌梗死术后的心脏康复体系，虽具有广阔前景，但在科学与实践层面仍面临多重挑战。目前对“肠 - 心轴”的具体信号通路和 FMT 作用机制理解尚不深入 [15, 28]。虽然已知 FMT 可通过调节菌群 - 代谢物 - 免疫轴发挥心脏保护作用，但关键效应菌株、活性代谢产物及其作用靶点仍有待系统鉴定。不同个体间肠道微生物组的高度异质性也使得确定菌群组成与心脏康复效果间的因果关系复杂化。未来的研究应集中在机制深入探索、治疗方案标准化和临床转化推进等方面，通过高质量的循证医学研究，逐步建立 FMT 在心血管疾病防治中的应用体系。深入研究从“全菌群”到“功能菌群 / 代谢物”的转变，为了长期有效性和安全性，探索“精准菌群移植”[29, 30]，寻找与心脏康复结局相关的特定菌群标志物，实现个体化治疗。未来十年间，我们或将见证从被动式通用治疗向主动型、数据驱动型精准干预的范式转变——这种新型策略将充分考量每位患者独特的生物特征、环境因素及心理社会背景。

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肠道微生态与肠功能维护临床应用研究
急性心肌梗死术后肠道菌群移植对心脏康复的影响

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目的： 旨在系统探讨肠道菌群移植（FMT）在急性心肌梗死（AMI）术后心脏康复中的作用机制与临床应用价 值。通过分析 FMT 通过 " 肠 – 心轴 " 调节心脏康复的潜在机制，评估其在改善心功能、促进心肌修复方面的治疗效果， 为 FMT 在心血管康复领域的临床应用提供理论依据和实践指导。同时，明确当前研究存在的空白与挑战，为未来 研究方向提供参考。

方法：采用系统性文献检索方法，检索 PubMed 、Web of Science 和 Embase 数据库的相关文献。检索策略结 合主题词与自由词，核心检索式包括急性心肌梗死、FMT 和心脏康复等相关术语。采用 Cochrane 偏倚风险评估工 具、纽卡斯尔 – 渥太华量表和 SYRCLE 工具评估文献质量，严格遵循 PRISMA 指南进行文献筛选和数据提取，确 保研究过程的科学性和可重复性。

结果：FMT 通过多重机制促进 AMI 后心脏康复：在代谢层面，通过产生多种生物活性分子直接参与心脏康复 与心血管功能的调节，显著降低血浆 TMAO 水平，以降低血小板活性和血栓形成；在免疫调节方面，增加普拉梭 菌等有益菌的丰度，促进调节性 T 细胞分化，产生抗炎效应，增加心脏组织 Treg 细胞比例，促进 M2 型巨噬细胞 极化；在肠道屏障功能方面，FMT 防止肠道屏障损伤并抑制白细胞介素 8（IL–8）和单核细胞趋化蛋白 1（MCP–1）的分泌，全身炎症反应显著改善。这些机制协同作用，共同改善心肌炎症反应、促进组织修复和改善心功能。

结论: FMT 通过调节 " 肠 – 心轴 " 在 AMI 后心脏康复中展现出多靶点治疗优势。尽管目前仍处于研究阶段，但其 通过代谢调控、免疫调节和屏障修复等多重机制显示巨大潜力。未来需要进一步深入研究具体作用机制，建立标 准化治疗方案，推进临床转化研究。随着精准医疗发展，FMT 有望推动心脏康复从通用治疗模式向个体化、数据 驱动的精准干预模式转变，为 AMI 患者提供新的康复策略。

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

基于人体成分分析的个体性化体重管理方案在门诊患者中的实践与成效

丁丽敏

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本研究借助构建“人体成分分析（ BCA ）+ 临床营养师”双核心干预模式，搭建基于肥胖亚型的个性化体重管理路径， 验证该模式在门诊患者中的临床有效性，为临床营养诊疗由“经验化” 向“精准化”转型提供循证依据。

选取郑州大学第五附属医院临床营养科在 2023 年 3 月至 2024 年 3 月期间接诊的 196 例成年体重管理患者，运用 ACCUNIQ 杰文 BCA 分析仪采集基础代谢率、体脂率、 内脏脂肪面积、 骨骼肌量等 12 项核心指标。结合临床诊 断，将患者划分为隐性肥胖型（占比 28.7%）、肌少型肥胖（占比 19.3%）、单纯性肥胖（占比 42.0%）及其他类 型（占比 10.0%）。由临床营养师根据不同亚型制定差异化方案：针对隐性肥胖患者，重点控制精制碳水的摄入量； 对于肌少型肥胖患者，采用“高蛋白 + 抗阻运动指导”策略；对单纯性肥胖患者，实施热量缺口动态调整。通过门 诊复诊、线上随访并结合智能饮食记录工具，开展为期 12 周的全程管理，对比干预前后人体成分以及空腹血糖、血脂等代谢指标的变化。

12 周干预后，整体人群中体重降幅≥ 5% 者占比达 78.0%，且达成了“减脂保肌”的双重目标。1. 体脂率方面：

65.9% 的患者体脂率显著下降，平均降幅达 4.2%。其中， 隐性肥胖组的内脏脂肪面积减少最为显著，均值降低了 21.3cm 。2. 肌肉量方面：56.2% 的患者骨骼肌量得以维持或提升，肌少型肥胖组的肌肉量平均增加了 1.8kg。3. 代谢指标方面 ： 空腹血糖、甘油三酯异常患者的改善率分别为 41.5%、38.2%。4. 依从性方面：患者的方案执行 率达 82.3%，满意度评分（ 10 分制）均值为 8.6 分。

基于人体成分分析的个性化体重管理方案，通过精准划分肥胖亚型，实现了干预措施的“量体裁衣”，有效攻克了传统模式中“只减重、不提质”的核心难题。该模式在增强体重管理成效的同时，显著改善患者的代谢状况，并且具有较高的临床可操作性，为门诊营养诊疗规范化提供了切实可行的实践途径，推动精准营养在体重管理领域的广泛应用。

