The Relationships Between Fall Risk, Depression, Executive Dysfunctions and Daily Life of Older Adults

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Abstract

Background: Falling is a major problem in older adults that may significantly reduce health and quality of life (QOL). Body dysfunctions that include depression, cognitive decline and executive dysfunctions may elevate fall risk and impair daily activities and QOL. Yet, most studies evaluate these body dysfunctions using laboratory measures in clinical settings. The present study aimed to: (1) compare these body dysfunctions between high/low risk fallers (2) examine the relationship between these body dysfunctions among the high risk fallers (3) explore the specific contribution of fall risk as a mediator between depression, executive dysfunctions and daily life.

Methods: Participants were 123 older adults who live in the community. Depression and cognitive status were measured by the GDS-15 and the MoCA. Fall risk was determined by a questionnaire supported by the Time Up and Go test (TUG). Executive functions (EF) were assessed by the BRIEF-A and the aEFPT medication management assessment. Daily activity performance was measured by the Barthel Index of ADL and the Instrumental ADL Scale. QOL was measured by the World Health Organization Quality of Life Brief Questionnaire.

Results: High fall risk was prevalent among 32% of the sample. High risk fallers had significantly lower cognitive level, higher depression, lower EF, lower daily activity performance and lower QOL. Among the high risk group, lower EF as measured in BRIEF-A scales correlated with lower performance of daily activities and lower QOL. SEM model revealed that fall risk mediated between depression, executive dysfunctions and daily life.

Conclusions: Depression and executive dysfunctions are more prevalent in older adults with high fall risk and are significantly related to their daily activity performance and to their QOL. Community fall-prevention and rehabilitation programs should screen for fall risk and related body dysfunctions as expressed during daily activity performance and understand their impacts on people's QOL.

Introduction

Falling is a major problem in older adults. 30–40% of people over the age of 65, who live in the community, fall at least once a year [1]. About half of them fall again in the following year and need long-term care [2]. The high health costs and the severe personal consequences - the injuries, immobilization, the reduced independence in daily activities, and death, turn falls to be a major concern for public health [3, 4]. Based on studies found that some fallers show resilience and maintain or improve functioning [5], factors that underlie resiliency or vulnerability among fallers should be identified. Early screening of body dysfunctions and related restrictions in daily activities that predict falls may assist in elevating awareness to fall risk and improve prevention programs [6].

It is known that frail older adults are at greater fall risk. Other geriatric syndromes such as depression are more prevalent among people aged 65 and above with a history of falling. Depressive symptomatology has been even identified as a risk factor for falls, independent of antidepressant use [9]. Depression is also known to be related to executive dysfunctions in the elderly [2, 7, 8].

The relation between falls, depression and executive dysfunctions is explained via changes that occur in biochemical mechanisms and in structures of the aged brain - the gray matter loss in somatosensory and motor areas, the prefrontal and the inferior parietal cortices [10], the loss of complexity of the neuronal connections [11] that impact motor, emotional and cognitive abilities [9, 12, 13].

The high cognitive abilities named executive functions (EF) are responsible for the individual's controlled, goal-oriented behavior [14]. Thus, EF are essential for motor function, emotional regulation, for daily activity performance and for maintaining an active lifestyle [15, 16]. Attention problems and uncontrolled goal-oriented behavior may significantly impair postural control and the maneuver around obstacles in the environment [17, 18]. Brain imaging studies showed that the increased connectivity within the executive network mediated between the caudate head gray matter volume and fall risk via attentional changes among people with Parkinson's Disease (PD) [19]. Other studies found that EF deteriorate prior to, or at the same time as physical performance [15, 20] suggesting that EF are also associated with fall risk in the older adults with no PD.

The frequent combination of reduced balance, impaired emotional status and executive dysfunctions may have far reaching impacts on older adults' daily life – they may decreased independence in Basic/Instrumental Activities of Daily Living (BADL/IADL) [21] and significantly reduce quality of life [3, 22–24]. Yet, a1 lack of information exists about the relationship between falls and depression in non-institutionalized older adults [2].

