

· 论著 ·

老年人夜间睡眠时长、体力活动与失能的关联研究

夏敏^{1, 2}, 钱瑾瑜^{1, 3}, 闫盼盼^{2, 4}, 吴茜^{1, 2}

1.同济大学医学院, 上海 200092; 2.同济大学附属第十人民医院护理部, 上海 200072;
3.上海交通大学医学院附属仁济医院护理部, 上海 200127; 4.河南大学护理与健康学院, 河南 开封 475004

摘要: 目的 探讨老年人夜间睡眠时长、体力活动与失能的关联, 为降低老年人失能风险、促进健康老龄化提供参考。
方法 通过中国健康与养老追踪调查(CHARLS)项目2020年调查资料收集≥60岁老年人的人口学信息、生活行为、慢性病和夜间睡眠时长等资料, 采用国际体力活动问卷短卷评估体力活动水平, 采用基础性日常生活活动能力量表评估失能情况; 采用多因素logistic回归模型分析老年人夜间睡眠时长、体力活动与失能的关联。**结果** 收集11 126名老年人资料, 其中男性5 423人, 占48.74%; 女性5 703人, 占51.26%; 年龄为(69.92±7.08)岁。夜间睡眠时长<7 h 6 838人, 占61.46%; 体力活动水平<600 MET-min/周2 247人, 占20.20%。失能3 213人, 检出率为28.88%。多因素logistic回归分析结果显示, 调整年龄、性别、婚姻状况、文化程度、居住地、吸烟、饮酒和慢性病共病等变量后, 与夜间睡眠时长7~8 h相比, <7 h ($OR = 1.535$, 95%CI: 1.386~1.700) 和>8 h ($OR = 1.186$, 95%CI: 1.003~1.402) 老年人失能风险增加53.5%和18.6%; 与体力活动水平≥600 MET-min/周相比, <600 MET-min/周 ($OR = 2.106$, 95%CI: 1.901~2.335) 老年人失能风险增加110.6%; 与夜间睡眠时长7~8 h且体力活动水平≥600 MET-min/周相比, 夜间睡眠时长<7 h且体力活动水平<600 MET-min/周 ($OR = 3.299$, 95%CI: 2.831~3.843)、夜间睡眠时长>8 h且体力活动水平<600 MET-min/周 ($OR = 2.566$, 95%CI: 1.954~3.369)、夜间睡眠时长7~8 h且体力活动水平<600 MET-min/周 ($OR = 1.911$, 95%CI: 1.564~2.334)、夜间睡眠时长<7 h且体力活动水平≥600 MET-min/周 ($OR = 1.503$, 95%CI: 1.334~1.692) 老年人失能风险分别增加229.9%、156.6%、91.1%和50.3%。**结论** 老年人夜间睡眠时长过短或过长及体力活动水平低可增加失能风险。

关键词: 夜间睡眠时长; 体力活动; 失能; 老年人

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Association between nighttime sleep duration, physical activity and disability among the elderly

XIA Min^{1, 2}, QIAN Jinyu^{1, 3}, YAN Panpan^{2, 4}, WU Qian^{1, 2}

1.School of Medicine, Tongji University, Shanghai 200092, China; 2.Department of Nursing, Tenth People's Hospital of Tongji University, Shanghai 200072, China; 3.Department of Nursing, Renji Hospital Affiliated to Shanghai Jiaotong University School of Medicine, Shanghai 200127, China; 4.School of Nursing and Health, Henan University, Kaifeng, Henan 475004, China

Abstract: Objective To investigate the association between nighttime sleep duration, physical activity and disability among the elderly, so as to provide the basis for reduce the risk of disability and promote healthy aging. **Methods** Based on the 2020 database of China Health and Retirement Longitudinal Study (CHARLS), demographic information, lifestyle behaviors, chronic diseases and nighttime sleep duration were collected from people aged 60 years and older. Physical activity level was evaluated using the International Physical Activity Questionnaire-Short. Disability status was

