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Time orientation and executive functions in the prediction of mortality in the elderly: Epidoso study

ABSTRACT

OBJECTIVE: To analyze the predictive ability of a functional cognitive index of mortality in the elderly.

METHODS: Cohort study performed with 1,667 elderly individuals aged more than 65 years and living in the city of São Paulo, Southeastern Brazil, between 1991 and 2001. Functional cognitive index was constructed from time orientation and executive functions (going shopping and taking medication), controlled by sociodemographic variables, life habits, morbidity, self-perception of health, hospitalization, edentulism and social support. Deaths occurred during this period were analyzed with family members in home interviews, notary public offices and records from the Fundação Seade (State System of Data Analysis Foundation), until 2003. Crude and adjusted relative risks were calculated with their respective 95% confidence intervals, using bivariate and multiple analysis with Poisson regression and $p < 0.05$.

RESULTS: In the final multivariate model, the following independent risk factors were identified by the index: partial loss of time orientation or executive functions (RR=1.37; 95% CI: 1.03;1.83); total loss of orientation and partial loss of functions (RR=1.71; 95% CI: 1.24;2.37); partial loss of orientation and total loss of functions (RR=1.76; 95% CI: 1.35;2.28); and total loss of orientation and functions (RR=1.64; 95% CI: 1.30;2.06). As regards health conditions, the following were observed: hospitalization (RR=1.45; 95% CI: 1.22;1.73); diabetes (RR=1.20; 95% CI: 1.00;1.44); and total edentulism (RR=1.34; 95% CI: 1.09;1.66). Monthly contact with relatives was identified as a protective factor (RR=0.83; 95% CI: 0.69;1.00).

CONCLUSIONS: The Functional Cognitive Index can help clinicians and health planners to make decisions on strategies for follow-up and prevention of treatable causes of cognitive deficit and functional loss to reduce mortality in the elderly.

DESCRIPTORS: Aged. Cognition. Time Perception. Activities of Daily Living. Cohort Studies.

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Received: 8/4/2008
Revised: 8/22/2009
Approved: 10/2/2009

INTRODUCTION

The association among cognitive state, functional capacity and mortality in the elderly is well known in the literature.^{1,2} Good cognitive and functional conditions reduce the risk of death, despite the presence of comorbidities.^{3,18-20} The Mini-Mental State Examination (MMSE) and the *Questionário Brasileiro de Avaliação Funcional Multidimensional* (BOMFAQ/OARS – Brazilian OARS Multidimensional Functional Assessment Questionnaire), adapted from the Older Americans Resources and Services questionnaire, both validated in Brazil, are indices used to measure cognitive state and functional capacity in the elderly, respectively. Several studies on elderly health^{2,4,15,20,21} have used these parameters to distinguish determining factors for healthy aging, once they are indirect, although sensitive, measures of risk of death.

Cognitive impairments are very prevalent in the elderly, although usually having a treatable cause. Likewise, transitions from poorer to better states of functional capacity are frequent in this population.⁷ This emphasizes the choice for these changeable factors when assessing risk of death in the elderly.

Executive functions are the most complex components of functional capacity, being responsible for organizing information, setting objectives, maintaining control of changeable environmental circumstances, foreseeing possibilities and changing objectives and plans in a coherent way. Brain regions that enable executive functions are the last to mature, usually not before early adulthood. During their development, executive functions become progressively more connected to domains of knowledge about facts, numbers, words and images and are applied to behavior linked to goals, management, learning and critical awareness.¹¹ Both age and the presence of chronic diseases are associated with possible losses of executive functions.^{22,23} On the other hand, these functions enable learning and organization throughout life. Assessment of executive functions can be done independently of the educational level.

Orientation to time is also an early marker to access cognitive impairments with high specificity and lower dependence on the level of education than other tasks, such as attention and calculation, spatial orientation, language and drawing; thus providing stable scoring^{24,25} that can be compared to executive functions.

The objective of present study was to analyze the ability of a functional cognitive index to predict mortality in the elderly.

