

## · 临床研究 ·

## 北京市门诊老年人跌倒风险与躯体功能的相关性

刘庭<sup>1,2</sup>, 皮红英<sup>3\*</sup>, 苏清清<sup>1</sup>, 宋咪<sup>1</sup>, 库洪安<sup>4</sup>, 肖红菊<sup>4</sup>, 刘丽楠<sup>4</sup>(中国人民解放军总医院:<sup>1</sup> 研究生院,<sup>2</sup> 第二医学中心消化内科,<sup>3</sup> 卫勤训练中心,<sup>4</sup> 第一医学中心门诊部, 北京 100853)

**【摘要】** 目的 调查老年人跌倒风险现状并分析其影响因素,为老年人跌倒预防措施的制定提供参考。方法 便利抽样法抽取2021年5月至2022年4月北京市某三甲医院多学科联合跌倒门诊进行跌倒测评的老年人572例为研究对象,采用现场面对面调查的方式采集研究对象的一般资料、疾病情况、跌倒风险评分,并进行躯体功能测试。根据跌倒风险评估得分,将患者分为2组。对比2组各指标差异,确定跌倒风险的独立影响因素。采用SPSS 26.0软件进行数据分析。采用多因素logistic回归分析跌倒风险的独立影响因素。结果 572例老年人中278例(48.60%)有跌倒风险。Logistic回归分析结果显示,大专及以上学历(OR=2.059, 95%CI 1.285~3.298)、共病(OR=1.978, 95%CI 1.321~2.962)、多重用药(OR=2.211, 95%CI 1.348~3.625)、睡醒后头晕/萎靡/疲劳(OR=2.948, 95%CI 1.906~4.560)是老年人跌倒风险的独立危险因素,男性(OR=0.520, 95%CI 0.343~0.788)、四阶段平衡测试达标(OR=0.487, 95%CI 0.275~0.862)、计时起步行走测试达标(OR=0.455, 95%CI 0.256~0.807)是老年人跌倒风险的保护因素( $P<0.05$ )。结论 老年人跌倒风险较高,且女性高于男性,大专及以上学历、共病、多重用药、睡醒后精神不佳是老年人跌倒的独立危险因素,应注意此类老年人的跌倒预防,动态和静态平衡能力的提升有利于降低老年人跌倒风险,应进行针对性训练。

**【关键词】** 老年人;跌倒风险;躯体功能;四阶段平衡测试;计时起步行走测试

**【中图分类号】** R473

**【文献标志码】** A

**【DOI】** 10.11915/j.issn.1671-5403.2023.01.001

## Correlation between fall risk and physical function in the elderly outpatients in Beijing

LIU Ting<sup>1,2</sup>, PI Hong-Ying<sup>3\*</sup>, SU Qing-Qing<sup>1</sup>, SONG Mi<sup>1</sup>, KU Hong-An<sup>4</sup>, XIAO Hong-Ju<sup>4</sup>, LIU Li-Nan<sup>4</sup>

(<sup>1</sup>Graduate School, <sup>2</sup>Department of Gastroenterology of Second Medical Center, <sup>3</sup>Medical Service Training Center, <sup>4</sup>Outpatient Department of First Medical Center, Chinese PLA General Hospital, Beijing 100853, China)