Several important points may be drawn from the literature: first, it is critical to elucidate key factors that contribute to loss of functioning as well as to resiliency. Second, being key factors in fall risk, the causative relationships between depression, EF, falls and daily function should be further explored. As for example: if depression is related to executive dysfunctions in the elderly, and both negatively impact daily activity performance, how does the fall risk affect this impact? Do older adults with depression, executive dysfunctions and higher fall risk differ in their daily activities' performance from those with only depression and executive dysfunction?

Moreover, when referring to daily activity performance - many studies use laboratory or neuro-psychological assessments. For example, EF are frequently evaluated by measures such as the Trail Making Test (TMT) [25], phonological fluency test (PF) [26]; Rey-Osterrieth Complex Figure test (ROCF) [27]. These measures refer to specific EF components and do not necessarily provide a thorough understanding of the impairments in real life. Information gathered from performance-based assessments with ecological validity in which task is the central part is missing. Using such tools may elaborate the knowledge about the individual's performance in real life [28] and express the precise manner in which balance-emotional-cognitive difficulties affect daily function. Moreover, by recognizing deterioration in emotional-cognitive/EF aspect during daily activity performance in routine lives, early intervention may be provided and minimize fall risk.

This approach is supported by the International Classification of Functioning Disability and Health (ICF) of the World Health Organization (WHO) [29]. According to this model, disability is no longer determined by body dysfunctions but by their interaction with the person's ability to perform daily activities. Moreover, performance of daily activities as well as quality of life are the main outcomes of intervention efficiency [30].

Since falls, depression and cognitive decline are usually recognized and detected in primary care, adequate and timely treatment is not always available, it is essential to elevate the awareness of older people, families and health care givers to emotional-cognitive early signs of falls and recognize them while older people perform daily life activities.

Based on the above, the aims of the present study were to: (1) examine fall risk prevalence among older adults living in the community. (2) compare depression, cognitive level/ executive functions, daily activity performance and QOL between high and low fall risk groups (3) Knowing that body functions such as cognitive level/ executive functions and depression may affect daily activity performance and QOL in the older age, this study aimed to explore what is the specific contribution of fall risk as a mediator between these body functions, daily activities and QOL.

Methods

Participants

This study included 123 old adults, aged 65–95 years, who lived in the community. Inclusion criteria: people who were not institutionalized in social or health centers, with no severe depression according to the Geriatric Depression Scale (GDS) [31]; people who scored 14 and above in the Montreal Cognitive Assessment (MoCA) [32] and were able to understand the study purpose, procedures and to sign the informed consent form. People with chronic illnesses such as high blood pressure, diabetes, osteoporosis, osteoarthritis, or urinary incontinence were included in the study. Most participants were using medications regularly (n = 112, 91.1%). Exclusion criteria: people with severe diseases such as Parkinson's Disease, Muscular Dystrophy, cancer, Dementia, severe and acute orthopedic limitations affecting function, significant visual impairments and those who were restraint to wheelchair or bed. Participants' socio-demographic information is included in table 1.

Instruments

Demographic and health status questionnaire, which also included the participants' current medication uptake.

Depression and cognitive status were measured by:

The Geriatric Depression scale, GDS-15 [31]- a self-report with 15 dichotomic items (yes/no questions) for screening depression in older adults. The total score ranges between 0-15 points. A higher score indicates more symptoms of depression. A score of ≥6 indicates a need for a thorough medical/psychiatric assessment. A score of ≥11 is considered a cutoff for indication of depression, and a higher score indicates higher depression severity.

The Montreal Cognitive assessment (MoCA) [32] - this short screening tool profile cognitive status. The areas of examination are visuo-spatial abilities, executive functions, attention, language, short term memory and orientation. Total score is achieved by summing the correct answers, up to a maximum of 30 points. The test is highly sensitive in identifying people with Mild Cognitive Impairment (MCI) (83%-90%) [32]. Based on an 8411 sample, Lu [33] noted that the appropriate cut of score for people without MCI or dementia and without formal education is 13/14. Since our study included participants with and without formal education, the MoCA cutoff score in the current study was set at ≥14.