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作者简介: 夏敏, 硕士研究生在读, 护理专业

通信作者: 吴茜, E-mail: qian_wu2010@163.com

measured using the basic Activities of Daily Living (ADL) scale. Association between nighttime sleep duration, physical activity and disability among the elderly were analyzed using multivariable logistic regression model. **Results** Totally 11 126 elderly participants were enrolled, with 5 423 males (48.74%) and 5 703 females (51.26%). The mean age was (69.92 ± 7.08) years. Among them, 6 838 individuals (61.46%) had a nighttime sleep duration of <7 hours, and 2 247 individuals (20.20%) had a physical activity level of <600 MET-min/week. A total of 3 213 individuals were identified as having disability, with a detection rate of 28.88%. Multivariable logistic regression analysis showed that, after adjusting for age, gender, marital status, education level, residence, smoking, alcohol consumption, and multimorbidity of chronic diseases, compared with a nighttime sleep duration of 7~8 hours, those with <7 hours ($OR=1.535$, 95%CI: 1.386~1.700) and >8 hours ($OR=1.186$, 95%CI: 1.003~1.402) had an increased risk of disability by 53.5% and 18.6%, respectively. Compared with a physical activity level of ≥600 MET-min/week, those with <600 MET-min/week ($OR=2.106$, 95%CI: 1.901~2.335) had an increased risk of disability by 110.6%. Compared with those who had a nighttime sleep duration of 7~8 hours and a physical activity level of ≥600 MET-min/week, the elderly with a nighttime sleep duration of <7 hours and a physical activity level of <600 MET-min/week ($OR=3.299$, 95%CI: 2.831~3.843), a nighttime sleep duration of >8 hours and a physical activity level of <600 MET-min/week ($OR=2.566$, 95%CI: 1.954~3.369), a nighttime sleep duration of 7~8 hours and a physical activity level of <600 MET-min/week ($OR=1.911$, 95%CI: 1.564~2.334), and a nighttime sleep duration of <7 hours and a physical activity level of ≥600 MET-min/week ($OR=1.503$, 95%CI: 1.334~1.692) had an increased risk of disability by 229.9%, 156.6%, 91.1%, and 50.3%, respectively. **Conclusion** Short or long nighttime sleep duration and low physical activity levels can increase the risk of disability in the elderly.

Keywords: nighttime sleep duration; physical activity; disability; the elderly

失能是指在年龄、疾病等因素作用下个体的身体功能和主要生活活动能力受损的状态，老年人生理储备功能、认知功能和社会参与下降^[1]，失能检出率为 6.9%~82.8%^[2]。研究表明，失能不仅导致老年人生理功能减退和心理障碍^[3]，还增加家庭经济负担。随着失能老人人数增加，家庭成员在照护方面投入的时间、精力和经济成本不断攀升，预计 2035 年老年人照护成本将是 2020 年的 2 倍^[4]。老年人的生活方式与失能风险密切相关，其中睡眠和体力活动是关键的生活方式。调查显示，43% 的老年人存在失眠^[5]，35.7% 的老年人体力活动不足^[6]。研究表明，每日步行有利于降低老年人失能风险，而睡眠时长过短或过长均会增加老年人失能风险^[7~8]。本研究基于中国健康与养老追踪调查（China Health and Retirement Longitudinal Study, CHARLS）项目 2020 年数据库分析老年人夜间睡眠时长、体力活动与失能的关联，为降低老年人失能风险、促进健康老龄化提供参考。

1 资料与方法

1.1 资料来源

CHARLS 项目采用概率比例抽样方法，抽取全国 28 个省（自治区、直辖市）≥45 岁中老年人为研究对象，项目通过北京大学生物医学伦理委员会审查（IRB00001052-11015）。本研究以 CHARLS 项

目 2020 年数据库中≥60 岁老人为研究对象，排除夜间睡眠时长、体力活动等资料缺失者。

1.2 方法

1.2.1 一般资料收集

收集年龄、性别、婚姻状况、文化程度和居住地等人口学信息，吸烟、饮酒等生活行为，以及慢性病等资料。慢性病包括高血压、血脂异常、糖尿病、恶性肿瘤、慢性肺疾病、肝病、心脏病、脑卒中、肾病、消化系统疾病、记忆相关疾病、关节炎或风湿病、哮喘、情绪和心理障碍，本研究将同时患有 2 种及以上慢性病定义为慢性病共病^[9]。