**【Abstract】 Objective** To investigate the risk status of falls in the elderly and analyze its influencing factors so as to provide reference for the formulation of fall prevention measures in older adults. **Methods** From May 2021 to April 2022, a total of 572 older adults who received fall assessment in the multidisciplinary fall clinic of a tertiary Class-A hospital in Beijing were subjected with convenience sampling. General information, disease status and fall risk score, and results of physical function test were collected through face-to-face survey. According to the risk assessment, the participants were divided into the risk group and the risk-free group. The differences of various indicators were compared between the 2 groups to determine the independent influencing factors of fall risk. SPSS statistics 26.0 was used for statistical analysis. Multivariate logistic regression was used to analyze the independent influencing factors of fall risk. **Results** Among the 572 participants, 278 were at risk of falling, accounting for 48.60%. Logistic regression analysis showed that junior college or above educational level (OR=2.059, 95%CI 1.285-3.298), comorbidities (OR=1.978, 95%CI 1.321-2.962), polypharmacy (OR=2.211, 95%CI 1.348-3.625), and dizziness/malaise/fatigue after waking up (OR=2.948, 95%CI 1.906-4.560) were independent risk factors of fall risk, while male (OR=0.520, 95%CI 0.343-0.788), qualified results of 4-stage balance test (OR=0.487, 95%CI 0.275-0.862) and qualified outcomes of timed up and go test (OR=0.455, 95%CI 0.256-0.807) were protective factors of fall risk in the elderly ( $P<0.05$ ). **Conclusion** Older adults are at high risk of falling, and older women are at higher risk. Junior college or above educational level, comorbidity, polypharmacy, being in poor spirits after waking up are independent risk factors of fall risk. More attention should be paid to these older adults. The improvement of dynamic and static balance abilities are beneficial to reduce the risk of falls in the elderly, so targeted training should be carried out.

收稿日期: 2022-06-27; 接受日期: 2022-09-13

基金项目: 国家重点研发计划(2018YFC2001400, 2020YFC2008601)

通信作者: 皮红英, E-mail: pihongying@301hospital.com.cn

**【Key words】** aged; fall risk; physical function; 4-stage balance test; timed up and go test

This work was supported by National Key Research and Development Program of China (2018YFC2001400, 2020YFC2008601).

Corresponding author: PI Hong-Ying, E-mail: pihongying@301hospital.com.cn

跌倒是65岁以上老年人受伤和因伤致死的首要原因<sup>[1]</sup>。有1/3的65岁以上及超过半数的80岁以上老年人每年至少发生1次跌倒<sup>[2]</sup>。跌倒可对老年人身体和心理造成双重伤害,增加家庭和社会医疗经济负担。第七次全国人口普查结果显示我国60周岁及以上人口已达2.64亿,占总人口的18.7%<sup>[3]</sup>。人口老龄化程度的加剧使得跌倒预防成为公共卫生工作的重要内容。老年人跌倒的影响因素众多,风险识别对跌倒预防至关重要,但目前多数研究对跌倒风险影响因素的分析较少纳入躯体功能。本研究以此为切入点,调查包括一般资料、疾病因素、躯体功能测试在内的老年人跌倒风险相关影响因素,明确门诊老年人跌倒风险相关因素,确定躯体功能与跌倒风险的关系,为老年人跌倒预防和躯体功能锻炼提供参考。

## 1 对象与方法

### 1.1 研究对象

采用便利抽样法,选取2021年5月至2022年4月于中国人民解放军总医院多学科联合跌倒门诊进行跌倒测评的老年人。本研究经中国人民解放军总医院伦理委员会批准(批准号:伦理第S2021-077-01号)。

纳入标准:(1)年龄 $\geq 60$ 岁;(2)可独立(或借助助行器)行走;(3)神志清楚,自愿参与本研究。排除标准:(1)患有严重精神疾病或认知障碍;(2)无法配合调查员完成调查及测评。

### 1.2 方法

1.2.1 研究工具 本研究为横断面研究。(1)一般资料:患者的性别、年龄、文化程度、居住状态等。(2)疾病相关资料:共病(患慢性病种数 $\geq 2$ <sup>[4]</sup>)、多重用药、视力、听力等。(3)中文版老年人跌倒风险自评量表:该量表于2011年由美国疾病预防控制中心发布,李亚玲等<sup>[5]</sup>对其进行了汉化和信效度检验,结果表明该量表信效度良好,量表总分0~14分,总分 $\geq 4$ 分为有风险。(4)躯体功能测试:四阶段平衡测试(4-stage balance test, 4-SBT)<sup>[6]</sup>用于测试静态平衡能力,共有7个动作,每完成一个动作记1分,得分 $\geq 4$ 分为4-SBT合格;计时起步行走测试<sup>[7]</sup>(timed up and go test, TUGT)用于测试动态

