

# 老年人多维度衰弱与内在能力的关联及机制综述

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## 摘要

多维度衰弱和内在能力是当前老年医学的两个重要概念, 分别描述老年人的功能易损状态和功能储备情况。二者的评估方法有一定重叠, 但其概念和关注重点有显著差异。现有研究证据发现, 随着多种功能受损的持续累积, 内在能力先出现异常减低, 老年个体最终可能表现出多维度衰弱特征。营养状况、骨骼肌质量与功能、认知和心理状态、共病和药物负担等反映了两者的相互作用和关联。本文将内在能力与多维度衰弱进行整合, 有助于动态理解老年人的功能变化过程, 也为功能评估和干预思路提供了理论基础。但相关研究仍受到评估工具异质性、纵向研究证据不足以及心理社会因素常被忽视等问题的制约, 未来有必要通过标准化评估和长期随访研究, 更系统地刻画内在能力下降与多维度衰弱的动态演变过程。

## 关键词

多维度衰弱, 内在能力, 功能储备, 老年综合征, 老年综合评估

# Review on the Association and Mechanism between Multidimensional Frailty and Intrinsic Capacity in the Elderly

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## Abstract

Multidimensional frailty and intrinsic capacity are two key concepts in contemporary geriatric medicine, describing the development of vulnerability and changes in physical functional reserve in the elderly, respectively. Although these two frameworks share partially overlapping assessment domains, they differ substantially in conceptual hierarchy and theoretical focus. Accumulating evidence suggests that with the progressive impairment of multiple functional domains, intrinsic capacity tends to decline earlier, whereas multidimensional frailty represents a later stage characterized by the accumulation of functional deficits. Within their overlapping domains, nutritional status, skeletal muscle mass and function, cognitive and psychological status, as well as comorbidity and medication burden constitute critical nodes through which intrinsic capacity and multidimensional frailty interact in real-world settings. From this perspective, integrating intrinsic capacity with multidimensional frailty allows for a more dynamic understanding of functional changes in the elderly and provides a theoretical framework for functional assessment and intervention planning. Nevertheless, existing research remains constrained by heterogeneity in assessment tools, a lack of longitudinal evidence, and the frequent underrepresentation of psychosocial factors. Future studies employing standardized assessments and long-term follow-up are needed to more systematically characterize the dynamic trajectory from intrinsic capacity decline to multidimensional frailty.

## Keywords

Multidimensional Frailty, Intrinsic Capacity, Functional Reserve, Geriatric Syndromes, Comprehensive Geriatric Assessment

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## 1. 引言

世界卫生组织(World Health Organization, WHO)预计, 到 2050 年全球 60 岁以上人口可增至 21 亿, 其中 80% 的老年人将来自中低收入国家。快速的老齡人口增幅及地区经济、医疗的不匹配使得全球面临着巨大的健康挑战[1]。寿命的延长不代表健康的延长, 衰老所带来的功能衰退影响了老年人的健康寿命。老年人多系统器官的老化及储备能力下降[2]且常患有不同慢性疾病[3], 易出现日常及工具性活动能力受损[4]、视听力下降、认知异常、焦虑抑郁、孤独感等功能异常[5][6]。这些功能异常有时并不能用单一疾病去描述, 而是一种症候群, 称之为老年综合征。老年综合征是老年人群功能状态失衡的集合, 通常包括跌倒、谵妄、压疮、大小便失禁和衰弱等[7]。通过问卷、影像学等方法对老年人群进行评估, 可以观察到老年人群功能的动态变化[8]。

多维度衰弱(Multidimensional Frailty) [9]和内在能力(Intrinsic Capacity, IC) [10]这两个综合性概念是对老年人群功能变化进行的结构化描述。衰弱一般是狭义的生理衰弱, 是指老年人随着年龄增长而出现的多系统功能储备下降、易损性增加, 对外来应激事件防御力减低的综合状态[11]。而多维度衰弱涵盖身体功能、心理精神以及社会家庭的多个领域, 更加强调多系统性与整体性, 被认为更能全面反映老年人复杂的健康状态[12]。内在能力是 WHO 于 2015 年首次提出的评估老年人整体功能储备的核心概念, 由多个功能域构成, 与环境因素共同决定老年个体功能能力, 其下降反映老年个体功能能力的持续减弱[13]。