1.2.2 夜间睡眠时长调查

根据 CHARLS 项目调查问卷中“过去 1 个月内，每天晚上真正睡着的时间大约是几小时？”调查夜间睡眠时长。参考文献[10]，夜间睡眠时长分为<7 h、7~8 h 和>8 h。

1.2.3 体力活动评估

CHARLS 项目 2020 年数据库中将体力活动分为高强度体力活动（如搬运重物、有氧运动、快速骑车和耕作等）、中等强度体力活动（如搬运轻物、拖地、常速骑车和疾走等）和轻度体力活动（如散步、行走等），参考文献[11]，体力活动时间分为 0 min、10~<30 min、30~<120 min、120~<240 min 和≥240 min，以平均值计算每日 3 种体力活动时间。根据 CHARLS 项目调查问卷中“通常每周有多少天做

某项活动至少 10 min?”评估每周各体力活动频率。采用代谢当量 (metabolic equivalent, MET) 评估体力活动水平^[12], 根据国际体力活动问卷短卷^[13]评价指标, 将轻度、中等和高强度体力活动的 MET 分别赋值 3.3、4.0 和 8.0, 每周各体力活动水平 (MET-min/周) 等于该体力活动对应的 MET 赋值×每周频率 (d/周) ×每日时间 (min/d), 每周总体力活动水平为 3 种体力活动水平之和。参考文献 [14], 总体力活动水平分为<600 MET-min/周和≥600 MET-min/周。

1.2.4 失能评估

采用基础性日常生活活动能力量表^[15]评估失能情况。该量表包括穿衣、上下床、进食、如厕、室内移动和洗澡 6 项, 选项分为“没有困难”“有困难但仍可以完成”“有困难需要帮助”“无法完成”; ≥1 项选择“有困难但仍可以完成”“有困难需要帮助”“无法完成”, 判定为失能^[16]。

1.3 统计分析

采用 SPSS 20.0 软件统计分析。定量资料服从正态分布的采用均数±标准差 ($\bar{x}\pm s$) 描述; 定性资料采用相对数描述, 组间比较采用 χ^2 检验。采用多因素 logistic 回归模型分析老年人夜间睡眠时长、体力活动与失能的关联。检验水准 $\alpha=0.05$ 。

2 结 果

2.1 老年人基本情况

收集 11 126 名老年人资料, 其中男性 5 423 人, 占 48.74%; 女性 5 703 人, 占 51.26%。年龄为 (69.92±7.08) 岁。有配偶 8 678 人, 占 78.00%。小学以下文化程度 5 748 人, 占 51.66%。居住在农村 6 640 人, 占 59.68%。吸烟 2 779 人, 占 24.98%。饮酒 3 656 人, 占 32.86%。有慢性病共病 7 343 例, 占 66.00%。

2.2 老年人夜间睡眠时长、体力活动和失能分析

夜间睡眠时长<7 h 6 838 人, 占 61.46%; 夜间睡眠时长 7~8 h 3 271 人, 占 29.40%; 夜间睡眠时长>8 h 1 017 人, 占 9.14%。体力活动水平<600 MET-min/周 2 247 人, 占 20.20%; 体力活动水平≥600 MET-min/周 8 879 人, 占 79.80%。失能 3 213 人, 检出率为 28.88%。年龄、性别、婚姻状况、文化程度、居住地、吸烟、饮酒、慢性病共病、夜间睡眠时长和体力活动水平不同的老年人失能检出率比较, 差异有统计学意义 (均 $P<0.05$)。见表 1。