平衡能力,用时 $\geq 12.3$ s为不合格;五次起坐测试(five times sit-to-stand test, FTSST)<sup>[8]</sup>用于测试下肢肌力,用时 $\leq 13.6$ s为合格。

1.2.2 调查方法 由经过跌倒测评培训的调查员采用课题组研发的跌倒风险测评软件面对面采集资料并测试躯体功能。

### 1.3 统计学处理

采用SPSS 26.0统计软件进行数据分析。计数资料用例数(百分率)表示,采用 $\chi^2$ 检验。采用多因素logistic回归分析跌倒风险的独立影响因素。 $P < 0.05$ 为差异有统计学意义。

## 2 结果

### 2.1 一般资料

本研究纳入患者572例,其中男性220例,女性352例,年龄69.0(66.0,75.0)岁,近1年发生过跌倒患者144例(25.2%),担心跌倒患者314例(54.9%)。

### 2.2 老年人跌倒风险影响因素的单因素分析

572例老年人中278例(48.6%)有跌倒风险。2组老年人在性别、年龄、文化程度、共病、多重用药、夜间起夜、睡醒后精神状态、视力、4-SBT得分及TUGT用时方面差异均有统计学意义(均 $P < 0.05$ ;表1)。

### 2.3 老年人跌倒风险影响因素的多因素分析

多因素logistic回归分析结果显示:文化程度大专及以上、共病、多重用药、睡醒后头晕/萎靡/疲劳是跌倒风险的独立危险因素,男性、4-SBT达标、TUGT达标是老年人跌倒风险的保护因素(均 $P < 0.05$ ;表2)。

## 3 讨论

2018年中国健康与养老追踪调查结果表明,无配偶、自评健康状况一般和不好、患慢性病、抑郁、自理能力受损、视力较差、听力较差、使用辅助用具的老年人跌倒风险更高<sup>[9]</sup>。本研究增加了躯体功能测试,得出4-SBT及TUGT达标为跌倒风险的保护因素的结果,筛选出女性、大专及以上文化程度、睡醒后精神不佳、共病、多重用药5项老年人跌倒风险的独立危险因素。

表 1 老年人跌倒风险的单因素分析

Table 1 Univariate analysis of fall risk in older adults

[n(%)]