Assessment of fall risk was based on a questionnaire supported by a clinical examination:

Based on the Israeli Ministry of Health (https://www.health.gov.il/PublicationsFiles/FallPreventionNationalProgram.pdf) [34], fall risk was determined according to two parameters:

(a) *A questionnaire* – that gathers information about the number of falls during the last year; information about fractions and significant injuries caused by falls; information about walking or stability difficulties.

(b) *Time Up and Go test (TUG)* [35]– this clinical examination measures mobility and lower extremity functions and is used as a screening tool for fall risk. The subject is requested to get up from a standard chair, without using upper extremity support, and walk three meters ahead in a regular pace. Then turn around and walk back to the chair and sit down. The subject can use a walking aid if needed. Rather that, no physical assistance is given throughout the test, but the examiner follows the participant in order to avoid any falling incidence. The test is carried out twice, but only the second round is scored. The score is the performance time in seconds measured by a stopwatch. Shorter performance time indicates better performance. A performance time longer than 13.5 seconds indicates fall [36].

In the present study, the high-risk group was defined when one of the three occurs: 1-the participant fell twice or more during the last year, 2-the participant had one fall during the last year with a significant injury, 3-the participant had one fall during the last year and a TUG score longer than 13.5 seconds.

Assessment of EF by a self-report and a performance-based assessment:

(a) *The Behavior Rating Inventory of Executive Function–Adult Version (BRIEF-A)* [37] which screens for possible executive dysfunction and indicates individuals' awareness of their own self-regulatory functioning. The BRIEF-A assesses everyday behaviors associated with specific domains of EF in adults that are summarized into two index scales: Behavioral Regulation Index (BRI) and Metacognition Index (MC) and a scale reflecting overall functioning (Global Executive Composite [GEC]). The BRI is composed of four scales: Inhibit, Shift, Emotional Control, and Self-Monitor. The MI is composed of five scales: Initiate, Working Memory, Plan/Organize, Task Monitor, and Organization of Materials. Behavior frequency is rated on a Likert Scale ranging from "rare" to "often". Raw scores are transferred into T scores (M=50, SD=10). T scores at or above 65 reflect executive dysfunction.

(b) *The medication management subtest of The Alternate Executive Function Performance Test (aEFPT)* [16]– this an addition part of the valid performance-based EFPT assessment which measures EF while carrying out a daily task. The subjects' functional independence level and the amount of help required in these tasks are also recorded. The four original EFPT tasks are: cooking an oatmeal, telephone use, taking medication and paying a bill (Lysack, Neufeld, Mast, MacNeill, & Lichtenberg, 2003). The aEFPT has four additional tasks - similar to the four original tasks but with a novel component to prevent a learning effect from the original form. In the medication management subtest – subjects are asked to sort medications into a 7-day pill sorter instead of taking a medication as requested in the original form [16]. The instruction is to find and sort medicines in a weekly pill

sorter. For a successful performance, the subject has to ignore distractors (other bottles) and use prospective memory to follow the specific sorting instructions. In this study the medication management task was chosen since it is a daily common function among older adults, which does not require special facilities (like a stove top for cooking pasta, which is one of the subtests) and is relatively short in time.

The scoring refers to five executive functions: initiation, organizing, sequencing, safety and judgment and completion. Each component is scored on a scale of 0-5 points, according to the level of assistance required in order to complete the task: 5- Doing for participant, 4- physical assistance, 3- verbal direct instruction, 2- gestural guidance, 1- verbal guidance, 0- independent. The score for the full task ranges between 0-25, a higher score indicates more required assistance [16,38].

Daily life measures:

(a) The Barthel Index of ADL [39]– which measures the performance of Basic Activities of Daily Living (BADL) in ten functional domains: eating, bathing, dressing, bowl and bladder control, personal hygiene, transfers, walking on straight surface and stair climbing. Item scores in 5-point intervals (0-15), depending on the level of assistance the participant requires. Total score range is 0-100, where higher score indicates better functional ability.

(b) Instrumental Activities of Daily Living Scale (IADL) [40]- this interview-based functional assessment consists of eight components: telephone use, shopping, food preparing, housekeeping, laundry, transportation use, responsibility for personal medication and money. Item scoring ranges between 0-3 or 0-4, according to the amount of assistance the participant requires. Total score ranges between 0-20, where higher score indicates better functional ability.