METHODS

Data from the study entitled “*Epidemiologia do Idoso*” (Epidoso – Elderly Epidemiology),^a performed in a residential area of the city of São Paulo, Southeastern Brazil, were analyzed in this article. Epidoso was the first longitudinal study in Latin America that aimed to identify factors associated with healthy aging and risk factors of mortality and functional incapacity in community-dwelling elderly.¹⁸⁻²⁰ Participants were followed by qualified interviewers for ten years, in four waves of household surveys. The first survey was conducted in 1991/1992, the second in 1994/1995, the third in 1998/1999, and the fourth in 2000/2001.

The geographical area selected was the district known as “Saúde”, one of the 55 districts of the city of São Paulo. Participants were selected using the census conducted in 52 census tracts of this district, which identified all residents aged more than 65 years as eligible for this study, of which 1,667 were interviewed in 1991-1992. Home interviews followed a structured questionnaire, adapted from the BOMFAQ/OARS, previously used in cross-sectional studies with elderly residents of São Paulo.¹⁸⁻²⁰ The instrument collected information about socioeconomic and demographic characteristics, informal support (not provided by the government or specialized institutions), level of independence in daily life activities (functional capacity), chronic diseases, mental health, cognitive state (MMSE) and self-perception of health. The period analyzed was between the first survey (1992) and the end of the collection for identification of deaths. Surveys were conducted in notary public offices and in the online archives of the *Fundação Seade* (São Paulo State Data Analysis System Foundation) between 2000 and 2003.

In the present analysis, data on mortality were obtained by interviewers in the other three successive waves of household surveys, in addition to a telephone contact and review of death certificates from notary public offices until 2000. Moreover, from this year until 2003, EPIDOSO mortality data were obtained from the *Fundação Seade* archives. A total of 544 deaths were identified (32.6% from the 1991/1992 initial cohort) until 2003. It was not possible to obtain information about the vital status of 134 elderly individuals (8.0%), who were thus excluded from the analysis.

Variables potentially associated with mortality were classified as: sociodemographic, self-perception of health, morbidity, life styles or habits, social support and Functional Cognitive Index (FCI) of orientation to time and executive functions.

^a This ongoing study has been performed by the *Centro de Estudos de Envelhecimento da Escola Paulista de Medicina da Universidade Federal de São Paulo* (São Paulo Federal University School of Medicine Center for Aging Studies) since 1991.

The FCI was conceived to integrate the concepts of cognition and functional capacity. It is of simple execution and capable to organize healthcare into a hierarchy, based on the risk of death of each group identified. The FCI was obtained from five questions about orientation to time from the MMSE and two questions from the BOMFAQ/OARS that fit into the concept of executive functions and which were representative of autonomy and independence (going shopping and taking medication at the right time and without help).

As regards the “functional capacity” variable, which comprised the FCI, questions about more complex executive-function-related instrumental activities of daily living (IADL) were selected.

This selection was also based on a model of loss of functional capacity, proposed by Ramos,¹⁸ and on a new proposal of a hierarchy of cognitive state and functional capacity, based on growing levels of complexity proposed by Xavier,²⁶ in addition to geriatric criteria of autonomy and independence.

Selection of the “orientation to time” variable (capacity to be oriented in time as measured by calendars)^{24,25} to be included in the FCI was made from the analysis of multiple discriminating capacity of MMSE sub-items, using a response variable with Bernoulli group distribution (1/10).⁸ To achieve this, data from the first (1991-1992) and second surveys (1993-1994) of the *Estudo Epidioso* were used. The following MMSE items were tested: orientation to time, spatial orientation, recall, calculation, language and complex commands.

Orientation to time, spatial orientation and serial sevens (calculation) were categorized as: 4/5 correct responses, 2/3 correct responses, 0/1 correct responses. Registration, language and complex commands were categorized as: was able to answer – yes/no. Recall memory was categorized as: was able to recall three objects, two objects, one object or no objects.

The following statistical parameters were used: correctly predicted percentage, sensitivity and specificity of model. First, a model with all MMSE items was designed and its discriminating power verified. Next, a model of each item was designed and individual parameters of each item were compared to the parameters of the complete model with all items, seeking to identify the item(s) that best discriminated the total MMSE score.

MMSE score equal to or below 24 points was considered as cognitive loss.²⁰ The discriminating capacity was tested in terms of cognitive loss in two moments: during the same survey (1991-1992) and two years later (1993-1994).