临床营养专科疾病、临床常见疾病和疑难危重症等营养诊疗研究和典型临床营养诊疗病例报告

膳食摄入 α－亚麻酸与癌症患者死亡的关联 ： 基于 NHANES 、GBD 的多维分析

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癌症是全球主要健康问题，而饮食是其关键行为危险因素。本研究旨在探讨 20 岁以上癌症患者中膳 食 α－亚麻酸与死亡风险之间的潜在关系。

本研究利用文献计量学分析脂肪酸与癌症相关研究的趋势。利用全球疾病负担（GBD）2021 数据回 顾了全球癌症负担及其危险因素的流行病学情况。利用美国国家健康与营养调查（NHANES）1999－ 2018 年的横断面数据，通过筛选共纳入 29979 名参与者，获取其两日膳食摄入的 α－亚麻酸数据。 采用多变量逻辑回归、亚组分析、中介分析、限制性立方样条图（RCS）分析其与癌症死亡之间的关 联，并校正年龄、性别、BMI、高血压、糖尿病、吸烟、饮酒、婚姻、教育、贫困程度等混杂因素。

文献计量学表明脂肪酸与癌症的相关研究仍是本领域的研究重点。根据 GBD 2021，饮食是仅次于吸 烟的第二大癌症危险因素，而饮食因素中的第一大危险因素是摄入过量红肉，导致多不饱和脂肪酸 摄入较少。NHANES 研究发现，经完全调整协变量后， α－亚麻酸与癌症死亡仍呈负相关（HR=0.91, 95%CI:0.84 ~ 0.99，P<0.05）。亚组分析结果显示，仅在 <60 岁以及从未结过婚的癌症患者中， α－亚麻酸与癌症死亡关系不显著，且 α－亚麻酸与分类型协变量无显著交互作用。RCS 显示， α－亚麻 酸与癌症死亡风险非线性关系不显著（非线性 P=0.30, 总体关联 P<0.01）。中介分析发现，C－反应 蛋白，BMI，白蛋白 , 总胆固醇 , 血小板是 α－亚麻酸与癌症死亡的中介因素。

本研究发现膳食摄入 α－亚麻酸与癌症死亡呈负相关，并在不同人群中作用程度不同。这些发现强调 了癌症患者改善膳食结构，补充 α－亚麻酸以降低死亡风险的必要性。

其他与临床营养相关的科研和工作总结、调查和建议

A Phase II Randomized Controlled Trial of Orally Administered Yeast-Derived β-Glucan for Alleviating Chemoradiotherapy-Induced Oral Mucositis in Nasopharyngeal Carcinoma Patients

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This Phase II trial evaluated oral yeast-derived β-g lucan (PGG) for alleviating mucositis and improving nutrition in NPC patients.

Sixty-three stage III-IVa NPC patients receiving radical radiotherapy (70 Gy/33F) with concurrent cisp latin were randomized to PGG supplementation (Experimental

group,5g/10kg/day, n=30) plus routine care or routine care alone (Control group, n=30). Mucositis severity (RTOG criteria), nutritional parameters (PG-SGA, body composition), and hematological indices were assessed weekly.

The experimental Group showed significantly reduced mucositis severity: 70% achieved

grade 0-I (vs. 36.7% controls; U=266.000, p=0.004), with grade III incidence at 6.67% (vs. 26.67%). Nutritional outcomes improved in the experimental Group, evidenced by

lower PG-SGA scores at week 4 (10.93±2.60 vs. 12.37±2.39, p=0.03), attenuated weight loss during weeks 3-4 (p<0.05), and increased body fat percentage (p<0.05). No

intergroup differences occurred in pain scores, muscle mass, or hematological parameters (leukocytes, hemoglobin, platelets, lymphocyte subsets).

Oral PGG significantly reduces severe mucositis incidence and mitigates nutritional deterioration during NPC chemoradiotherapy without added toxicity.

Demystifying Feature Importance: Machine Learning Assessment of Nutrients Effects on Blood Lipids and Tolerance Thresholds in Infants with LPL Gene Deficiency

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Abstract

Object: To identify nutritional treatment patterns at an early stage to save the lives of children with rare diseases and to develop a personalized nutritional management regimen for a pediatric Familial chylomicronemia syndrome(FCS) patient and identify tolerance thresholds for key nutrients.

Methods: The 31 follow-up points of FCS patients in the early follow-up period of 7 months were considered as 31 samples for study. Clinical nutritionists dynamically and individually adjusted patients' dietary plans through long-term follow-up, thereby controlling and reducing blood triglycerides (TG) and cholesterol (TC) levels. Random

Forest (RF), eXtreme Gradient Boosting (XGBoost), and Bayesian optimization, were employed to assess nutrient effects and interactions on TG/TC to develop clinical decision protocols.

Result: When measured in g/kg, Carb ranks first in importance, followed by LCT in second place; when measured in %TE, LCT takes the top position in importance, with Carb ranking second. In both cases, the influence of MCT and PRO is ranked third and fourth, respectively. When measured in two units, the effects of the four nutrients on TC were consistent with their effects on TG. Carbohyd rate and fat intake exhibit interaction effects. When carbohydrate intake exceeds 15g/kg, every 0.1g/kg increase in LCT raises TG by 1.2mmol/L (50% higher than baseline), while the protective effect of MCT decreases by 40%. When carbohydrate intake is below 10g/kg, the lipid-raising effect of LCT is reduced by 30%, and the lipid-lowering efficacy of MCT is enhanced by 35%. MCT/LCT exhibits an antagonistic effect against elevated blood lipids, with ratios >0.6 indicating "strong antagonism (maximum protective effect)", >0.4 indicating "moderate antagonism", >0.2 indicating "weak antagonism", and <0.2 indicating "no significant antagonism". However, the machine learning model confirmed 2.28 g/kg as the clinical safety threshold for MCT intake, beyond which TG shows an upward trend. The optimal protein intake range is established at 2.5-3.0g/kg, while exceeding >3.5g/kg may pose risks by slightly elevating TC levels. Since protein acts primarily as a secondary regulatory factor in metabolic processes, maintaining stable intake is clinically sufficient. Calculated in g/kg, Carb intakeis the primary driver of dyslipidemia (>48% contribution), with LCT being the major risk if calculated in kcal/kg, MCT demonstrating significant protective effects (>38% contribution), the carbo-fat interaction effect is more critical than individual factors alone. If a conventional LCT diet without MCT supplementation is adopted, to achieve TG ⩽ 5.6mmol/L, Carb can be increased to 12g/kg while raising Pro to 3.2g/kg, allowing the LCT energy ratio to reach 6.2%TE. If TG ⩽ 11.3mmol/L is permitted, Carb can be further increased to 16g/kg ,and pro raised to 3.5g/kg, with the LCT energy ratio still reaching 8.7%TE。In terms of total caloric intake, 72 kcal/kg and 102 kcal/kg represent the upper limits for achieving TG ⩽ 5.6 mmol/L and TG ⩽ 11.3 mmol/L, respectively. The infant was fed according to the prescribed diet during the 7-month follow-up period in the Nutrition Department, with both weight and