因评估方法具有一定重叠, 多维度衰弱与内在能力在研究中常常同时出现[14], 但前者主要用于刻画不同功能受损所体现的易损状态, 后者则侧重于反映个体整体功能储备及能力水平, 二者在概念和理论侧重点上存在差异, 相关研究多聚焦于各自框架内部, 缺乏系统整合[15][16]。这种割裂在一定程度上限制了对老年人功能衰退复杂性及其动态变化过程的全面理解。

## 2. 多维度衰弱和内在能力的概念及演变

### 2.1. 多维度衰弱的概念演变与特征

衰弱概念的形成并非源于单一理论, 而是长期在临床实践中对“同病不同结局”多年探究得出的系统性的老年人群现象概述[17]。早期研究人员已注意到, 部分老年人在遭遇轻微应激事件时即出现功能急剧下降或严重不良结局, 这种易损性难以用具体疾病或器官损害加以解释, 直到 2001 年, Fried 等人首次从生理层面将这些与多系统功能储备下降的综合现象定义为“衰弱”, 并且首次提出了以体重减轻、乏力、肌力下降、活动减少为核心的衰弱表型模型, 使衰弱得以量化评估[18]。衰弱逐渐从最初较为狭义、静态的概念逐渐拓展为连续性、多系统、多结局的综合征。Rockwood [19]及 Searle [20]等学者将衰弱解构为健康缺陷不断累积所形成的危险状态, 并据此提出衰弱指数(Frailty Index, FI)模型, 并强调了衰弱程度呈连续性, 且与多种不良结局间存在梯度性关联。随着研究的进一步深入, 学界逐渐认识到衰弱并不仅仅局限于单一生理层面, 而是一种涉及神经、肌肉、代谢、免疫等多系统的功能易损状态。基于这一认识, Gobbens 等[9]提出了整合生理、心理及社会三个维度的衰弱概念框架, 并在此基础上开发了 Tilburg 衰弱指数(Tilburg Frailty Indicator, TFI), 强调衰弱不仅表现为躯体功能下降, 还涉及心理状态和社会资源等方面的受损。这一多维度视角为衰弱研究从单一生理模型向综合功能框架的转变以及进一步探索提供了重要理论与实践基础。

衰弱理论发展至现在, 从各国相关专家共识中也可明确: 衰弱并非单一疾病, 而是一种由多系统功能储备下降和易损性增加所构成的综合状态[21]-[23]。总而言之, 衰弱概念经历了由生理表型向缺陷累积、多系统功能易损状态演变的过程, 逐步从“可识别综合征”发展为描述老年功能系统性脆弱的概念。

### 2.2. 内在能力的提出与健康老龄化

内在能力是 WHO 2015 年在健康老龄化框架下提出的核心概念, 用以描述个体在特定时间点内可调动的全部身体和心理能力。该概念强调从功能储备角度理解老年人健康状态, 区别于单一器官或系统功能为导向的传统医学模式, 更加关注老年人行走、思考、视听和记忆的能力水平[13]。内在能力提出初期缺乏明确的评估路径和实践工具, 在社区和临床环境中的应用较难实施。经过 4 年探索, WHO 再次发布了全新指南, 进一步明确了内在能力包含运动、认知、心理、感官、活力在内的 5 大核心领域。此外, WHO 还明确了内在能力的评估工具, 即老年人整合照护(Integrated care for older people, ICOPE), 将内在能力从理论变成可评估、干预、随访的体系, 标志着内在能力从健康老龄化理论迈向临床与社区实践转化的重要一步[24]。

### 2.3. 多维度衰弱和内在能力的概念差异与部分功能重叠的理论基础

尽管多维度衰弱与内在能力在评估方法上存在一定重叠, 但二者概念和理论侧重点并不相同。多维度衰弱通常被视作一种综合性的异常健康状态, 是功能储备下降在多领域累积后的整体表现。内在能力侧重于描述身心能力总和, 是功能储备本身的动态水平变化。简单来说, 衰弱是功能表现, 内在能力是功能本身, 内在能力下降可能是多维度衰弱发生和进展的重要基础, 而多维度衰弱一定程度体现了多领域持续受损后的状态。