(c) The World Health Organization Quality of Life Brief questionnaire (WHOQOL-BREF) [41] – this is an abbreviated 26 item version of the WHOQOL-100 which is the gold standards for measuring quality of life in four domains: physical, psychological, social relationships and environment. Scores in each domain range from 0 to 100. Higher score represent higher quality of life.

Procedure

The research was authorized by the Ethics Committee of the Faculty of Social Welfare and Health Sciences, University of Haifa and Ono Academic College, Israel. Advertisements calling to participate in the study were published in neighborhoods in day care centers in the central Israel. Those who agreed to participate in the study, contacted the study conductor by phone. In this phone call they answered some questions to verity inclusion criteria. With those who answered the inclusion criteria, a meeting was set in their homes or in the day care center (after obtaining the approval of the management of day care centers). In the first meeting each participant signed an informed consent and continued to complete the evaluation battery – first the demographic and health status questionnaire, then the MoCA, The fall questionnaire, TUG test, and then the GDS, BRIEF-A, the aEFPT - medication management task, the ADL questionnaires and the WHOQOL-BREF. In case the participant got tired during the battery completion, the meeting was stopped, and a second meeting was set, to avoid exhaustion and complete the evaluations.

Data Analysis

All the analyses were performed using the Statistical Package for Social Sciences (SPSS) for Windows 25.0. T-tests, ANOVA and MANOVA examined whether significant differences existed between groups in all subscales / total scores of the dependent measures. Pearson correlation test examined the correlations between the dependent measures in the high fall risk group.

Structural Equation Modeling (SEM) was used to examine the relationships between age, education, depression, executive functions, performance of activities of daily living, health related quality of life and fall risk. The model examined the role of fall risk in mediating between all other parameters and daily life – in terms of ADL performance and QOL. For that, fall risk was calculated as a continues parameter and the examination was performed on the general sample. The following different fit indices were tested: the Goodness-of-Fit Statistic, Goodness-of-Fit Index (GFI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Standardized RMR, and Comparative Fit Index (CFI). Chi-square was used for nested models comparison.

The level of significance was set at .05.

Results

In the present sample, high fall risk was prevalent among 32% of the sample.

Participants with high fall risk were slightly older than those with low fall risk, had fewer years of education, lower cognitive status, higher depression level, more executive dysfunctions – as manifested in performance based assessment (EFPT) and in the self-report -BRIEF-A (the largest difference was in working memory), more restrictions in basic/instrumental ADL and lower QOL (see table 2). Gender was not found to differ between both groups.

As presented in Table 3, better cognitive level, as assessed by MoCA correlated only with better performance in IADL. Depression level correlated with worse QOL, in all measured domains. Most of BRIEF-A scales correlated with BADL, IADL and all QOL domains, where lower executive functions correlated with lower performance of daily activities and lower QOL.

For examining the role of fall risk in mediating between body dysfunctions and daily life, fall risk was calculated as a continues parameter that included the TUG score ("0"= no risk or "1"= fall risk) plus the summary of the fall questionnaire scores. The range of the fall risk score was 0–10 (mean 2.33 ± 2.53).

Then the correlations between the continues fall risk score and the other variables were examined. Higher fall risk score significantly correlated with elevated age (r = .34, p < .0001), lower years of education (r=-.35, p < .0001), higher depression (r = .34, p < .0001), lower cognitive level (r=-.31, p < .0001) and lower total QOL (r=-.41, p < .0001).

Based on these significant correlations, the variables were entered to the SEM model.

The SEM model revealed good fit indices: χ^2 (25) = 38.275, p = .04; CFI = .97; NFI = .93, RMSEA = .06.

There was a significant correlation between age and number of education years (r=-.32, p < .0001) as well as between age and depression (GDS) (r = .34, p < .0001).

Age was directly related to aEFPT Medication Management score (β = .18, p = .03) and to lower performance in IADL (β=-.25, p < .0001)– older adults had lower education, higher depression, reduced EF and restricted IADL.