length gradually achieving catch-up growth. Using the WHO 0-3 years height and weight standard curves as reference, the infant's growth curves were plotted. During the follow-up period from the 2nd to the 7th month (approximately 6-12 months of age), the infant's weight increased by 2.82 kg, whereas the typical weight gain for this age group over 6 months is approximately 1.8 kg. Therefore, under the nutritional intervention and follow-up by the Nutrition Department, the infant achieved catch-up growth in weight.Other than the initial follow-up period documented, at the patient's final follow-up visit (age 3 years and 8 months), growth parameters were within normal ranges: weight 12.5 kg (P3-P10), height 95 cm (P10-P25), and BMI 13.8kg/m2 (P5-P10). Language, motor, and social development were unremarkable.

Conclusion: We conducted a 7-month nutritional intervention and follow-up for a 4-month-old infant diagnosed with FCS due to biallelic LPL gene mutations, achieving effective control of TG and TC. Core management principles comprised: 1) implementing a fat-free/very-low-fat diet during the acute phase to rapidly reduce lipid levels; 2) during the stable phase, supplementing MCT while gradually introducing LCT up to the patient's tolerable upper limit, with vigilant monitoring to prevent complications such as pancreatitis; and 3) dynamically adjusting other macronutrients based on serial TG and TC measurements to support growth. Machine learning analysis of 31 longitudinal monitoring points revealed that in addition to LCT restriction—The primary initial focus, due to the impact of LDL deficiency on VLDL metabolism, the decomposition of VLDL-TG synthesized from excessive carbohydrates will also be inhibited，Carb intake constitutes a significant contributor to TG levels and must also be carefully addressed. Furthermore, while MCT demonstrates an antagonistic effect against hyperlipidemia, its supplementation requires dosage limitations. Future clinical nutrition decision-making for similar FCS cases can be informed by the machine learning-derived nutrient tolerance thresholds and prioritization sequence established in this study.

New Quality Productivity-Driven Development of Clinical Nutrition in Chinese Public Hospitals: Evolution, Status Quo, and Solutions—A Chongqing Survey

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Objectives : This study assesses clinical nutrition departments in Chinese public hospitals via a Chongqing survey, extrapolating nationwide insights to propose data-driven solutions.

Methods: All clinical nutrition departments in secondary and above public hospitals (including comprehensive hospitals as well as specialized hospitals in oncology, pediatric care, psychiatry, and other disciplines) in Chongqing Municipality were selected as the target population for the survey.From January 2022 to December 2024, under the Health Commission of Chongqing Municipality (HCCQ), the Clinical Nutrition Quality Control Centre of Chongqing Municipality (CNQCC-CQ) retrieved the list of medical institutions in Chongqing Municipality from the official website. A total of 294 secondary hospitals and above were identified and allocated to five district-level clinical nutrition quality control centers according to geographical distribution. Standardized training protocols were implemented across regional subcenters to enable clinical nutrition department directors to complete validated electronic surveys through the National Clinical Nutrition Quality Control Platform (NCNQCP, https://www.cnnqcc.cn), which served as the central data repository for this study. The electronic questionnaire included institutional profiles of hospitals and affiliated clinical nutrition departments. The Supplementary Figure shows this e-questionnaire in more detail.

Results: A total of 294 public hospitals are located in Chongqing, with 100 tertiary hospitals and 194 secondary hospitals. As of December 2024, 160 hospitals had established

clinical nutrition departments, with a setting ratio of 54.4%, an increase of 73 compared with 2023 and 107 compared with 2022. Among them, tertiary hospitals represent 95%, and secondary hospitals represent 33.5%. The survey results indicate that a total of 643 professional staff members, including physicians, technicians, and nurses, are affiliated with the 160 hospitals with established CNDs. Specifically, there are 284 physicians (44.17%), 187 technicians (29.08%), and 172 nurses (26.75%). Additionally, the doctor-to-bed ratio for CNDs in Chongqing (calculated as the ratio of the number of permanently employed clinical nutrition physicians to the number of hospital beds during the same period) is 1:451. In 2024, the average nutritional risk screening rate in secondary and higher-level public hospitals in Chongqing was 76.46%, surpassing the target of 55%. Specifically, tertiary hospitals achieved a screening rate of 77.07% (target value 65%), whereas secondary hospitals reached 75.13%. Both figures exceeded the national clinical nutrition quality control index targets. Compared with previous years, the screening rate increased by 13.2% from 2023 and by 22.6% from 2022, ranking fourth among all provinces and municipalities in China. Furthermore, both tertiary and secondary hospitals demonstrated an increasing trend in screening rates compared with prior years.The average inpatient nutritional assessment rate in Chongqing in 2024 was 12.21%, exceeding the target value of 6%. Tertiary hospitals recorded an assessment rate of 12.41% (target value 8%), whereas secondary hospitals achieved an assessment rate of 11.8%. These results surpassed the national clinical nutrition quality control indicator targets. Compared with previous years, the assessment rate increased by 0.11% from 2023 and by 5.39% from 2022, ranking fifth among all provinces and cities in China.In 2024, the average rate of nutritional assessment for inpatients with diabetes in secondary and above public hospitals in Chongqing was 11.93%. The proportion of patients receiving nutritional intervention was 24.18%, and among insulin-treated diabetic inpatients, the reduction in insulin dosage following nutritional treatment was 21.87%.Current empirical data demonstrate that within regional healthcare institutions, 42.10% have implemented nutrition department clinical diagnosis, treatment, and management information systems, whereas 52.60% have operationalized clinical nutrition physician workstations. However, critical equipment allocation remains suboptimal: only 4 medical facilities (2.63%) possess indirect calorimetry units for precise energy expenditure measurement, and only 16 institutions (10.53%) are

equipped with bioelectrical impedance analyzers for body composition analysis.Among medical institutions in the municipality, 11.92% of CNDs undertake academic instruction in clinical nutrition for tertiary education institutions, whereas 33.30% conduct scientific research.