Item	Total (n=572)	Fall risk group (n=278)	Fall risk-free group (n=294)	$\chi^2$	P value
Gender				12.944	<0.001
Male	220 (38.5)	86 (39.1)	134 (60.9)		
Female	352 (61.5)	192 (54.5)	160 (45.5)		
Age				8.378	0.015
60 years ≤ age < 70 years	287 (50.2)	126 (43.9)	161 (56.1)		
70 years ≤ age < 80 years	197 (34.4)	126 (43.9)	99 (50.3)		
≥ 80 years	88 (15.4)	54 (61.4)	34 (38.6)		
Education level				10.008	0.018
Illiteracy	150 (26.2)	60 (40.0)	90 (60.0)		
Middle or primary school	108 (18.9)	48 (44.4)	60 (55.6)		
High or technical school	79 (13.8)	39 (49.4)	40 (50.6)		
Junior college or above	235 (41.1)	131 (55.7)	104 (44.3)		
Living status				3.228	0.072
Alone	68 (11.9)	40 (58.8)	28 (41.2)		
With others	504 (88.1)	238 (47.2)	266 (52.8)		
BMI				4.397	0.222
BMI < 18.5 kg/m <sup>2</sup>	20 (3.5)	14 (70.0)	6 (30.0)		
18.5 kg/m <sup>2</sup> ≤ BMI < 23.9 kg/m <sup>2</sup>	285 (49.8)	132 (46.3)	153 (53.7)		
23.9 kg/m <sup>2</sup> ≤ BMI < 28.0 kg/m <sup>2</sup>	212 (37.1)	104 (49.1)	108 (50.9)		
≥ 28.0 kg/m <sup>2</sup>	55 (9.6)	28 (50.9)	27 (49.1)		
Comorbidity				43.141	<0.001
Yes	347 (60.7)	207 (59.7)	140 (40.3)		
No	225 (39.3)	71 (31.6)	154 (68.4)		
Polypharmacy				24.558	<0.001
Yes	121 (21.2)	83 (68.6)	38 (31.4)		
No	451 (78.8)	195 (43.2)	256 (56.8)		
Get up to urinate				9.451	0.009
Never	67 (11.7)	23 (34.3)	44 (65.7)		
Occasional	118 (20.6)	51 (43.2)	67 (56.8)		
Often	387 (67.7)	204 (52.7)	183 (47.3)		
Poor spirits after waking up				36.906	<0.001
Yes	163 (28.5)	112 (68.7)	51 (17.3)		
No	409 (71.5)	166 (40.6)	243 (59.4)		
Eyesight				6.067	0.014
Normal (including corrected)	410 (71.7)	186 (45.4)	224 (54.6)		
Abnormal	162 (28.3)	92 (56.8)	70 (43.2)		
Hearing				0.758	0.348
Normal (including corrected)	427 (74.7)	203 (47.5)	224 (52.5)		
Abnormal	145 (25.3)	75 (51.7)	70 (48.3)		
4-SBT				19.288	<0.001
≥ 4 points	480 (83.9)	214 (44.6)	266 (55.4)		
< 4 points	92 (16.1)	64 (69.6)	28 (30.4)		
TUGT				24.669	<0.001
< 12.30 s	474 (82.9)	208 (43.9)	266 (56.1)		
≥ 12.30 s	98 (17.1)	70 (71.4)	28 (28.6)		
FTSST				1.350	0.245
≤ 13.60 s	414 (72.4)	195 (47.1)	219 (52.9)		
> 13.60 s	158 (27.6)	83 (52.5)	75 (47.5)		

BMI: body mass index; 4-SBT: 4-stage balance test; TUGT: timed up and go test; FTSST: five times sit-to-stand test. -: no datum.

表2 老年人跌倒风险的多因素分析

Table 2 Multivariate analysis of fall risk in older adults

Item	$\beta$	SE	Wald $\chi^2$	P value	OR	95%CI
Gender	-0.655	0.212	9.499	0.002	0.520	0.343-0.788
Age	-	-	1.305	0.521	-	-
70 years $\leq$ age < 80 years	0.161	0.218	0.547	0.460	1.175	0.767-1.800
$\geq$ 80 years	0.342	0.318	1.151	0.283	1.407	0.754-2.626
Education level	-	-	9.564	0.023	-	-
Middle or primary school	0.263	0.295	0.797	0.372	1.301	0.730-2.321
High or technical school	0.469	0.313	2.244	0.134	1.599	0.865-2.956
Junior college or above	0.722	0.240	9.017	0.003	2.059	1.285-3.298
Comorbidity	0.682	0.206	10.951	0.001	1.978	1.321-2.962
Polypharmacy	0.793	0.252	9.888	0.002	2.211	1.348-3.625
Poor spirits after waking up	1.081	0.222	23.621	<0.001	2.948	1.906-4.560
Eyesight	-0.357	0.217	2.715	0.099	0.700	0.458-1.070
4-SBT	-0.720	0.292	6.090	0.014	0.487	0.275-0.862
TUGT	-0.789	0.293	7.243	0.007	0.455	0.256-0.807

4-SBT: 4-stage balance test; TUGT: timed up and go test. -: no datum.