2.3 夜间睡眠时长、体力活动与失能的关联

以失能为因变量 (0=否, 1=是), 分别以夜间

表 1 老年人失能检出率比较

Table 1 Comparison of detection rate of disability among the elderly

项目	调查人数	失能检出人数	检出率/%	χ^2 值	P 值
年龄/岁				259.235	<0.001
60~<70	6 143	1 449	23.59		
70~<80	3 773	1 219	32.31		
≥80	1 210	545	45.04		
性别				145.351	<0.001
男	5 423	1 278	23.57		
女	5 703	1 935	33.93		
婚姻状况					
有配偶	8 678	2 322	26.76	86.387	<0.001
无配偶	2 448	891	36.40		
文化程度				260.033	<0.001
小学以下	5 748	2 014	35.04		
小学	2 280	610	26.75		
初中	1 822	364	19.98		
高中及以上	1 276	225	17.63		
居住地				102.564	<0.001
城市	4 486	1 058	23.58		
农村	6 640	2 155	32.45		
吸烟				89.282	<0.001
是	2 779	607	21.84		
否	8 347	2 606	31.22		
饮酒				89.814	<0.001
是	3 656	843	23.06		
否	7 470	2 370	31.73		
慢性病共病				455.814	<0.001
有	7 343	2 604	35.46		
无	3 783	609	16.10		
夜间睡眠时长/h				118.479	<0.001
<7	6 838	2 203	32.22		
7~8	3 271	711	21.74		
>8	1 017	299	29.40		
体力活动水平/(MET-min/周)				386.119	<0.001
<600	2 247	1 026	45.66		
≥600	8 879	2 187	24.63		

睡眠时长、体力活动水平、夜间睡眠时长和体力活动水平不同组合为自变量, 分别建立 3 个多因素 logistic 回归模型, 其中模型 1 未调整变量; 模型 2 调整年龄、性别、婚姻状况、文化程度和居住地; 模型 3 在模型 2 的基础上进一步调整吸烟、饮酒和慢性病共病。结果显示, 与夜间睡眠时长 7~8 h 相比, 夜间睡眠时长<7 h、>8 h 增加老年人失能风险 (均 $P<0.05$) ; 与体力活动

水平 $\geq 600 \text{ MET-min/周}$ 相比, 体力活动水平 $< 600 \text{ MET-min/周}$ 增加老年人失能风险 ($P < 0.05$); 与夜间睡眠时长 7~8 h 且体力活动水平 $\geq 600 \text{ MET-min/周}$ 相比, 夜间睡眠时长 7~8 h 且体力活动水平 $< 600 \text{ MET-min/周}$ 、夜间睡眠时长 $< 7 \text{ h}$ 且

体力活动水平 $\geq 600 \text{ MET-min/周}$ 、夜间睡眠时长 $< 7 \text{ h}$ 且体力活动水平 $< 600 \text{ MET-min/周}$ 、夜间睡眠时长 $> 8 \text{ h}$ 且体力活动水平 $< 600 \text{ MET-min/周}$ 增加老年人失能风险 (均 $P < 0.05$)。见表 2。

表 2 老年人夜间睡眠时长、体力活动与失能关联的多因素 logistic 回归分析

Table 2 Multivariable logistic regression analysis of the association between nighttime sleep duration, physical activity and disability among the elderly

变量	模型 1		模型 2		模型 3	
	OR 值 (95%CI)	P 值	OR 值 (95%CI)	P 值	OR 值 (95%CI)	P 值
夜间睡眠时长/h						
7~8	1.000		1.000		1.000	
<7	1.711 (1.553~1.886)	<0.001	1.660 (1.502~1.834)	<0.001	1.535 (1.386~1.700)	<0.001
>8	1.499 (1.280~1.757)	<0.001	1.208 (1.025~1.423)	0.024	1.186 (1.003~1.402)	0.046
体力活动水平/(MET-min/周)						
≥ 600	1.000		1.000		1.000	
<600	2.571 (2.336~2.830)	<0.001	2.179 (1.971~2.408)	<0.001	2.106 (1.901~2.335)	<0.001
夜间睡眠时长和体力活动水平组合						
夜间睡眠时长 7~8 h 且体力活动水平 $\geq 600 \text{ MET-min/周}$	1.000		1.000		1.000	
夜间睡眠时长 7~8 h 且体力活动水平 $< 600 \text{ MET-min/周}$	2.345 (1.938~2.837)	<0.001	1.990 (1.636~2.419)	<0.001	1.911 (1.564~2.334)	<0.001
夜间睡眠时长 <7 h 且体力活动水平 $\geq 600 \text{ MET-min/周}$	1.678 (1.497~1.882)	<0.001	1.626 (1.447~1.827)	<0.001	1.503 (1.334~1.692)	<0.001
夜间睡眠时长 <7 h 且体力活动水平 $< 600 \text{ MET-min/周}$	4.521 (3.910~5.228)	<0.001	3.713 (3.197~4.312)	<0.001	3.299 (2.831~3.843)	<0.001
夜间睡眠时长 >8 h 且体力活动水平 $\geq 600 \text{ MET-min/周}$	1.340 (1.101~1.630)	0.003	1.115 (0.912~1.362)	0.288	1.086 (0.885~1.333)	0.427
夜间睡眠时长 >8 h 且体力活动水平 $< 600 \text{ MET-min/周}$	3.676 (2.842~4.754)	<0.001	2.661 (2.038~3.473)	<0.001	2.566 (1.954~3.369)	<0.001