Conclusion: China's clinical nutrition discipline, exemplified by Chongqing's progress, has expanded significantly over the past 15 years but requires continued quality refinement. In alignment with national health goals, hospitals must address standardization gaps, talent imbalances, and weak influence. The 2022 National Health Commission mandate calls for innovation, interdisciplinary collaboration, and international exchange to increase the medical, educational, and research impact of clinical nutrition—ultimately protecting public health.

Comparison of Two Nutritional Risk Screening Tools in Hospitalized Children with Japanese Encephalitis: A Causal Inference of Clinical Outcomes and Implications for Optimized Management

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Abstract

Objectives: This study used two nutritional risk screening(NRS) tools to explore the causal relationship between nutritional risk and clinical outcomes (length of hospital stay and cost), as well as clinical results (incidence of sequelae), in hospitalized children with Japanese encephalitis (JE). The goal is to screen for a more suitable nutrition risk tool for JE reveal the underlying mechanisms, accurately quantify the impact, and provide a reliable basis for optimizing clinical management and reducing the burden of the disease in affected children.

Methods:The classical Screening Tool for Risk of Nutrition in Growth Kids (STRONGkids) and Screening Tool for Assessment of Malnutrition in Pediatrics (STAMP) were utilized to evaluate the nutritional risk of the children. A heatmap analysis was conducted to investigate the correlation between variables influencing the STRONGkids score and STAMP score. Subsequently, a decision tree was employed to identify the main factors influencing the STRONGkids score and STAMP score.Finally,causal inference was employed to calculate the causal effects between the NRS score,clinical outcomes, and clinical results.

Results: Dysphagia was the most significant factors affecting STRONGKids scores, and the weight and height was the most significant factors affecting STAMP scores. Causal

analysis revealed that for every unit increase in the severity of JE type, the STRONGkids score increased by 0.515 units, and 1.339 units for STAMP. Moreover,

the presence of dysphagia led to a 1.944-unit increase in the STRONGkids score, and 1.497-unit for STAMP. Additionally, for every unit increase in the STRONGkids score, the length of hospital stay increased by 2.541 days, and hospitalization costs increased by $612.507. Similarly, for every unit increase in the STAMP score, the length of hospital stay increased by 1.571 days, and hospitalization costs increased by $425.595.

Conclusions: Based on decision tree,causal analysis and the actual situation of SNI, the internal structural setup of the STAMP tool is more suitable for screening pediatric patients with JE, making it a more reasonable choice for this purpose when compared to STRONGkids.

Validation of the Efficacy of Nutritional Protocols for Suspected Cow's Milk Protein Allergy in IPEX Syndrome Driven by Multimodal Artificial Intelligence

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Objective: To implement individualized nutritional therapy for immune dysregulation, polyendocrinopathy, enteropathy, X-linked (IPEX) syndrome children with suspected cow's milk protein allergy and explore the clinical effects of nutritional intervention via artificial intelligence methods.

Methods: A child diagnosed with IPEX syndrome received personalized nutritional intervention: oral short peptide formula showed poor efficacy in treating inflammatory bowel disease (IBD). Considering the possibility of secondary cow's milk protein allergy, the formula was adjusted to an extensively hydrolyzed formula on Day 31st day; blood glucose was controlled using the carbohydrate counting method. The efficacy of nutritional intervention was double-verified by the Bayesian Online Change Point Detection (BOCD) algorithm and the piecewise linear regression model. The analysis method centered on the McNemar test combined with the Generalized Estimating Equation (GEE) model was used to detect the efficacy of blood glucose control.

Results: After nutritional intervention, the blood glucose compliance rate was higher than that before the intervention. A significant inflection point in gastrointestinal symptoms

appeared between days 32 to 35, the nutritional status was improved, and the therapeutic effect was verified.

Conclusions: Clinical nutritionist improve gastrointestinal symptoms and nutritional status in children with IPEX syndrome through personalized nutrition plans, promote disease stability, and lay the foundation for subsequent hematopoietic stem cell transplantation. When biological sample verification is unavailable, artificial intelligence (AI) provides certain guidance for diagnosis and efficacy assessment.

Key words: IPEX syndrome, Food Allergy, Carbohydrate counting method, Nutritional Therapy, Artificial Intelligence.

Cognitive Impairments and Plasma Metabolic Characteristics in Deficit Schizophrenia: A Two-Year Follow-Up Longitudinal Study

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Abstract

Background: Deficit schizophrenia (DS) is a clinically distinct subtype of schizophrenia (SZ) characterized by enduring primary negative symptoms. However, its long-term cognitive trajectory and metabolic profile remain poorly understood. This study aimed to examine progressive cognitive impairments in DS over a two-year period and to identify associated plasma metabolites and potential diagnostic biomarkers using untargeted metabolomics.

Methods: A total of 126 hospitalized patients (51 DS and 75 non-DS) completed cognitive and symptom assessments using the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) and the Positive and Negative Syndrome Scale (PANSS) at baseline and two-year follow-up. Fasting plasma samples collected at baseline were analyzed using untargeted metabolomics. Repeated-measures ANOVA assessed cognitive changes in DS patients. LASSO regression, combined with cross-validation, identified potential diagnostic metabolites and their associations with cognitive impairments.