在实际应用中, 两者亦呈现出不同的侧重点。多维度衰弱更多用于临床风险分层和结局预测, 在住院管理、围手术期评估及急性照护决策中具有重要价值[25]。相比之下, 内在能力下降更适用于社区和初级保健环境中的早期筛查与动态监测, 有助于早期识别功能下降趋势并实施干预[26]。二者互补使用, 有助于医务工作者构建从社区预防到临床管理的连续照护路径[27]。

### 3. 多维度衰弱和内在能力的评估方法

#### 3.1. 多维度衰弱评估工具

多维度衰弱由单一生理衰弱发展而来, 在此基础上还包含心理、社会层面[28]。而目前对于多维度衰弱尚未形成完全统一化的评判标准, 根据不同研究目的、研究对象和应用场景, 所选用的工具也有所差异, 但总体而言均能涵盖三个维度的功能域。

从评估方法上看, 多维度衰弱的测量大致可分为三类。第一类是整合型多维度衰弱量表, 如 TFI [9]。该量表将生理、心理及社会维度作为同级并列的核心测量域, 有效性得到验证, 常用于社区人群的衰弱筛查和健康状态评估。但该量表的主观性较强, 不涉及客观体测, 且心理和社会维度因条目较少, 可能造成一定的影响[29]。第二类是在缺陷累积模型基础上构建的 FI [19] [20], 通过覆盖多系统缺陷反映多维度衰弱程度。该模型不需事先预设维度, 通常包含 30~70 个变量, 通过计算个体已存在缺陷数量与所评估缺陷总数之间的比例来反映衰弱程度的梯度变化, 优点是灵活性高, 可以根据不同数据库或调查问卷的项目构建。该模型在流行病学和风险分层分析中更为常用[30]。第三类则采用组合式评估策略, 采用以衰弱表型为基础, 加入认知功能、抑郁水平或社会支持等独立功能域评估工具, 对特定功能维度与衰弱之间的关系进行更为深入的探讨。这类研究在一定程度上推动了衰弱相关子领域的发展, 如认知衰弱、社会衰弱等概念的提出[31] [32]。此外, 临床还可使用老年综合评估(Comprehensive Geriatric Assessment, CGA)来鉴别衰弱[33]。

#### 3.2. 内在能力的评估

WHO 起初提出的内在能力概念难以直接转化为具体的评估与管理路径, 而 ICOPE 围绕其核心功能领域, 构建了以“筛查-评估-干预-随访”为主线的可操作路径, 为内在能力的评估提供了评估策略 [13] [24]。目前对于各领域的评估工具没有统一性, 具体可根据不同功能领域的特点和研究需求进行选择 [34] [35]。

在认知功能领域, ICOPE 主要关注记忆力、定向力等日常生活能力, 研究中常采用简易精神状态检查量表(Mini-Mental State Examination, MMSE)和蒙特利尔认知评估量表(Montreal Cognitive Assessment, MoCA)等工具识别存在认知功能下降风险的老年个体。

运动能力评估则侧重于老年人的行走、平衡及下肢功能, 常通过步行速度测试、起立-行走测试(Timed Up and Go test, TUG)或简化体能测试(如短程步行、椅子起立)等方式识别早期活动受限或活动能力下降的情况。

在心理功能方面, 评估重点在于情绪低落、兴趣减退等可能影响功能表现的心理症状, 研究中多采用老年抑郁量表(Geriatric Depression Scale, GDS)或患者健康问卷(Patient Health Questionnaire, PHQ-9)进行筛查。

感官功能评估主要关注视力和听力对日常交流和社会参与的影响, 通常通过简要的视听力筛查方式识别潜在的感官功能受损。

活力领域则反映老年人的整体生理储备状态, 常结合体重变化、营养状况及疲劳感等指标, 研究中常用微型营养评估量表(Mini Nutritional Assessment, MNA)来进行评估。

除了研究工具不统一以外, 目前也没有统一的内在能力受损或下降的判定标准。指南认为内在能力受损并非指某一疾病状态, 对五个功能领域进行操作化评估加以识别, 任一核心领域受损即认为存在内在能力下降[24]。