Higher depression level (GDS score) correlated with lower number of education years (r=-.39, p < .0001) and was directly related to lower Meta-Cognition and behavioral regulation (based on BRIEF-A) (β = .55, p < .0001; β = .42, p < .0001, respectively) and to lower performance in IADL (β=-.23, p < .0001) – people with higher depression were less educated, had reduced EF and lower performance in IADL.

Lower Meta-Cognition (based on BRIEF-A) was directly related to higher risk fall and lower QOL (β = .34, p = .005; β=-.31, p < .0001, respectively).

Worse performance in aEFPT Medication Management score was directly related to lower number of education years (β=-.37, p < .0001) and to higher fall risk (β = .32, p < .0001).

Fall risk was directly related to lower performance in BADL and IADL (β=-.41, p < .0001; β=-.34, p < .0001) and to lower QOL (β=-.13, p = .05).

Fall risk did not mediate between BRIEF-A-BRI and BADL/IADL; BRIEF-A-BRI and QOL.

However, aEFPT Medication Management and meta-cognition in BRIEF-A were mediated to ADL and QOL by fall risk as follow: aEFPT and IADL (standardized indirect effect=-.10) (95% CI: − .23−.04, p < .001); aEFPT and BADL (standardized indirect effect=-.13) (95% CI: − .28−.04, p < .001); aEFPT and QOL (standardized indirect effect=-.04) (95% CI: − .11−.003, p = .03); BRIEF-A-MI and IADL (standardized indirect effect=-.11) (95% CI: − .24−.03, p = .003); BRIEF-A-MI and BADL (standardized indirect effect=-.14) (95% CI: − .29−.04, p = .004); BRIEF-A-MI and QOL (standardized indirect effect=-.04) (95% CI: − .13−.002, p = .04); (see Fig. 1). The model explains 27% of the fall risk, 17% of the performance in BADL, 34% of the performance in IADL and 55% of total QOL.

To summarize, in older adults fall risk has a significant role in mediating the association between depression, executive dysfunctions and daily life – as reflected by reduced performance of basic and instrumental ADL and in lower health related quality of life.

Discussion

This study examined the fall risk prevalence in older adults who live in the community. In line with the ICF model, this study examined the relationship between fall risk, other known geriatric body dysfunctions: depression; cognitive decline/executive dysfunctions, daily activity performance and QOL. The unique aspect of this study is that it combined the use of standard self-reports, clinical observation and performance-based assessments with ecological validity to understand the expressions of the body dysfunctions in daily situations.

Although this study referred to older adults who are relatively functional, about one third of them had high fall risk and significantly worse body dysfunctions that those with low fall risk. This was reflected in depression, lower cognitive status, lower executive functions, restricted ADL and lower QOL.

The findings of the present study support previous reports. The relationships between fall risk, depression and reduced executive dysfunctions, were explained by the less efficient cortical information processing and reduced attentional resources of the aged brain. The literature also supports the relationships found in the present study between these body dysfunctions and the personal-socio-demographic factors: depression was found to be more frequent in people with a medium-low socioeconomic status, with higher disability and comorbid conditions [22, 42–45]. Hence, fall-prevention programs in the elderly community should pay special attention to specific populations.

Yet, while a relatively large part of the studies about EF and falls have used traditional assessments in clinical settings and referred to particular domains of EF (e.g. inhibition, working memory) [5, 15], the present study used measures that reflected the executive dysfunctions in daily life– by using the BRIEF-A self-report and the performance-based aEFPT medication management test. The results showed that the greatest difference in EF between individuals with high fall risk and those with low fall risk was in BRIEF-A-working memory domain. Earlier reports mentioned that attention and memory are more affected by age and have greater impacts on posture control [22]. Moreover, EF were found to mediate the association between changes in memory and reduced performance in IADL [46].

These results are supported by the correlations presented in Table 3 - while cognitive level assessed by MoCA was not found to correlate with QOL, all BRIEF-A scales significantly correlated with almost all QOL domains, probably because of the ability of the BRIEF-A to reflect the dysfunctions as expressed in real life. These correlations also emphasize the far- reaching impacts of the combination of both executive dysfunction and fall risk in decreasing people's QOL. In order to better understand these relationships, the present study explored the specific contribution of fall risk to the relation between EF and daily activity performance, using the SEM model. Interestingly, not only that depression and reduced EF restrict the ability of older people to perform daily activities and experience good QOL, but the elevated fall risk augmented these restrictions significantly.