As regards the 15 daily life activities assessed by the BOMFAQ/OARS, the following basic non-instrumental activities, not associated with executive functions, were

excluded: lying in/getting up from bed, eating, combing hair, walking on a level surface, taking a shower, getting dressed, going to the bathroom in time, going up (one flight) of stairs, and clipping nails. After the analysis of all variables associated with executive functions, those less related to gender were selected: preparing meals is an instrumental daily life activity more associated with women, especially elderly ones, once activities such as house cleaning and taking public transportation can be strongly influenced by physical and sensory limitations, in addition to economic ones. Finally, two executive functions were selected, representative of an independent and autonomous life in the community and also able to be simulated or compensated in digital environments with the purpose of rehabilitation: taking medication at the right time and going shopping.

The discriminating capacity of the “going shopping” and “taking medication at the right time” variables (executive functions) was tested by BOMFAQ/OARS¹⁸ for functional loss of up to two instrumental daily life activities in the same survey (1991-1992) and two years later (1993-1994).

From this conceptual basis, a preliminary FCI with nine possibilities was constructed from the finest (00) to the worst (22) functional and cognitive state (Table 1). Some preliminary FCI categories did not show significant association with risk of death (categories “20”, “10” and “02”). These categories were recombined with category “01”, which shared the fact that at least one of their components (orientation to time or the ability to go shopping and taking medication alone) was preserved (represented by “0”). Thus, the FCI was created with six categories, which, when tested, were significantly associated with risk of death in all categories.

After the discriminating analysis and use of geriatric criteria to construct the FCI, bivariate and multivariate analyses were performed. Associations between the proportions of elderly individuals who had died were tested, according to categories of variables of interest and using Pearson chi-square test or linear trend chi-square, when applicable, to a 95% significance level ($p < 0.05$).

Crude and adjusted relative risks and their respective 95% confidence intervals were calculated using Poisson regression, aiming to identify the best set of predictive variables of mortality and to test the FCI predictive ability. In the multiple model, all variables with $p < 0.05$ in the bivariate analysis were tested. Variables were included one by one to construct the model, with $p < 0.05$ as criterion of inclusion and maintaining a criterion of variables of $p < 0.10$ in the following model. Analysis was performed using the Stata 9.0 software.

This study was approved by the Ethics Committee of the *Universidade Federal de São Paulo*, under record

Table 1. Preliminary Functional Cognitive Index designed from executive functions and orientation to time.

Orientation to time	Executive functions		
	Going shopping and taking medication (0)	Going shopping or taking medication (1)	Neither going shopping nor taking medication (2)
Correctly answered 4-5 questions (0)	00	01	02
Correctly answered 2-3 questions (1)	10	11	12
Correctly answered 0-1 question (2)	20	21	22

Table 2. Bivariate analysis of socio-demographic and self-perception of health variables, according to deaths in the elderly. City of São Paulo, Southeastern Brazil, 1991-2001.

Variable	n	Death (%)	RR	95% CI	p
Sex					<0.001
Female	993	30.4	1		
Male	540	44.8	1.47	1.29;1.68	
Age (years)					<0.001
65 to 69	445	22.7	1		
70 to 74	382	29.6	1.30	1.03;1.64	
75 to 79	353	36.5	1.61	1.29;2.00	
80 and more	353	56.9	2.50	2.06;3.04	
Level of education					0.013
Higher and secondary education	428	31.1	1		
Primary education – grades 5 to 8	262	35.5	1.13	0.91;1.40	
Primary education – grades 1 to 4	505	34.5	1.10	0.91;1.32	
Illiterates/able to read and write	338	42.3	1.35	1.12;1.63	
Marital status					0.262
Single	136	30.1	1		
Married	787	34.4	1.14	0.86;1.50	
Widowed	559	37.7	1.25	0.94;1.65	
Divorced	51	41.2	1.36	0.90;2.07	
Ethnicity					0.853
White	1.391	35.7	1		
Mixed (black and white)	30	30.0	0.84	0.48;1.46	
Black	38	39.5	1.10	0.74;1.65	
Asian	66	33.3	0.93	0.65;1.32	
Paid work					0.223
Yes	185	31.4	1		
No	1348	36.1	1.15	0.91;1.43	
Per capita income					0.046
Up to US\$99	474	39.0	1		
US\$100 or more	1006	33.8	0.86	0.75;0.99	
Who do you live with?					0.344
Alone	200	31.0	1		
1 generation	558	34.6	1.11	0.88;1.41	
2 generations	490	36.5	1.17	0.92;1.49	
3 or more generations	285	38.6	1.24	0.96;1.60	

Table 3. Bivariate analysis of variables associated with life conditions, according to deaths in the elderly. City of São Paulo, Southeastern Brazil, 1991-2001.