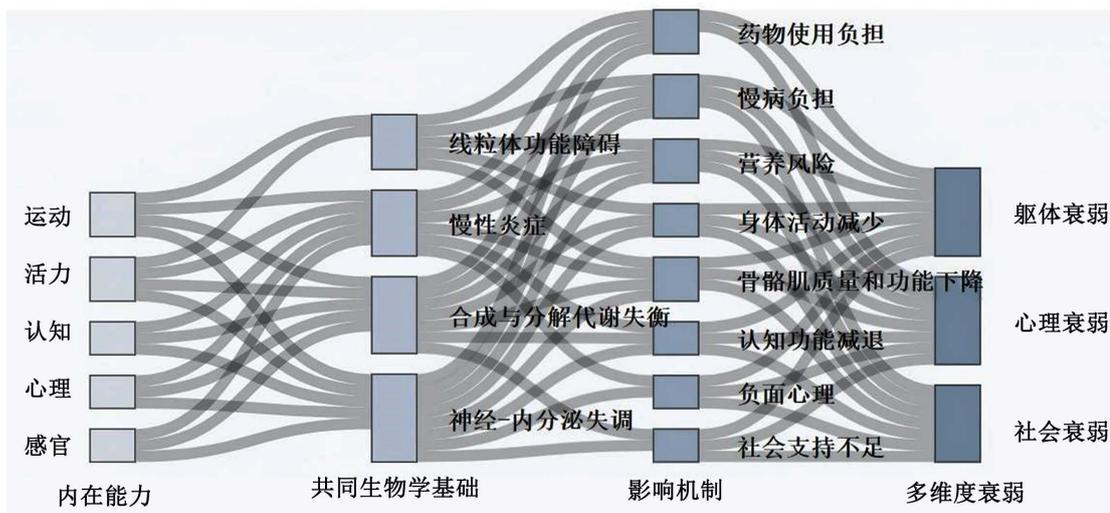
### 3.3. 多维度衰弱与内在能力下降在同一个个体中同时存在

多维度衰弱与内在能力下降均涉及运动、认知、心理状态及社会或感官相关功能。

在实际研究中, 多维度衰弱与内在能力下降时常被共同讨论, 给人以“紧密交织”的印象。这种现象反映了老年功能变化过程本身的连续性和复杂性。当功能储备持续下降时, 内在能力减低往往先于易损状态的显现, 随着受损领域的增加和累积, 个体逐渐表现出多维度衰弱特征。而多维度衰弱的状态一定程度上又可以暗示个体已发生内在能力减低。对二者内在特性及其共性的理解, 有助于优化功能筛查策略, 并为多领域干预设计提供思路。

## 4. 多维度衰弱和内在能力下降之间可能的共同机制

个体衰老从微观分子层面[36] [37]至宏观表现[38]呈现极为广泛而异质化的改变。因衰老相关功能变化的复杂性, 内在能力和多维度衰弱之间在机制层面可能存在交联, 形成功能储备逐步下降、多系统功能失调、行为能力与适应能力减弱、易损状态显现的动态演化链[18] [39]。为直观展示内在能力下降与多维度衰弱之间的潜在机制关联, 本文构建了一个综合性的概念关联图(见图 1)。



**Figure 1.** A conceptual diagram of the dynamic associations linking intrinsic capacity decline and multidimensional frailty through multisystem biological pathways and intermediate mechanisms

**图 1.** 多系统生物学通路与中介机制在内在能力下降与多维度衰弱之间的动态关联概念图

### 4.1. 内在能力下降向多维度衰弱进展的共同生物学基础

在微观层面, 内在能力下降与多维度衰弱呈现出高度一致的生物学特征, 其共同的生物标志物多来源于多系统衰老过程。单一生物标志物或病理生理通路往往并非只作用于某一功能维度, 而是通过连锁反应同时影响多个系统, 从而推动功能下降的累积[40]。

慢性低度炎症是其中最为常见且具有代表性的通路之一。随着年龄增长, 固有免疫细胞长期处于低度激活状态,  $\text{NF-}\kappa\text{B}$  信号通路持续上调, 促使  $\text{IL-6}$ 、 $\text{TNF-}\alpha$  等炎症因子长期释放[41] [42]。 $\text{TNF-}\alpha$  通过  $\text{TNFR-1}$  持续激活泛素-蛋白酶体系统及自噬-溶酶体通路, 直接促进骨骼肌蛋白降解, 同时抑制  $\text{mTOR}$

介导的蛋白合成,使机体蛋白代谢逐渐转向分解优势状态[43][44]。上述改变削弱了机体维持肌肉质量和力量的能力,临床上表现为持续疲劳、体重下降以及运动与活力维度的功能减退[45]。