3 讨论

本研究基于 CHARLS 项目 2020 年数据库, 共纳入 11 126 名 ≥ 60 岁老年人, 检出失能 3 213 人, 检出率为 28.88%, 与洪燕芳等^[17]调查结果相近。本研究结果显示, 夜间睡眠时长 $< 7 \text{ h}$ 、 $> 8 \text{ h}$ 、体力活动水平 $< 600 \text{ MET-min/周}$ 、夜间睡眠时长 $< 7 \text{ h}$ 且体力活动水平 $< 600 \text{ MET-min/周}$ 、夜间睡眠时长 $< 7 \text{ h}$ 且体力活动水平 $\geq 600 \text{ MET-min/周}$ 与老年人失能存在统计学关联, 提示老年人夜间睡眠时长过短或过长及低体力活动水平可增加失能风险, 睡眠时长过短和低体力活动水平共同增加失能风险。建议社区医务人员将保持合理的夜间睡眠时长和积极参与运动锻炼纳入老年人健康教育, 帮助老年人改善不良生活方式, 提高其健康水平和生活质量。

夜间睡眠时长 $< 7 \text{ h}$ 老年人失能风险增加 53.5%, 与其他研究结果^[8]类似。睡眠时长减少影响老年人免疫功能和能量代谢, 导致身体功能衰退, 增加跌倒和失能风险; 也可引起神经内分泌系统紊乱, 增加认知功能下降风险, 进一步导致失能^[18]。建议老年人应保持充足的夜间睡眠时长, 以保证良好的功能储备。本研究还发现, 夜间睡眠时长 $> 8 \text{ h}$ 增加老年人失能风险, 与 VINCENT 等^[8]研究结果一致, 但与基于 CHARLS 项目 2015 年数据库分析结果相反^[19], 这可能与夜间睡眠时长的分组不一致和后者研究对象为 ≥ 45 岁人群有关。体力活动水平 $< 600 \text{ MET-min/周}$ 与老年人失能风险之间存在正向关联, 与马仁涛等^[16]研究结果一致。体力活动水平越高, 肌纤维缩短速度越快, 肌肉功能改善更加明显^[20], 提示老年人应积极参与运动锻炼, 提高体力活动水平, 以降低

失能风险。

夜间睡眠时长<7 h 且体力活动水平<600 MET-min/周老年人失能风险增加最多, 为 229.9%。相关基础研究表明, 睡眠不足可激活核因子 κB 信号通路, 上调促炎因子表达、C 反应蛋白浓度^[21], 而低体力活动减少抗炎细胞因子分泌^[22], 两者协同加剧慢性低度炎症, 加速肌肉萎缩, 共同增加失能风险。提示该类型老年人应作为社区健康管理的优先群体, 也提示单一生活方式的干预效果有限, 需制定“睡眠-运动”协同管理策略, 提高老年人日常生活活动能力。夜间睡眠时长<7 h 且体力活动水平≥600 MET-min/周 ($OR=3.299$) 老年人与失能的关联强度较夜间睡眠时长<7 h 且体力活动水平<600 MET-min/周 ($OR=1.503$) 老年人弱。这可能是因为睡眠节律紊乱通过抑制雷帕霉素靶蛋白复合物 1 (mTORC1) 磷酸化, 减少核糖体蛋白 S6 激酶 1 和真核翻译起始因子 4E 结合蛋白 1 的激活, 从而降低肌肉蛋白的翻译效率^[23], 而体力活动通过激活 mTOR 通路部分抵消此效应^[24], 表明老年人需维持适度体力活动以延缓功能衰退。