Results: Over two years, patients with DS showed significant declines in cognition, mainly in visuospatial/constructional ability, attention, and delayed memory. Untargeted metabolomics identified 34 differential metabolites, primarily amino acids, fatty acids, and acylcarnitines. Pathway enrichment analysis revealed abnormalities in histidine

metabolism, alanine-aspartate-glutamate metabolism, and lysine degradation. Further LASSO regression identified a 20-metabolite panel that accurately distinguished DS from non-DS patients, with an AUC of 0.929 (95% CI: 0.887-0.970). Several metabolites, including aminoadipic acid, succinylcarnitine, and gamma-glutamylthreonine, were significantly associated with cognitive impairments.

Conclusions: This study is the first to reveal progressive cognitive impairments and distinct plasma metabolites in DS, identifying potential diagnostic markers and insights into its mechanisms.

Keywords: Schizophrenia; Deficit Syndrome; Cognitive Impairments; Untargeted Metabolomics; Metabolic Biomarkers; Longitudinal Study.

1. Introduction

Schizophrenia (SZ) is a severe and chronic psychiatric disorder characterized by disturbances in perception, thinking, emotion, and behavior, along with marked cognitive impairments [1]. However, the clinical presentation of SZ is highly heterogeneous, posing significant challenges to the understanding of its underlying biological mechanisms [2]. Therefore, subtyping SZ based on distinct clinical characteristics is particularly important. Deficit SZ (DS), as one such subtype, is characterized by primary, stable, and enduring negative symptoms, and accounts for approximately one-third of all patients with SZ [3, 4]. Previous studies have shown that the clinical classification of DS demonstrates high reliability and stability [5, 6]. Therefore, in-depth research on this subgroup may enhance our understanding of the pathophysiological mechanisms of SZ.

There are significant differences in clinical manifestations between patients with DS and non-DS (NDS). A 20-year follow-up longitudinal study reported that, compared to patients with NDS, those with DS exhibit more persistent illness-related impairments and poorer long-term outcomes [7]. Furthermore, the study indicated that DS present with more severe negative symptoms, while no significant differences were observed in positive symptoms [7]. However, several cross-sectional studies have found that patients with DS display lower levels of positive symptoms and general psychopathology [8, 9]. Moreover,

evidence indicates that individuals with DS may experience either broader or domain-specific cognitive impairments, although current findings remain inconclusive [9–14]. Therefore, further research is needed to better understand the cognitive functioning of DS, particularly through long-term longitudinal studies.

To date, diagnostic biomarkers associated with DS have primarily included neuroimaging markers, genetic markers, and inflammatory markers. Neuroimaging studies have demonstrated significantly increased oligodendrocyte density in the dorsolateral prefrontal cortex and inferior parietal lobule in patients with DS [15, 16]. Early studies reported marked reductions in frontal and parietal white matter volumes in patients with DS [17]. Further meta-analyses have indicated that DS exhibit more pronounced cortical thinning compared to NDS, particularly in the right frontoparietal cortex [18]. Genetic studies have revealed specific abnormalities in DNA methylation and gene expression of the peripheral matrix metalloproteinase 9 (MMP9) gene in patients with DS [19]. Additionally, compared to NDS, patients with DS show significantly elevated levels of C-reactive protein (CRP) and interleukin-6, with stepwise logistic regression analyses further suggesting that CRP may be an independent risk factor for DS [9, 20, 21].While previous studies have identified structural and immune-related biomarkers in DS, these approaches offer limited insight into dynamic physiological processes such as energy metabolism or neurotransmitter synthesis.

To the best of our knowledge, no studies have yet comprehensively explored the metabolic characteristics and related biomarkers of DS using untargeted metabolomics approaches. In this study, we investigated cognitive impairment differences between DS and NDS longitudinally within a relatively large sample of patients with SZ. For the first time, we applied ultra-high-performance liquid chromatography-high resolution mass spectrometry (UHPLC-HRMS) to analyze plasma samples from DS and NDS, aiming to elucidate the distinct metabolic characteristics of DS. The main objectives of this study were: 1) to longitudinally assess DS-specific cognitive impairments; 2) to identify DS-associated differential metabolites and potential diagnostic metabolic biomarkers; and 3) to examine the relationship between these candidate biomarkers and cognitive deficits in DS. Through these objectives, we aim to provide a novel untargeted metabolomics perspective

to advance clinical research on DS and its associated cognitive dysfunction.

2. Materials and methods

2.1 Participants

The participants in this study were recruited from the psychiatric inpatient wards of the Tianjin Mental Health Center in China. All participants followed a standardized diet regimen, and none of the participants had diabetes. The inclusion criteria were as follows: 1) meeting the diagnostic criteria for SZ according to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5); 2) Han ethnicity, aged between 18 and 75 years; 3) stable antipsychotic treatment for at least three months prior to enrollment. The exclusion criteria included: 1) presence of severe organic diseases or neurological disorders; 2) history of substance use disorders or alcohol abuse (excluding tobacco); 3) pregnancy or lactation; 4) comorbid psychiatric disorders other than SZ

Baseline and follow-up assessments were conducted in 2022 and 2024, respectively. A total of 280 patients with SZ were recruited at baseline. During the two-year follow-up, 134 patients were discharged, and 146 patients participated in the follow-up assessment. After excluding 20 patients with missing data, 126 patients were included in the final analysis. This study was approved by the Ethics Committee of Tianjin Anding Hospital (Approval No. 2022-09), and written informed consent was obtained from all participants or their families. The study procedures adhered to the ethical principles outlined in the Declaration of Helsinki.

2.2 Clinical assessments at baseline and two-year follow-up

This study used the Schedule for the Deficit Syndrome (SDS) to assess the severity of six negative symptoms: restricted affect, diminished emotional range, poverty of speech, curbing of interests, reduction of sense of purpose, and reduction of social drive. Each symptom was rated on a scale from 0 to 4, with 0 indicating no abnormality and 4 indicating severe impairment. If a patient had two or more symptoms with a score of $\geqslant 2$ (i.e., moderate or higher severity) that persisted for at least 12 months, they were diagnosed with deficit syndrome [22]. Among the 126 patients included in the final analysis, 51 were

diagnosed with DS, while the remaining 75 were categorized as NDS.