According to the SEM model, fall risk mediates between executive dysfunctions- and mainly meta-cognitive (MI) abilities, daily activity performance and QOL. First, MI components such as initiation, working memory, planning, monitoring and organization are more essential for motor planning, motor control and for overcoming obstacles in the environment. Second, an important aspect included in meta-cognition is awareness [47]. Awareness is critical for motor performance in the challenging environments, especially for older adults. Awareness is a key factor in cognitive rehabilitation. Awareness strategies are used to improve daily activity performance in populations with disabilities [48, 49]. Hence, prevention and intervention programs for minimizing falls in older adults, should screen for EF problems and give special attention to the individual's meta-cognition, elevate the awareness to self-performance and to environmental context and cues (Burgess et al., 2006).

To achieve optimal intervention outcomes and in line with the ICF model, clinicians should gather information not only from isolated tasks in a lab setting, but from tasks that imitate daily life scenarios (Chaytor et al., 2006; Odhuba et al., 2005), with referral to the environmental context where the regulation of balance takes place [18]. With this information, clinicians may

improve the choice of the best-adapted behavioral strategy [16, 28]. For example, how to approach the activity in the certain environment, how to compensate the slow reaction time, or the physical difficulties [3], what environmental adaptations should be performed to enhance the adaptive responds to environmental demands at home or in the community [50].

Conclusions

Fall risk should be routinely screened among older people who live in the community and involvement in physical activity should be encouraged [51]. Moreover, health services should note that although older people's ability to function in daily activities is related to their emotional/cognitive/EF status affect, good balance and low falling tendency play a major role in this relationship. Hence, fall prevention and intervention programs should understand the impacts of these body dysfunctions on daily life [52], and look for impaired emotional-cognitive cues as expressed in daily activity performance of older people, in their natural environment. These cues may serve as red lights that predict the next fall and thus lead to early fall risk evaluation and intervention when needed. For that, intervention programs should be based on a multi-disciplinary approach, and apply models such as the ICF that were found to be relevant to fall rehabilitation [53]. Intervention should apply performance-based ecological assessments to map body dysfunctions that predict falls in real life context. By that intervention will be more directed to the person's specific needs, interests, resilience and vulnerability and promise better results in terms of enhanced daily function and better QOL.

This study has some limitations: it referred to a specific part of the population – older adults, who live in the community. The distribution of participants in each group – high/low fall risk was not equal. This study did not examine the role of concern about falling. Additional studies should refer to older adults who live in other settings such as nursing homes, examine the differences between men and women, use larger sample sizes to examine group differences. Cohort studies are also recommended in order to better understand aging impacts on falls, related body dysfunctions and expressions in people's daily function and life experience.

Abbreviations

Quality of life (QOL)

Executive functions (EF)

Basic/Instrumental Activities of Daily Living (BADL/IADL)

International Classification of Functioning Disability and Health (ICF)

World Health Organization (WHO)

Geriatric Depression Scale (GDS)

The Montreal Cognitive Assessment (MoCA)

Time Up and Go test (TUG)

The Behavior Rating Inventory of Executive Function–Adult Version (BRIEF-A)

Behavioral Regulation Index (BRI)

Metacognition Index (MC)

Global Executive Composite (GEC)

The Alternate Executive Function Performance Test (aEFPT)

Structural Equation Modeling (SEM)

Declarations

- Ethics Approval and Consent to Participate: the study was performed based on the ethics approval of the Ethics Committee of the Faculty of Social Welfare and Health Sciences, University of Haifa (number 007/18) and Ono Academic College, Israel, and after participants singed the written consent to participate in this study.
- Consent for publication – Not Applicable.
- Availability of Data and Materials - The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.
- Competing interests – The authors declare no competing interests.
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Tables

Table 1.