本研究数据来源于 CHARLS 项目, 样本量充足、代表性好, 结果外推性好。但本研究存在局限性: 采用横断面研究设计, 无法从因果时序的角度论证三者之间的关系; 核心变量的数据由研究对象自我报告, 存在一定主观偏倚。未来需开展前瞻性队列研究, 结合可穿戴设备监测体力活动动态指标, 系统评估不同体力活动类型、强度及持续时间与夜间睡眠时长对老年人失能的影响, 为制定针对性的健康管理策略提供依据。

参考文献

- [1] 张媛, 史凌云, 吴瑞凯, 等. 老年病科住院患者轻度认知功能障碍的影响因素分析 [J]. 预防医学, 2024, 36 (4): 299–303.
ZHANG Y, SHI L Y, WU R K, et al. Influencing factors for mild cognitive impairment among geriatric inpatients [J]. China Prev Med J, 2024, 36 (4): 299–303. (in Chinese)
- [2] 何雨欣, 吴艺新, 杨珊, 等. 中国老年慢性病患者失能状况的 Meta 分析 [J]. 中国全科医学, 2025, 28 (2): 159–168.
HE Y X, WU Y X, YANG S, et al. Prevalence of disability in older adults with chronic disease in China: a meta-analysis [J]. Chin Gen Pract, 2025, 28 (2): 159–168. (in Chinese)
- [3] 王怀昭, 乔婷婷, 范艳存. 老年人日常生活活动能力、自评健康状况在慢性病影响抑郁症状中的效应研究 [J]. 预防医学, 2023, 35 (7): 574–577.
WANG H Z, QIAO T T, FAN Y C. Mediating role of activities of daily living and self-rated health in chronic disease-caused depressive symptoms among the elderly [J]. China Prev Med J, 2023, 35 (7): 574–577. (in Chinese)
- [4] 胡宏伟, 李延宇. 中国农村失能老年人照护需求与成本压力研究 [J]. 中国人口科学, 2021, 35 (3): 98–111.
HU H W, LI Y Y. A study on the demand and cost of the care for the disabled elderly in rural China [J]. Chin J Popul Sci, 2021, 35 (3): 98–111. (in Chinese)
- [5] PANGARIBUAN S M, WU T, HERLIANITA R, et al. Global occurrence rates of sleep disturbances among institutionalized older adults: a systematic review and meta-analysis [J/OL]. Sleep Med Rev, 2025, 81 [2025-04-30]. <https://doi.org/10.1016/j.smrv.2025.102091>.
- [6] 蔡维维, 谢晖, 王飞, 等. 社区老年人体力活动不足现状及其影响因素分析 [J]. 中华全科医学, 2022, 20 (7): 1170–1173.
CAI W W, XIE H, WANG F, et al. Analysis on status and influencing factors of physical inactivity among the elderly in community [J]. Chin J Gen Pract, 2022, 20 (7): 1170–1173. (in Chinese)
- [7] MORIKAWA M, HARADA K, KURITA S, et al. Association of objectively measured physical activity with incidence disability in older adults with/without social isolation [J/OL]. Arch Gerontol Geriatr, 2024, 120 [2025-04-30]. <https://doi.org/10.1016/j.archger.2024.105338>.
- [8] VINCENT B M, JOHNSON N, TOMKINSON G R, et al. Sleeping time is associated with functional limitations in a national sample of older Americans [J]. Aging Clin Exp Res, 2021, 33 (1): 175–182.
- [9] XI J, LI P W, YU D S. Multimorbidity: the need for a consensus on its operational definition [J]. J Adv Nurs, 2024, 80 (12): 4755–4757.
- [10] CHAPUT J, DUTIL C, FEATHERSTONE R, et al. Sleep duration and health in adults: an overview of systematic reviews [J]. Appl Physiol Nutr Metab, 2020, 45 (10 Suppl. 2): 218–231.
- [11] 龚华彪, 冷嵩, 王熙熙, 等. 体力活动对中国老年人抑郁的影响 [J]. 中国老年学杂志, 2024, 44 (21): 5343–5347.
GONG H B, LENG S, WANG X X, et al. Impact of physical activity on depression in elderly Chinese adults [J]. Chin J Gerontol, 2024, 44 (21): 5343–5347. (in Chinese)
- [12] LEAL-MARTIN J, MUÑOZ-MUÑOZ M, SIERRA-RAMÓN M, et al. Metabolic equivalents intensity thresholds for physical activity classification in older adults [J/OL]. Eur Rev Aging Phys Act, 2024, 21 [2025-04-30]. <https://doi.org/10.1186/s11556-024-00348-5>.
- [13] 屈宁宁, 李可基. 国际体力活动问卷中文版的信度和效度研究 [J]. 中华流行病学杂志, 2004, 25 (3): 265–268.
QU N N, LI K J. Study on the reliability and validity of international physical activity questionnaire (Chinese version, IPAQ) [J]. Chin J Epidemiol, 2004, 25 (3): 265–268. (in Chinese)
- [14] 樊萌语, 呂筠, 何平平. 国际体力活动问卷中体力活动水平的计算方法 [J]. 中华流行病学杂志, 2014, 35 (8): 961–964.
FAN M Y, LYU J, HE P P. Chinese guidelines for data processing and analysis concerning the international physical activity questionnaire [J]. Chin J Epidemiol, 2014, 35 (8): 961–964. (in Chinese)
- [15] LAWTON M P, BRODY E M. Assessment of older people: self-maintaining and instrumental activities of daily living [J].