线粒体功能障碍及能量感知通路失衡进一步降低机体的活力储备和抗应激能力,使内在能力的下降更容易向多维度衰弱转化。老化线粒体常伴随DNA损伤和呼吸链复合体功能下降,ATP生成效率降低[46]。在活动需求增加时,线粒体逐渐出现功能失代偿,持续应激状态下产生的活性氧(ROS)进一步激活NF- $\kappa$ B信号通路,炎症反应反过来加重线粒体损伤,形成炎症与能量代谢失衡相互放大的恶性循环[47]。

除蛋白质分解增强外,肌肉合成代谢通路异常同样在内在能力下降过程中发挥重要作用。在骨骼肌细胞中,胰岛素样生长因子-1(IGF-1)水平下降可导致下游mTORC1激活减弱,使肌肉蛋白合成能力持续受限[48]。同时,肌源性因子(Myostatin)-SMAD2/3通路的激活抑制肌细胞分化和肌纤维生长,推动肌肉结构和功能的双重退化[49]。此外,myokines分泌异常削弱了骨骼肌作为内分泌器官的调节功能,进而影响炎症控制、能量代谢及中枢神经系统功能[50],使认知、运动和活力等多个内在能力维度同步受损。

神经-内分泌相关病理生理通路为身体、心理和认知维度的内在能力下降提供了关键的生物学基础。下丘脑-垂体-肾上腺轴(HPA轴)长期激活可导致皮质醇分泌持续升高或昼夜节律紊乱,从而加重肌肉分解、骨质流失,并增加胰岛素抵抗、心理和社会支持缺陷风险[51]。在慢性炎症与神经-内分泌失衡并存的背景下,IL-6与HPA轴之间形成相互刺激的正反馈,使原本可能具有一定可逆性的功能下降逐渐固定为稳定的易损状态[52]。脑源性神经营养因子(BDNF)作为维持神经元存活、突触形成和神经可塑性的关键因子,其表达和循环水平随衰老下降,海马区突触密度减少,最终表现为学习、记忆和执行功能受损,并可能伴随情绪调节能力下降和环境适应能力减弱[53]。

综上所述,当内在能力下降已经出现时,其是否进一步演变为多维度衰弱,取决于炎症、能量代谢、肌肉合成代谢及神经-内分泌等多条病理生理通路是否长期处于激活状态。这些通路的持续异常共同决定了功能下降是停留在可逆阶段,还是逐步演变为稳定的衰弱表型。

## 4.2. 营养风险

内在能力五大领域定义中,活力主要反映个体维持生命活动和应对内外应激所需的整体生理储备[54]。从生理机制层面看,营养为机体维持基础代谢、生理活动及组织更新提供必要的物质和能量基础。能量与蛋白质供给直接影响肌肉质量、细胞更新及内脏功能维持,相关微量营养素亦参与神经、肌肉和骨骼系统的正常运作[55]。因此,营养状态可被视为功能储备较为直接的外在表现之一,动态反映运动、神经、免疫、心血管及呼吸等多系统功能水平[56]-[58]。

随着衰老发生,老年人在营养摄入、代谢、行为、环境方面均可能出现不同程度受损,更易发生营养风险[59]。老年人食物摄入能力下降,口腔功能减弱、牙齿缺失[60]及吞咽障碍[61]等问题限制了食物选择和进食效率,导致营养素种类受限及总摄入量下降。同时,感官功能退化和食欲减退[62]亦在一定程度上进一步减少营养摄入。蛋白质分解代谢相对增强、线粒体功能下降,使营养摄入难以有效转化为功能储备,甚至推动肌少症的发生[63]。此外,慢性低度炎症状态、共病负担及多重用药对营养代谢产生持续影响[64][65],而独居、抑郁等社会心理因素则可能通过行为和生活方式改变进一步加重营养风险[66][67]。

综上所述,衰老所致营养风险可通过持续降低功能储备、改变多系统功能,最终增加老年人发生多维度衰弱的风险[68]。

## 4.3. 骨骼肌质量与功能

骨骼肌质量与功能是老年人功能储备的物质基础,是链接内在能力下降与多维度衰弱的关键枢纽。

除了运动功能, 骨骼肌还参与机体的能量代谢、炎症调控及信号转导[69]。骨骼肌是衰老主要的靶器官之一, 增龄使其结构改变及调节能力减退, 骨骼肌逐渐表现为肌肉数量、质量以及功能的丧失, 最终可能发展为肌少症[63]。