性别、文化程度等社会人口学因素与老年人跌倒密切相关。多项研究指出老年女性跌倒风险较男性高<sup>[10,11]</sup>,本研究也得出一致的结果,这可能与老年女性雌激素水平下降、骨量丢失有关。文化程度与跌倒的关系还存在争议,本研究中大专及以上学历的老年人较文盲跌倒风险更高,与刘素等<sup>[12]</sup>的研究结果一致,而袁亚运等<sup>[13]</sup>的研究却指出文化程度高的老年人更注重身体健康且拥有更多的医疗资源,因此跌倒风险更低,也有研究指出文化程度与老年人跌倒无关<sup>[9]</sup>,这可能与不同研究的样本代表性及样本结构有关。本研究中文化程度构成大专及以上学历最多,且老年人通过主动预约进行跌倒风险筛查,对跌倒重视程度更高或更害怕跌倒,因此跌倒风险自评结果有风险的比例更高。

关于睡眠与跌倒的研究较多,相关危险因素包括失眠、睡眠时间过长或过短、睡眠质量差,睡眠障碍与步速下降和行动受限相关<sup>[14]</sup>。有研究指出,白天嗜睡是增加老年人跌倒风险的主要原因之一<sup>[15]</sup>。本研究中睡醒后存在头晕/萎靡/疲劳现象的老年人跌倒风险是无此现象老年人的2.7倍,提示我们应重视老年人睡眠相关问题,初筛发现问题的老年人应采用更为全面的睡眠评估量表或到医疗机构进行睡眠监测,积极采取干预措施。

疾病相关因素对跌倒的影响不容忽视,多病共存和多重用药增加老年人跌倒风险<sup>[16,17]</sup>。本研究中共病和多重用药使老年人的跌倒风险分别增加0.978和1.211倍。一项以2年内跌倒发生例数为结局指标的纵向队列研究表明,与未跌倒组相比,跌倒组共病现象更明显<sup>[18]</sup>。服药种类越多的老年人,损伤性跌倒风险更高<sup>[17]</sup>,可能是因为多重用药老年

人中药物副反应的发生率更高,而药物副反应往往预示着较高的跌倒风险<sup>[19]</sup>。这提示我们应指导老年人积极治疗慢性病并注意用药安全,治疗疾病和精简用药是存在矛盾点的,这有赖于多学科团队的共同努力,医院门诊也可将老年人跌倒风险评估纳入日常诊疗活动中,针对跌倒高风险老年人,应尽量减少高危药品的使用,还可通过信息平台等多种形式将安全用药知识传播到社区。

平衡能力是维持人体站立和行走时姿势稳定性的基本条件,平衡障碍是老年人跌倒的最常见原因之一。本研究显示静态平衡能力和动态平衡能力合格为跌倒风险的保护因素。静态平衡能力与身体活动水平和久坐时间相关,拥有较高的中高强度身体活动水平或较少久坐时间者静态平衡控制能力更好<sup>[20]</sup>。因此应建议老年人在身体状况允许的情况下进行足量的中高强度身体活动、减少久坐时间,从而提高静态平衡控制能力。动态平衡能力反映了老年人在行走过程中对身体姿势的动态控制能力,其下降可能与下肢肌力和踝关节灵活性下降有关<sup>[21,22]</sup>,也可能与血清维生素D3水平不足有关<sup>[23]</sup>。应指导老年人进行下肢肌力和关节灵活性训练,并通过日晒或其他外源性途径增加维生素D3摄入。

本研究有一定局限性。首先,本研究为单中心的横断面研究,研究对象仅为跌倒门诊测评的老年人,样本代表性有一定局限性;其次,本研究样本量为572例,但年龄分布呈偏态,70岁以下老年人占比较大,这可能是由于主动到三甲医院进行跌倒测评的老年人身体活动水平相对较好,因而相对年轻。针对研究的局限性,今后应扩大样本量,开展多中心研究。



综上,老年人跌倒风险较高,特别是老年女性。在老年人跌倒风险控制中应重点关注睡眠质量欠佳、共病、多重用药和平衡功能下降问题。其中平衡功能干预较易取得效果,应重点从这方面入手,制定针对性的训练方案,提高老年人平衡能力,从而降低跌倒风险。