- Gerontologist, 1969, 9 (3): 179–186.
- [16] 马仁涛, 王世强, 郑华涛, 等. 中国老年人身体活动和失能的相关性研究 [J]. 中国慢性病预防与控制, 2024, 32 (5): 332–336.
- MA R T, WANG S Q, ZHENG H T, et al. Chinese guidelines for data processing and analysis concerning the international physical activity questionnaire [J]. Chin J Prev Contr Chron Dis, 2024, 32 (5): 332–336. (in Chinese)
- [17] 洪燕芳, 张宇, 徐丹丹, 等. 中国老年人肌肉质量与失能关系的前瞻性队列研究 [J]. 现代预防医学, 2025, 52 (6): 1125–1130.
- HONG Y F, ZHANG Y, XU D D, et al. A prospective cohort study on the relationship between muscle mass and disability among the elderly in China [J]. Mod Prev Med, 2025, 52 (6): 1125–1130. (in Chinese)
- [18] KONG Y, YU B B, GUAN G M, et al. Effects of sleep deprivation on sports performance and perceived exertion in athletes and non-athletes: a systematic review and meta-analysis [J/OL]. Front Physiol, 2025, 16 [2025-04-30]. <https://doi.org/10.3389/fphys.2025.1544286>.
- [19] 王云艳, 李莉, 孙东晗, 等. 睡眠与肥胖对中老年人功能损失的联合作用研究 [J]. 中华疾病控制杂志, 2023, 27 (8): 883–888.
- WANG Y Y, LI L, SUN D H, et al. Study on the combined effects of sleep and obesity on functional loss in middle-aged and elderly people [J]. Chin J Dis Control Prev, 2023, 27 (8): 883–888. (in Chinese)
- [20] YEO H S, LIM J Y. Impact of physical activity level on whole-body and muscle-cell function in older adults [J/OL]. Ann Geriatr Med Res, 2025 [2025-04-30]. <https://doi.org/10.4235/agmr.240141>.
- [21] ENGERT L C, LEDDEROSE C, BINIAMIN C, et al. Effects of low-dose acetylsalicylic acid on the inflammatory response to experimental sleep restriction in healthy humans [J]. Brain Behav Immun, 2024, 121: 142–154.
- [22] ALMURAIKHY S, SELLAMI M, AL-AMRI H S, et al. Impact of moderate physical activity on inflammatory markers and telomere length in sedentary and moderately active individuals with varied insulin sensitivity [J]. J Inflamm Res, 2023, 16: 5427–5438.
- [23] ZHANG H, LIANG J L, CHEN N. Do not neglect the role of circadian rhythm in muscle atrophy [J/OL]. Ageing Res Rev, 2020, 63 [2025-04-30]. <https://doi.org/10.1016/j.arr.2020.101155>.
- [24] ZENG Z Z, LIANG J L, WU L W, et al. Exercise-induced autophagy suppresses sarcopenia through Akt/mTOR and Akt/FoxO3a signal pathways and AMPK-mediated mitochondrial quality control [J/OL]. Front Physiol, 2020, 11 [2025-04-30]. <https://doi.org/10.3389/fphys.2020.583478>.