因长期处于内分泌稳态改变及慢性炎症背景, 老化骨骼肌对营养摄入和蛋白质合成信号反应减弱, 总体代谢处于分解优势状态[70]。在此过程中, 老化骨骼肌结构逐渐被破坏, 逐步出现衰老相关的适应性重塑, 包括线粒体功能减退、肌纤维组成调整、脂肪浸润和结缔组织增生等改变[71]。而上述改变代偿有限, 最终难免力量和耐力下降的结局。神经系统的退行性改变使得骨骼肌的老化雪上加霜。运动神经元退化、神经-肌接头稳定性下降和反应减弱, 肌肉募集和协调能力受限, 即便肌肉数量无明显变化, 但功能亦可表现为显著受损状态[72] [73]。

骨骼肌运动能力的外在表现形式主要表现为身体活动, 骨骼肌功能的下降则进一步表现在自理能力和工具性日常活动能力受损方面[74]。老年人群骨骼肌在结构和功能上的改变往往较为隐匿, 当出现明显临床症状时, 部分个体可能已进展至肌少症阶段[75]。因此, 在明显功能障碍出现之前, 识别身体活动能力受限的老年个体具有十分重要的意义。在各种日常活动中, 工具性日常活动通常对功能储备和活动能力要求更高, 如购物、做饭、家务管理和外出办事等, 通常在功能下降早期即可出现受损, 能更加敏锐地捕捉骨骼肌功能下降[76]。当骨骼肌功能受损逐渐累积至一定程度, 老年个体完成日常任务所需的体力、耐力及协调能力出现显著缺陷, 自理能力亦随之受到影响[77]。反之, 日常活动受限又可能进一步压缩社会活动机会, 促使老年人肌群进入更加明显的废用状态, 形成恶性循环, 最终促成多维度衰弱状态[78]。

#### 4.4. 认知与心理状态

认知功能和心理状态是老年人功能变化过程中重要的调控因素, 它们通过影响行为选择、资源分配和适应能力, 从而放大其他危险因素对内在能力的损害。相比于骨骼肌萎缩和身体活动减少等相对直观的改变, 老年人认知和心理变化往往更为隐匿, 常常被大众忽视[79]。从机制层面看, 神经系统随增龄逐渐发生诸如脑萎缩、脑白质病变、神经元链接减少、突触数量减少及大脑网络功能受损等退行性改变[80], 同时老年人动脉粥样硬化和脑血管事件风险升高[81], 使神经系统的结构完整性和信息整合能力进一步受限。此外, 独居、社交隔离[82]及死亡相关焦虑[83]等社会心理暴露持续累积, 长期影响着老年人群精神健康。

认知功能下降削弱了老年人对复杂任务的计划、执行和环境适应的能力, 使老年人在工具性日常活动中更早出现困难, 并逐步限制身体活动和社会参与[84]。与此同时, 抑郁、焦虑及动机减退等心理状态改变降低了老年人的活动意愿和自我效能感, 使老年人即便在躯体功能尚可的情况下, 也倾向于回避活动和收缩行为范围[85]。这类以行为退缩为特征的功能受限在真实世界中广泛存在, 并在功能下降过程中发挥着重要的放大作用[86]。

认知与心理状态的改变也并非单向作用于功能行为。身体活动减少、自理能力下降及社会参与受限还可能加重认知负担和负性情绪, 形成“生理-心理-生理”相互强化的负向循环[87]。内在能力中认知和心理相关领域的减退与多维度衰弱中生理和心理维度的相互影响, 昭示着老年个体逐渐从可逆的功能下降过渡至更稳定的易损状态的结局。

#### 4.5. 多病共存与药物负担

多病共存(简称共病)和药物负担构成了老年人功能变化的复杂背景, 在内在能力下降和多维度衰弱的相互作用中可能起到持续放大的作用。共病是指同时患有两种及以上的慢性疾病、老年综合科或老年健康问题的状态。共病常常通过慢性炎症、疼痛、能量消耗等途径持续影响着老年人的身心健康[88]。共病负担我们常用查尔森共病指数(Charlson Comorbidity Index, CCI)进行评估, 它综合考察患病的数量和程