Comparing socio-demographic parameters, cognitive status, depression, executive functions, performance of activities of daily living and quality of life between groups

	Total sample	Low fall risk (n=84)	High fall risk (n=39)	p
Age (years, mean±SD)	78.63±7.57	77.81±7.66	80.74±6.99	0.05
Gender - men (%)	41.5	70.6	29.4	NS
Widows (%)		29.8	53.8	0.01
Living alone (%)	38.2	65.1	34.9	0.017
Years of education (mean±SD)	14.73±2.71	13.77±4.37	10.74±4.43	0.05
Moderate/ poor socio-economic status (%)	35	27.4	51.3	0 .010
Frail (%)	38	12.7	50	0

# Qualitative variables: Chi-square test; Quantitative variables: T-test
NS=not significant

Table 2.
Comparing depression, EF, ADL and QOL between high/low risk fallers

		Low fall risk (n=84)	High fall risk (n=39)	
		mean±SD	mean±SD	Statistic Significance of differencesbetween high/low risk fallers#
MoCA		23.29±3.74	20.94±4.11	0.003
Depression (GDS) (mean±SD)		2.76±2.78	3.85±2.73	0.05
aEFPT Medication Management		2.21±2.84	4.22±4.63	0.05
BRIEF-A	Inhibition	49.25±9.21	51.53±9.97	NS
	Shift	55.23±12.17	60.05±15.55	NS
	Emotional control	54.62±13.35	61.81±15.54	0.01
	Self-monitor	45.17±8.13	49.14±11.21	0.03
	Initiate	51.23±10.11	55.54±16.26	NS
	Working memory	55.98±12.83	64.53±16.72	0.003
	Plan/organize	54.44±11.83	57.61±15.19	NS
	Task monitor	51.81±9.85	55.28±13.24	NS
	Organization of materials	50.68±12.97	52.25±12.98	NS
	BRI	41.30±8.88	45.51±10.95	0.01
	MI	56.97±12.16	61.60±15.97	0.05
	GEC	97.82±19.32	107.11±25.83	0.02
BADL		97.82±6.14	92.01±10.65	0.004
IADL		19.62±4.17	16.23±5.81	0.003
QOL	Physical	69.29±18.83	54.79±20.93	0
	Psychological	75.46±16.52	68.43±18.58	0.04
	Social	76.24±18.25	71.91±20.52	NS
	Environmental	76.52±14.68	69.54±15.68	0.02
	Total	74.37±14.17	66.16±16.27	0.006

Quantitative variables: T- test, ANOVA, MANOVA; NS=not significant

BRIEF-A-MI components are marked in Italic

Table 3.

The significant correlations between cognitive level, depression, executive functions and QOL in the high fall risk group

		BADL	IADL	Physical QOL	Psychological QOL	Social QOL	Environmental QOL	Total QOL
MoCA			.513**					
Depression (GDS)				-.423* *	-.633** *	-.537** *	-.517** *	-.617** *
BRIEF-A	Inhibition							
	Shift			-.555* **	-.647* **		-.474**	-.565** *
	Emotional control			-.479**	-.524** *		-.450**	-.515**
	Self-monitor	-.440**	-.384*	-.478**	-.423*		-.384*	-.408*
	Initiate	-.517***	-.521***	-.647***	-.558***		-.519***	-.592***
	Working memory			-.582***	-.538***	-.371*	-.491**	-.583***
	Plan/organize	-.493**	-.506**	-.704***	-.618***	-.390*	-.616***	-.683***
	Task monitor		-.341*	-.577***	-.490**		-.588***	-.563***
	Organization of materials	-.374*		-.384*	-.449**		-.422**	-.419**
	BRI	-.353*	-.346*	-.530***	-.558***		-.465**	-.520***
	MI	-.435**	-.438**	-.663***	-.610***	-.349*	-.602***	-.651***
	GEC	-.419*	-.418*	-.635***	-.614***		-.569***	-.623***