Variable	n	Death (%)	RR	95% CI	p
Diagnosis of mental disorder					0.001
No	1214	33.1	1		
Yes	295	42.7	1.28	1.10;1.50	
Rheumatism					0.232
No	1014	36.5	1		
Yes	498	33.3	0.91	0.78;1.05	
Asthma					0.184
No	1376	35.0	1		
Yes	154	40.3	1.14	0.93;1.41	
Arterial hypertension					0.184
No	918	34.0	1		
Yes	606	37.3	1.09	0.95;1.25	
Varicose veins					0.400
No	869	34.5	1		
Yes	653	36.6	1.06	0.92;1.21	
Diabetes					0.003
No	1314	34.1	1		
Yes	197	44.2	1.29	1.08;1.54	
Obesity					0.029
No	1266	36.7	1		
Yes	256	29.3	0.79	0.65;0.97	
Stroke					<0.001
No	1448	34.5	1		
Yes	79	51.9	1.50	1.20;1.88	
Urinary incontinence					<0.001
No	1268	32.8	1		
Yes	263	48.3	1.47	1.26;1.70	
Insomnia					0.813
No	957	35.7	1		
Yes	572	35.1	0.98	0.85;1.13	
Cataract					0.183
No	1125	34.5	1		
Yes	393	38.2	1.10	0.95;1.28	

CEP 1663.07. During the entire research development, the ethical principles described by Resolution 196/96 from the *Conselho Nacional de Saúde* (Brazilian Health Council) were followed.

RESULTS

In the discriminating analysis and in relation to the first survey, orientation to time predicted 87.2% of cognitive loss correctly, represented by MMSE equal to or below 24 points, with a sensitivity of 92.0% and specificity of 76.3%. As regards the second survey, conducted two years later, orientation to time predicted 81.1% of cognitive loss, represented by MMSE equal to or below 24 points, with a sensitivity of 86.6% and

specificity of 59.2%. Only orientation to time had the same predictive ability than the complete model with the 30 MMSE questions.

In terms of the first survey, the executive function “taking medication correctly and without difficulties” predicted 57.5% of those with functional loss (more than two ADLs), with a sensitivity of 100.0% and specificity of 35.9%. The executive function “going shopping without difficulties” predicted 60.9% of those with functional loss, with a sensitivity of 100.0% and specificity of 41.1%. As regards the second survey, “taking medication correctly without difficulties” predicted 61.9% of those with functional loss, with a sensitivity of 90.1% and specificity of 16.8%. “Going

Table 4. Bivariate analysis of variables associated with morbidity and Functional Cognitive Index of orientation to time and executive functions in the elderly. City of São Paulo, Southeastern Brazil, 1991-2001.

Variable	n	Death %	RR	95% CI	p
Presence of teeth					<0.001
All/most of them	321	24.6	1		
Only some	367	35.4	1.43	1.13;1.82	
None	842	39.8	1.61	1.31;1.99	
Falls					0.322
No	1046	34.6	1		
Yes	484	37.2	1.07	0.93;1.23	
Hospitalization					<0.001
No	1412	33.7	1		
Yes	114	57.9	1.71	1.44;2.04	
Self-perception of health					<0.001
Excellent	225	23.1	1		
Good	826	34.0	1.47	1.13;1.90	
Poor	395	41.3	1.78	1.36;2.32	
Very poor	70	52.9	2.28	1.65;3.16	
Functional Cognitive Index classification					<0.001
00	930	29.1	1		
01,02,10,20	431	37.8	1.29	1.10;1.51	
11	61	49.2	1.68	1.28;2.22	
21	28	60.7	2.08	1.52;2.85	
12	25	76.0	2.60	2.04;3.32	
22	56	78.6	2.69	2.27;3.19	

shopping without difficulties” predicted 72.8% of those with functional loss, with a sensitivity of 90.8% and specificity of 44.1%.