度两个方面, 其累积效应与不良功能结局密切相关[89]。

与之相对的, 药物负担进一步增加了老年人功能调控的复杂性。早期研究多将用药数量视为功能受损和不良结局的风险信号, 遂衍生出了多重用药的概念, 即同时使用 5 种及以上的药物[65]。近年来的认识逐渐转向强调用药适宜性本身。在慢性疾病长期管理背景下, 药物相关不良反应、相互作用及对认知、体能和食欲的潜在影响, 可能以非特异性的方式削弱内在能力, 并加速多维度衰弱的进展[90]。因此, 老年人慢病管理中最为重要的是对症合理用药, 对药物数量做减法的前提是减去的药物对于病情无益, 甚至出现毒副作用。

## 5. 干预启示

通过对内在能力下降至多维度衰弱显现这个过程的机制探索后, 研究者们得到了许多对延长健康寿命的启示。干预的窗口期即内在能力下降初期, 实施干预的最基本要求是发现存在可能内在能力下降的个体。在功能下降早期, 通过识别和维护关键功能领域, 可能有助于延缓后续衰弱的出现。但发现内在能力下降后采取什么样的措施呢? 研究发现单一维度难以逆转这个复杂的进程, 需要采取多领域协调共同干预。在这个环节中最为重要的即营养补充和骨骼肌功能的提高。地中海饮食模式特别是新鲜水果蔬菜、蛋白质和抗氧化物的摄入, 对于预防和改善衰弱状态都有很好的帮助[91][92]。因此在发展为衰弱前应当尽早改善生活模式, 加强蛋白质和抗氧食品的摄入。而对于恢复骨骼肌功能, 除了营养上的支持[93], 还需要进行骨骼肌锻炼, 特别是抗阻训练[94][95]。

除了针对躯体功能和生理储备的干预外, 精神和心理层面的干预同样具有重要意义。前文机制分析已表明, 认知功能下降和负性心理状态可能削弱老年个体对功能受损的应对能力。通过虚拟现实、动物辅助、回忆干预等非药物干预治疗, 提高认知功能维护和改善心理状态, 一定程度上有助于减缓行为退缩和活动回避, 从而延缓功能受限向多维度衰弱的演变[96]-[98]。在社会层面, 社会支持通过维持社会参与、缓冲孤独感, 为老年人提供活动机会[65]。

当内在能力下降已发展至多维度衰弱形成, 则需要更综合的策略以降低不良结局风险。但无论策略如何变化, 以功能维护为核心的多领域协同干预是老年综合照护的首要宗旨。

## 6. 局限性与未来研究方向

尽管内在能力和多维度衰弱的串联为老年综合研究提供了动态视野, 但现有研究仍存在若干不可忽视的局限。首先, 内在能力各功能领域的测量工具和评估方式尚未完全统一, 不同研究在指标选择和截断值设定上存在较大差异, 限制了研究结果之间的可比性。内在能力作为相对新近提出的概念, 目前有关的纵向研究证据有限, 而现有的横断面研究难以明确变量改变的时间先后顺序。其次, 内在能力的下降和衰弱并非具体疾病, 这在一定程度上增加了干预研究在真实世界中的实施难度。由于受试人群对自身功能变化的主观感知有限, 其对预防性或功能维护性干预的依从性可能不如对所患疾病的干预, 影响干预效果评估。最后, 精神心理状态和社会环境因素在内在能力与多维度衰弱演变中的作用日益受到关注, 但相关研究证据仍相对不足, 在既往研究中常被简化处理或忽视。

未来研究需更多多样本多中心数据, 采用纵向设计和多维评估策略, 探索不同功能领域变化的动态轨迹及其相互影响, 以更好地指导早期识别和分层干预。

## 7. 总结与展望

内在能力下降与多维度衰弱在不同层面描述了老年人功能动态变化的连续过程。二者在评估方法上的部分重叠反映了老年功能衰退本身的多系统性和动态性。在真实世界中, 功能储备的持续下降、行为模式的改变以及心理和社会因素的参与, 使两者在实践中呈现出“相互交织、相互推动”的特征。

对二者内在联系的系统梳理, 有助于深化对老年功能变化机制的理解, 并为构建以功能维护为核心的照护模式提供理论基础。未来, 通过整合内在能力与多维度衰弱的交叉领域, 或可更有效地指导老年健康评估、风险识别及多领域干预策略的计划。

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