*p<.05

**p<.01

**p<.001

Figures
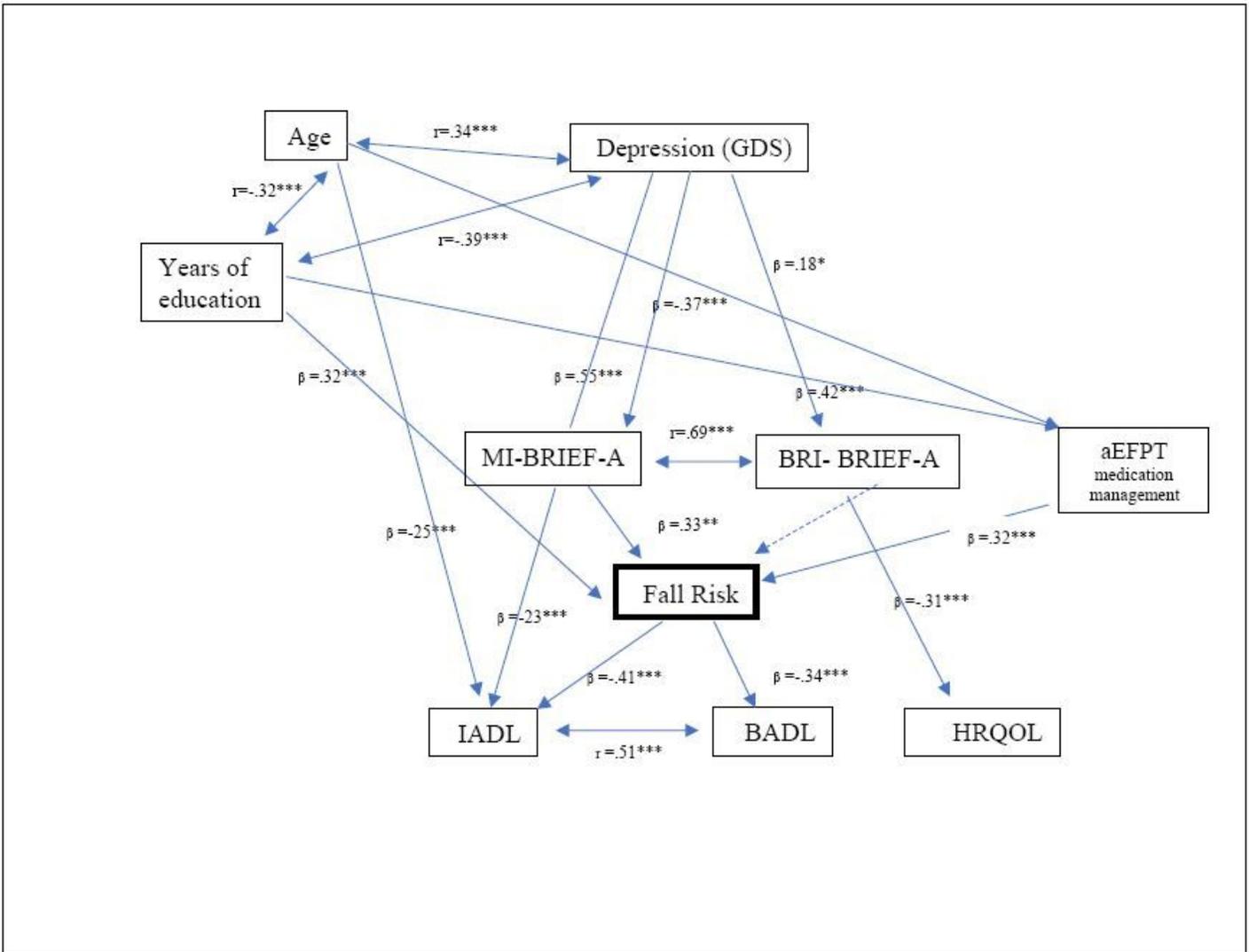
Figure 1

Structural equation modeling – fall risk medicate the association between executive dysfunctions and daily life *p≤.05; **p≤.01; ***p≤.001 GDS=The Geriatric Depression Scale; BRIEF-A= The Behavior Rating Inventory of Executive Function–Adult Version ; aEFPT= The Alternative Executive Function Performance Test; MI=meta cognition; BRI=behavioral regulation index; BADL = Basic activities of daily living; IADL = instrumental activities of daily living; HRQOL = Health related quality of life; Dashed line = non-significant effect