In addition, the study utilized the Positive and Negative Syndrome Scale (PANSS) and the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) to systematically assess the psychiatric symptoms and cognitive function of patients with SZ [23, 24]. The PANSS consists of 30 items, including the Positive Symptom Scale (7 items), Negative Symptom Scale (7 items), and General Psychopathology Scale (16 items). A higher total score indicates more severe symptoms. The RBANS is a cognitive screening tool used for patients with psychiatric disorders, dementia, and neurological diseases, and it has demonstrated good reliability and validity. The scale includes 12 subtests, primarily assessing five core cognitive domains: immediate memory, visuospatial/constructional, language, attention, and delayed memory. A lower total score indicates more severe cognitive impairments.

2.3 Collection and preparation of baseline blood samples

In the baseline assessment, 280 participants provided fasting venous blood samples (5 mL) after fasting for more than 12 hours, between 6:00 and 8:00 AM. The blood samples were collected in vacuum tubes containing sodium heparin and centrifuged at 1000 rpm for 15 minutes at 4 ° C on the same day. The separated plasma was transferred into polypropylene centrifuge tubes and stored at 80° C until metabolomic analysis. Finally, metabolomic analysis was performed on the plasma samples from the 126 patients included in the study.

2.4 UHPLC-HRMS analysis and metabolomic data processing

The UHPLC-HRMS analysis protocol used in this study is consistent with our previous publication [25]. In brief, this study employed the Meta-Phenotyper high-throughput precision metabolomics platform, based on the UHPLC-HRMS method, to systematically and comprehensively analyze and detect metabolites and lipids in plasma samples.

Plasma samples were processed in batches, with each batch containing both experimental and quality control (QC) samples. QC samples were evenly distributed within each batch to monitor and correct for potential batch effects, ensuring data consistency

throughout the analysis. A total of 699 metabolites were identified, all of which passed the QC quality assessment.

Metabolomic data processing followed the methods outlined in our previous publication [25]. Briefly, the Compound Discoverer software (Thermo Scientific, San Jose, USA) was used to systematically extract and analyze the full scan data and data-dependent MS2 metabolite profiles. The Supplementary Methods in the supplementary materials provide detailed information on the UHPLC-HRMS analysis and metabolomic data processing.

2.5 Identification of differentially expressed metabolites between DS and NDS groups

To perform the metabolomic analysis, we combined both multivariate and univariate analysis methods to identify differentially expressed metabolites between the DS and NDS groups [26]. Multivariate analysis was carried out using SIMCA software (Sartorius AG Umetrics, G ttingen, Germany). First, unsupervised principal component analysis (PCA) with unit variance scaling was employed to assess the overall metabolic changes between the groups. Subsequently, supervised orthogonal partial least squares discriminant analysis (OPLS-DA) with unit variance scaling was used to maximize group differences, and key metabolites contributing quantitatively to the classification were selected based on their variable importance in projection (VIP) values. The advantage of OPLS-DA is its ability to effectively separate predictive variables from non-predictive variables (orthogonal variation), thereby enhancing model interpretability by focusing on group differences [27]. This method is particularly suited to addressing the multicollinearity issues commonly present in metabolomic data. To validate whether the OPLS-DA model was overfitting, we performed 200 permutations.

Univariate analysis was conducted using the online platform MetaboAnalyst [28]. Differential metabolites between the DS and NDS groups were selected based on VIP values greater than 1.0 and P-values adjusted by the false discovery rate (FDR) less than 0.05 [29]. In constructing the OPLS-DA model, the VIP method was used to identify the most critical variables for group separation and to summarize the importance of all variables in the model, ensuring a comprehensive selection of biomarkers [30]. Specifically, metabolites with VIP values greater than 1.0 were considered crucial for group separation, while p-values less than 0.05 were considered statistically significant.

2.6 Identify potential diagnostic metabolites

Using the "glmnet" package in R, we applied the Least Absolute Shrinkage and Selection Operator (LASSO) regression method and determined the optimal penalty parameter lambda.1se through 10-fold cross-validation [31]. Differentially expressed metabolites with non-zero β coefficients generated by the LASSO model were selected as potential diagnostic metabolites.

2.7 Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows version 26.0. The differences between groups for categorical variables were analyzed using the chi-squared test. All continuous variables were first tested for normality using the Shapiro-Wilk test. For continuous variables that followed a normal distribution, one-way analysis of variance (ANOVA) was used; for non-normally distributed variables, the Mann-Whitney U test was applied. To evaluate the individual diagnostic performance of potential diagnostic metabolites, receiver operating characteristic (ROC) curves and area under the curve (AUC) were calculated. Subsequently, a joint analysis of diagnostic metabolites was conducted to assess their classification ability as a combination of metabolic markers. Additionally, to explore the relationship between potential diagnostic metabolites and cognitive impairments in the DS group, partial correlation and linear regression analyses were performed with gender, age, and disease duration as covariates. All statistical tests were two-sided, and statistical significance was set at $p < 0.05$.

3. Results

3.1 Demographic and clinical characteristics

As shown in Table 1, the DS and NDS groups did not differ significantly in gender, age, education, smoking status, age of onset, disease duration, chlorpromazine equivalent, or BMI (all ps > 0.05). At baseline, the DS group showed significantly higher PANSS total, negative, and general psychopathology scores ($p < 0.001$, $p < 0.001$, $p = 0.012$). After two years, DS patients still had higher PANSS total and negative scores ($p = 0.001$, $p < 0.001$), while general psychopathology scores showed no difference ($p > 0.05$). Positive symptom scores did not differ at either time point (both ps > 0.05).

Antipsychotic use is detailed in Supplementary Table 1. Risperidone was most common in the DS group (25/88), while risperidone or olanzapine was most used in the NDS group (37/140). Supplementary Table 2 shows no group difference in combination therapy ($F = 0.50$, $p = 0.482$).

3.2 RBANS scores at baseline and two-year follow-up

Table 1 shows that at baseline, the DS group had significantly lower visuospatial/constructional scores than the NDS group ($p = 0.043$), with no significant differences in immediate memory, language, attention, delayed memory, or RBANS total scores (all ps > 0.05). At the two-year follow-up, the DS group showed significantly lower scores in visuospatial/constructional, attention, delayed memory, and RBANS total scores (all ps < 0.05), while immediate memory and language scores remained comparable (both ps > 0.05).