## 【参考文献】

- [1] Jin J. Prevention of falls in older adults[J]. *JAMA*, 2018, 319(16): 1734. DOI: 10.1001/jama.2018.4396.
- [2] Tew GA, Ward L, Hewitt C, *et al*. Does yoga reduce the risk of falls in older people? [J]. *BMJ*, 2020, 370: m3246. DOI: 10.1136/bmj.m3246.
- [3] 中华人民共和国国家统计局. 第七次全国人口普查公报(第五号)[EB/OL]. [2021-07-23]. [http://www.stats.gov.cn/tjsj/tjgb/rkpcgb/qgrkpcgb/202106/t20210628\\_1818824.html](http://www.stats.gov.cn/tjsj/tjgb/rkpcgb/qgrkpcgb/202106/t20210628_1818824.html). National Bureau of Statistics of the People's Republic of China. Bulletin of the Seventh National Census(No. 5)[EB/OL]. [2021-07-23]. [http://www.stats.gov.cn/tjsj/tjgb/rkpcgb/qgrkpcgb/202106/t20210628\\_1818824.html](http://www.stats.gov.cn/tjsj/tjgb/rkpcgb/qgrkpcgb/202106/t20210628_1818824.html).
- [4] Barnett K, Mercer SW, Norbury M, *et al*. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study[J]. *Lancet*, 2012, 380(9836): 37-43. DOI: 10.1016/S0140-6736(12)60240-2.
- [5] 李亚玲, 丁福. STEADI老年人跌倒风险自评量表的汉化及信效度检验[J]. *护理学杂志*, 2020, 35(3): 8-12. DOI: 10.3870/j.issn.1001-4152.2020.03.008.  
Li YL, Ding F. Translation of a fall risk self-assessment tool of the STEADI toolkit: testing reliability and validity in the elderly[J]. *J Nurs Sci*, 2020, 35(3): 8-12. DOI: 10.3870/j.issn.1001-4152.2020.03.008.
- [6] Oddsson LIE, Bisson T, Cohen HS, *et al*. The effects of a wearable sensory prosthesis on gait and balance function after 10 weeks of use in persons with peripheral neuropathy and high fall risk — the walk2wellness trial[J]. *Front Aging Neurosci*, 2020, 12: 592751. DOI: 10.3389/fnagi.2020.592751.
- [7] Browne W, Nair BKR. The timed up and go test[J]. *Med J Aust*, 2019, 210(1): 13-14 e1. DOI: 10.5694/mja2.12045.
- [8] Munoz-Bermejo L, Adsuar JC, Mendoza-Munoz M, *et al*. Test-retest reliability of five times sit to stand test (FTSST) in adults: a systematic review and meta-analysis[J]. *Biology (Basel)*, 2021, 10(6). DOI: 10.3390/biology10060510.
- [9] 张田田, 丰志强, 王婉晨, 等. 中国老年人跌倒现状及影响因素研究[J]. *中华疾病控制杂志*, 2022, 26(5): 502-507. DOI: 10.16462/j.cnki.zhjbkz.2022.05.002.  
Zhang TT, Feng ZQ, Wang WC, *et al*. A study on the status quo and influencing factors of falls among the elderly in China[J]. *Chin J Dis Control*, 2022, 26(5): 502-507. DOI: 10.16462/j.cnki.zhjbkz.2022.05.002.
- [10] Wu H, Ouyang P. Fall prevalence, time trend and its related risk factors among elderly people in China[J]. *Arch Gerontol Geriatr*, 2017, 73: 294-299. DOI: 10.1016/j.archger.2017.08.009.
- [11] Frankenthal D, Saban M, Karolinsky D, *et al*. Falls and fear of falling among Israeli community-dwelling older people: a cross-sectional national survey[J]. *Isr J Health Policy Res*, 2021, 10(1): 29. DOI: 10.1186/s13584-021-00464-y.
- [12] 刘素, 严亚琼, 李芳, 等. 2018年武汉市老年人跌倒伤害及其影响因素[J]. *中华疾病控制杂志*, 2020, 24(4): 480-484. DOI: 10.16462/j.cnki.zhjbkz.2020.04.021.  