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(上接第555页)

- [8] WANG W L, CHEN K X, XIAO W W, et al. Determinants of health poverty vulnerability in rural areas of Western China in the post-poverty relief era: an analysis based on the Anderson behavioral model [J]. BMC Public Health, 2024, 24 (1): 459–474.
- [9] 曹红梅, 何新羊. 积极老龄化视域下社会活动参与对老年人健康的影响 [J]. 江苏社会科学, 2022 (2): 166–175.
- CAO H M, HE X Y. The impact of social activity participation on the health of older adults from the perspective of active aging [J]. Jiangsu Soc Sci, 2022 (2): 166–175. (in Chinese)
- [10] SMILKSTEIN G, ASHWORTH C, MONTANO D. Validity and reliability of the family APGAR as a test of family function [J]. J Fam Pract, 1982, 15 (2): 303–311.
- [11] DIENER E, EMMONS R A, LARSEN R J, et al. The Satisfaction with Life Scale [J]. J Pers Assess, 1985, 49 (1): 71–75.
- [12] WONGPAKARAN N, WONGPAKARAN T, PINYOPORN PANISH M, et al. Development and validation of a 6-item Revised UCLA Loneliness Scale (RULS-6) using Rasch analysis [J]. Br J Health Psychol, 2020, 25 (2): 233–256.
- [13] SHEIKH J I, YESAVAGE J A. Geriatric Depression Scale (GDS): recent evidence and development of a shorter version [M]. London: Routledge, 2014.
- [14] ZHANG Y, LI X N, BI Y X, et al. Effects of family function, depression, and self-perceived burden on loneliness in patients with type 2 diabetes mellitus: a serial multiple mediation model [J]. BMC Psychiatry, 2023, 23 (1): 636–644.
- [15] AMIN S M, KHEDR M A, TAWFIK A F, et al. The mediating and moderating role of social support on the relationship between psychological well-being and burdensomeness among elderly with chronic illness: community nursing perspective [J]. BMC Nurs, 2025, 24 (1): 156–170.
- [16] NGUYEN T N B, ROSKE K, CHANCE P, et al. Relationships between adolescent perception of family functioning and affective symptomatology [J/OL]. JAACAP Open, 2024 [2025-05-07]. <https://doi.org/10.1016/j.jaacop.2024.09.002>.
- [17] BAI Q, FU D D, CHEN S C, et al. Configurational effects of intergenerational support on older adults' depression: an empirical study from CHARLS data [J]. BMC Public Health, 2025, 25 (1): 392–401.
- [18] WANG X F, XIA F H, WANG G Q. Mediating effect of anxiety and depression between family function and hope in patients receiving maintenance hemodialysis: a cross-sectional study [J]. BMC Psychol, 2023, 11 (1): 130–138.
- [19] ZAID S M, HUTAGALUNG F D, ABD HAMID H S B, et al. The power of emotion regulation: how managing sadness influences depression and anxiety? [J]. BMC Psychol, 2025, 13 (1): 38–49.
- [20] 黎旭娇, 欧阳泽平, 罗雨星, 等. 中小学生心理韧性、情绪调节在家庭累积风险与积极应对方式间的中介效应 [J]. 预防医学, 2024, 36 (11): 941–944.
- LI X J, OUYANG Z P, LUO Y X, et al. Mediating effects of resilience and emotion regulation on family cumulative risk and positive coping style among primary and middle school students [J]. China Prev Med J, 2024, 36 (11): 941–944. (in Chinese)

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