Table 2 presents longitudinal changes in RBANS scores. Two-way repeated measures analysis of variance revealed significant group × time interactions for RBANS total, visuospatial/constructional, attention, and delayed memory scores (all ps < 0.01). Significant time effects were found for RBANS total and visuospatial/constructional scores (both ps < 0.01), and a group effect was noted for attention scores ($p = 0.033$).

Figure 1 and Supplementary Figure 1 illustrate score trends at baseline and follow-up. Compared to the NDS group, the DS group showed greater declines in RBANS total, visuospatial/constructional, attention, and delayed memory scores over two years (all ps < 0.01).

3.3 Metabolomics analysis of plasma samples between DS and NDS groups

PCA, an unsupervised multivariate method, was applied to all analytical samples to assess data variability. The tight clustering observed (Supplementary Figure 2) indicated minimal inter-sample variation and high data quality, supporting the reliability of the metabolomic data.

To explore plasma metabolite differences, OPLS-DA was conducted. The score plot (Figure 2a) showed clear separation between DS and NDS groups, indicating distinct metabolic profiles. Model validation via 200 permutation tests confirmed no overfitting ($R = 0.647$, $Q = 0.455$) (Figure 2b). Most samples fell within the 95% confidence ellipse.

Using VIP > 1 and FDR-adjusted p < 0.05, 34 differential metabolites were identified (Table 3), including amino acids (8), exogenous chemicals (4), microbial metabolites (4), fatty acids (2), acylcarnitines (2), peptides (2), purines/pyrimidines (2), bile acids (1), steroids (1), carbohydrates (1), organic acids (1), and 6 unannotated compounds (Figure 2c).

Hierarchical clustering (Figure 2d) revealed distinct expression patterns between groups. DS samples showed clear separation and tighter clustering of metabolites with similar profiles, underscoring group-specific metabolic alterations.

Metabolic pathway enrichment (Figure 2e; Supplementary Table 3) identified three key pathways: histidine metabolism (impact = 0.17213, p = 0.0049), alanine-aspartate-glutamate metabolism (impact = 0.13462, p = 0.0149), and lysine degradation (impact = 0.11247, p = 0.0170).

3.4 Identification of differentially expressed metabolites as potential diagnostic biomarkers for DS and NDS groups

LASSO regression was employed to identify potential diagnostic biomarkers distinguishing DS from NDS. Supplementary Table 4 lists the selected metabolites and corresponding lambda.1se. The regression path (Supplementary Figure 3) illustrates coefficient changes under varying regularization strengths, while the cross-validation curve (Supplementary Figure 4) evaluates model fit and generalizability.

The model identified 20 metabolites with significant group differences. Their AUC values are shown in Supplementary Table 5, and group-level comparisons in Supplementary Table 6. A composite diagnostic model based on these metabolites achieved an AUC of 0.929 (95% CI: 0.887 0.970) (Figure 2f), demonstrating high accuracy and strong discriminative power for DS.

3.5 Association between potential diagnostic metabolites and changes in RBANS scores in the DS group

Figure 3 illustrates correlations between potential diagnostic metabolites and RBANS score changes in the DS group. After adjusting for gender, age, and disease duration, partial correlation analysis showed that aminoadipic acid was negatively associated with

overall cognitive impairment (r = −0.33, p = 0.022), but positively associated with immediate (r = 0.39, p = 0.006) and delayed memory impairment (r = 0.30, p = 0.041). Thymidine (r = 0.29, p = 0.049) was also linked to immediate memory impairment. Succinylcarnitine (AcCa(4:0−DC)) (r = 0.37, p = 0.009) and N−Acetyl−L−aspartic acid (r = 0.30, p = 0.038) were positively correlated with visuospatial/constructional impairment, while gamma−Glu−Thr showed a negative correlation (r = −0.41, p = 0.004). N−Acetylthreonine was associated with attention impairment (r = 0.29, p = 0.044).

Linear regression further confirmed that aminoadipic acid significantly predicted overall (B = 2.773, p = 0.022) and immediate memory impairments (B = 4.506, p = 0.005). Succinylcarnitine (B = 13.421, p = 0.003) and gamma−Glu−Thr (B = −6.527, p < 0.001) predicted visuospatial/constructional impairment, while N−Acetylthreonine predicted attention impairment (B = 5.471, p = 0.039).

4. Discussion

This study first systematically investigate the plasma metabolic characteristics of DS using an untargeted metabolomics, combined with a two−year follow−up to assess its specific cognitive impairments. The results revealed that DS exhibited significant declines in cognitive domains such as visuospatial/constructional, attention, and delayed memory. A total of 34 differential metabolites associated with DS were identified, primarily involving amino acids, fatty acids, and acylcarnitines. Metabolic pathway enrichment analysis indicated that histidine metabolism, alanine−aspartate−glutamate metabolism, and lysine degradation may play key roles in the pathophysiology of DS. A diagnostic model based on 20 selected metabolites demonstrated strong discriminative performance in differentiating DS from NDS. Moreover, levels of metabolites such as aminoadipic acid, succinylcarnitine, and gamma−Glu−Thr were significantly associated with cognitive impairments, suggesting that metabolic abnormalities may be closely linked to the cognitive deficits observed in DS.

Cognitive impairment is one of the core symptoms of SZ, typically emerging in the early stages of the illness and persisting throughout its course [32]. In this study, patients with DS exhibited a significant decline in cognitive function over a two−year follow−up period, particularly in the domains of visuospatial/constructional, attention, and delayed memory. Our findings are consistent with several previous studies. For instance, three studies have reported that patients with DS demonstrate more severe global cognitive impairments

compared to those with NDS [10, 33, 34]. However, other studies have indicated that cognitive deficits in DS are primarily confined to specific domains such as immediate memory, attention, and language function, which is not entirely consistent with our findings [9, 12, 14]. Notably, these previous studies were cross-sectional in design, whereas our longitudinal approach allowed for a more accurate depiction of the trajectory of cognitive change over time. Moreover, it has been established that patients with chronic SZ exhibit more severe cognitive impairments than those experiencing first episode, suggesting that cognitive deficits are present early in the disease and worsen with its progression [35-37]. Additionally, two longitudinal studies have reported that patients with persistent negative symptoms exhibit more pronounced cognitive impairments and lower overall cognitive functioning than those with predominantly non-negative symptoms [38, 39]. Given that DS is characterized by predominant and persistent negative symptoms, these findings further support our conclusion that cognitive deficits in DS are more severe and progressive.