Liu S, Yan YQ, Li F, *et al*. Epidemiologic characteristics of fall related-injuries and related factors among elderly population in Wuhan, 2018[J]. *Chin J Dis Control Prev*, 2020, 24(4): 480-484. DOI: 10.16462/j.cnki.zhjbkz.2020.04.021.
- [13] 袁亚运, 李红芳. 健康中国背景下中国老年人跌倒的不平等——基于 CHARLS 三期数据的实证分析[J]. *人口与发展*, 2020, 26(04): 72-85.  
Yuan YY, Li HF. Inequalities in fall of Chinese elderly under healthy China background: an empirical analysis based on three samples of CHARLS data[J]. *Popul Dev*, 2020, 26(4): 72-85.
- [14] Zhang L, Liu S, Li Y, *et al*. Associations of sleep quality with gait speed and falls in older adults; the mediating effect of muscle strength and the gender difference [J]. *Gerontology*, 2022, 68(1): 1-7. DOI: 10.1159/000514894.
- [15] Min Y, Slattum PW. Poor sleep and risk of falls in community-dwelling older adults: a systematic review[J]. *J Appl Gerontol*, 2018, 37(9): 1059-1084. DOI: 10.1177/0733464816681149.
- [16] 王旭, 章轶立, 孙凯, 等. 社区中老年人居民跌倒风险筛查与相关因素分析[J]. *中国骨伤*, 2021, 34(12): 1108-1113. DOI: 10.12200/j.issn.1003-0034.2021.12.004.  
Wang X, Zhang YL, Sun K, *et al*. Fall risk screening and related factors analysis of middle aged and elderly population in communities; a cross sectional study[J]. *China J Orthop Trauma*, 2021, 34(12): 1108-1113. DOI: 10.12200/j.issn.1003-0034.2021.12.004.
- [17] Morin L, Calderon Larranaga A, Welmer AK, *et al*. Polypharmacy and injurious falls in older adults: a nationwide nested case-control study[J]. *Clin Epidemiol*, 2019, 11: 483-493. DOI: 10.2147/CLEP.S201614.
- [18] Valderrama-Hinds LM, Al Snih S, Chen NW, *et al*. Falls in Mexican older adults aged 60 years and older[J]. *Aging Clin Exp Res*, 2018, 30(11): 1345-1351. DOI: 10.1007/s40520-018-0950-9.
- [19] Hoel RW, Giddings Connolly RM, Takahashi PY. Polypharmacy management in older patients[J]. *Mayo Clin Proc*, 2021, 96(1): 242-256. DOI: 10.1016/j.mayocp.2020.06.012.
- [20] 赵晨曦, 朱文斐, 孙方君, 等. 老年人身体活动及久坐时间与静态平衡能力的相关性[J]. *医用生物力学*, 2022, 37(5): 839-845.  
Zhao CX, Zhu WF, Sun FJ, *et al*. Correlation of physical activity, sedentary time with static balance ability in the elderly[J]. *J Med Biomech*, 2022, 37(5): 839-845.
- [21] 王疆娜, 杨敬暖, 周亭, 等. 有跌倒经历老年人静态及动态平衡能力特征研究[J]. *湖北体育科技*, 2019, 38(5): 423-426. DOI: 1003-983X(2019)05-0423-04.  
Wang JN, Yang JN, Zhou T, *et al*. Static and dynamic balance ability among the elderly with fallen history[J]. *Hubei Sports Sci*, 2019, 38(5): 423-426. DOI: 1003-983X(2019)05-0423-04.
- [22] Hernandez-Guillen D, Tolsada-Velasco C, Roig-Casasus S, *et al*. Association ankle function and balance in community-dwelling older adults[J]. *PLoS One*, 2021, 16(3): e0247885. DOI: 10.1371/journal.pone.0247885.
- [23] Menant JC, Close JC, Delbaere K, *et al*. Relationships between serum vitamin D levels, neuromuscular and neuropsychological function and falls in older men and women[J]. *Osteoporos Int*, 2012, 23(3): 981-989. DOI: 10.1007/s00198-011-1637-7.