This study demonstrates that the onset and progression of SZ are closely associated with multiple amino acid metabolic pathways, including histidine metabolism, alanine-aspartate-glutamate metabolism, and lysine degradation. Histidine serves as a precursor of histamine, an important neurotransmitter that, through interactions with H1, H2, and H3 receptors and modulation of N-methyl-D-aspartate (NMDA) receptor activity, regulates arousal, emotion, cognition, and synaptic plasticity in the central nervous system [40]. Several studies have reported dysfunction of the histaminergic system in patients with SZ [41-44], which may manifest as overactivation of H3 receptors, leading to the suppression of various neurotransmitters such as dopamine, acetylcholine, and glutamate [45]. This dysregulation is associated with cognitive impairments, negative affect, and motivational deficits [46-48], which are core clinical features of DS.

The alanine-aspartate-glutamate metabolic pathway involve glutamate, a major excitatory neurotransmitter closely linked to the function of NMDA receptors. The glutamate hypothesis is a prominent theory explaining the pathophysiology of SZ, proposing that NMDA receptor hypofunction leads to disrupted glutamatergic signaling in the prefrontal cortex and striatum, thereby contributing to negative symptoms and cognitive impairments [49-52]. Glutamate is also tightly connected to brain energy metabolism, such

as the tricarboxylic acid cycle, and its metabolic dysregulation may reflect mitochondrial dysfunction. This metabolic abnormality is potentially related to common clinical features of motivational deficits and cognitive decline [53–55].

Metabolic products of the lysine degradation pathway, such as α-ketoglutarate, aldehydes, and glutamine, also participate in the regulation of the excitatory–inhibitory balance in the brain [56]. Lysine metabolism intersects with γ-aminobutyric acid (GABA) synthesis and the glutamate cycle [57]. Previous studies have demonstrated impaired GABAergic function in patients with SZ, and this reduction in inhibitory neurotransmission may exacerbate negative symptoms, particularly manifesting as affective flattening, avolition, and social withdrawal in patients with DS [58, 59]. Taken together, dysregulation of multiple amino acid metabolic pathways may collectively affect neurotransmitter systems, energy metabolism, and neural regulatory functions in DS, leading to their characteristic persistent negative symptoms and cognitive impairments.

This study further identified that differential metabolites associated with DS, beyond amino acids, primarily include fatty acids and their β-oxidation intermediate—acylcarnitines. Acylcarnitines serve as key carriers transporting fatty acids across the mitochondrial inner membrane, regulating β-oxidation and ATP production; abnormal levels often reflect mitochondrial dysfunction and disrupted cellular energy metabolism [60]. Previous studies have reported significant reductions in energy metabolism within critical brain regions such as the prefrontal cortex and striatum in patients with DS [61]. This may be closely related to dysregulation of fatty acid metabolism and altered acylcarnitine levels, further impacting neural circuit function in these brain areas and contributing to persistent negative symptoms and cognitive deficits. Moreover, abnormalities in fatty acid metabolism can promote mitochondrial reactive oxygen species production, triggering oxidative stress that damages neuronal membrane lipids and proteins, thereby activating inflammatory responses and exacerbating neuroinflammation [62, 63]. The interaction between neuroinflammation and oxidative stress not only impairs neuronal function but may also disrupt neurotransmitter systems including glutamate and dopamine, further aggravating the pathological manifestations of DS [64, 65]. Additionally, altered acylcarnitine levels may influence cellular autophagy and apoptosis pathways, affecting neuronal survival

and neuroplasticity [66]. Therefore, abnormalities in fatty acid metabolism and changes in acylcarnitine levels not only reflect systemic metabolic dysregulation in patients with SZ but may also represent specific pathological mechanisms underlying DS.

It is important to note that the findings regarding the analysis of confounding factors such as medication use and dietary habits do not imply that these factors have no impact on plasma metabolite levels. On the contrary, the results reflect that, within the study population, the effects of these factors are relatively minor compared to those of the disease itself. Since the sample size of this study was primarily designed to detect disease-related metabolic alterations, it is insufficient to adequately assess the independent effects of confounding variables. Therefore, this critical issue warrants further investigation in studies with larger sample sizes.

This study has several limitations. First, the sample size of the DS group was relatively small, and the findings were not validated in an independent cohort, which limits the generalizability of the identified potential diagnostic metabolite panel. Second, an untargeted metabolomics approach was used, which, compared to targeted methods that provide absolute concentrations, may affect the comparability of results with other studies. Third, the sample size was insufficient to thoroughly assess the effects of potential confounding factors such as medication use and dietary habits. Fourth, plasma samples were not collected at the two-year follow-up, making it impossible to capture dynamic changes in metabolic profiles over time. Therefore, these findings should be considered preliminary. Future research should involve larger DS cohorts with extended longitudinal follow-up, incorporate detailed data on medication and dietary intake to control for confounders, and include independent cohort validation to strengthen the robustness of the results.

5. Conclusion

In conclusion, the findings of this study indicate that patients with DS exhibit significant abnormalities in both cognitive function and plasma metabolic profiles. Notably, patients with DS demonstrated marked declines in visuospatial ability, attention, and delayed memory. Distinct metabolic disruptions were observed in the DS group, primarily involving

amino acids, fatty acids, and acylcarnitines. Metabolic pathway enrichment analysis further suggested that histidine metabolism, alanine-aspartate-glutamate metabolism, and lysine degradation may play critical roles in the cognitive pathophysiology associated with DS. Importantly, a panel of 20 potential diagnostic metabolites was identified, showing high efficacy in distinguishing DS from NDS. These findings provide novel metabolomic evidence for understanding cognitive impairments in DS and offer a theoretical foundation for its objective identification and the development of targeted interventions. Future studies are warranted to validate and extend these results through larger sample sizes, dynamic metabolic profiling, and long-term longitudinal follow-up.

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