In the bivariate analysis, among sociodemographic variables (Table 2), a significantly higher percentage of deaths in elderly males was found, when compared to elderly females.

The percentage of deaths increased with age: 56.9% of elderly individuals aged more than 80 years died, whereas only 22.7% died in the youngest age group (65 to 69 years) (Table 2).

A significantly higher percentage of deaths in elderly individuals with lower level of education (illiterates or those who only knew how to read and write) and per capita income of up to US\$99 was observed (Table 2).

Among the variables related to morbidity in the elderly, the following were associated with higher mortality: diagnosis of mental disorder, diabetes, stroke and urinary incontinence. Obesity had a protective effect on mortality (Table 3).

In addition, partial or total absence of teeth and hospitalization in the last six months were also significantly associated with mortality, as well as good, poor and

very poor self-perception of health, when compared to excellent self-perception (Table 4).

The FCI was significantly associated with mortality (Table 4). Among elderly individuals with the worst index value, i.e. those who answered no questions or only one question about orientation to time correctly and who neither went shopping nor took medication correctly alone (category “22”), 78.6% died, whereas among those with preserved orientation to time and the ability to go shopping and taking medication alone (category “00”), only 29.1% died. Probability of death was 8.92 times higher (95% CI: 4.64; 17.14) in group “22” than in group “00” (Table 6). This probability decreased as FCI categories progressed towards better preserved orientation to time and executive functions. Bivariate analysis showed a 48% higher probability of death in elderly individuals in the “01, 02, 10 and 20” categories (those with preserved orientation to time or ability to go shopping and take medication). Next, category “11” remained (those who correctly answered two or three questions about orientation to time and managed to go shopping or taking medication alone), with a probability of death that was 2.35 times higher. Subsequently, categories “21” and “12” showed a probability of death 3.76 and 7.70 times higher, respectively, while the categories in which one of the

Table 5. Bivariate analysis of variables associated with life habits and social support in the elderly, according to death. City of São Paulo, Southeastern Brazil, 1991-2001.

Variable	n	Death %	RR	95% CI	p
Frequency of contact with neighbors					<0.001
Annual/never	196	45.4	1		
Monthly	1.327	33.9	0.74	0.62;0.88	
Frequency of contact with relatives					0.007
Annual/never	162	44.4	1		
Monthly	1.367	34.5	0.77	0.64;0.93	
Frequency of contact with friends					0.013
Annual/never	250	42.0	1		
Monthly	1.269	34.1	0.81	0.68;0.95	
Confidant(e)					0.047
No	1.076	36.4	1		
Yes	436	31.0	0.84	0.72;0.99	
Frequency of sexual intercourse					0.104
Monthly/none	1.083	37.0	1		
Monthly or more	372	32.3	0.87	0.73;1.02	
Physical activity					0.037
No	1.146	37.0	1		
Yes	387	31.0	0.83	0.70;0.99	

FCI components (orientation to time or the ability to go shopping or taking medication alone) had already been completely lost. Probability of death was higher for category "12" (correctly answered 2-3 questions about orientation to time, but could not go shopping or take medication alone) than for "21" (correctly answered 0-1 question about orientation to time and could go shopping or take medication alone), showing greater influence of loss of executive functions than that of orientation to time on the probability of death.

Physical activity showed lower association with mortality (Table 5). All variables related to social support were associated with mortality, especially among those who do not have a relationship with neighbors, relatives or friends.

In the multiple regression analysis, the following risk factors of mortality remained in the final model: male sex, age group (75 to 79 years; 80 years and more), self-perception of health (good, fair and very poor, compared to excellent), diabetes, hospitalization in the last six months, partial or total absence of teeth and FCI. A monthly relationship with relatives was found to be a protective factor (Table 6).

Comparison of crude and adjusted relative risks in the final model (Table 6) revealed that, for the majority of covariables studied, the adjusted relative risk showed a value close to or below that of the crude relative risk, indicating that part of the individual effect of each variable was due to the effect of other covariables.

The FCI showed the greatest magnitude of association, observed both in the crude and adjusted relative risks, with a consistent increasing trend as index categories became worse.

DISCUSSION

The previous analysis of mortality between the first and the second Epidoso surveys (with an interval of two years between them) identified the following as independent factors of risk of death: male sex, more advanced age, history of hospitalization in the last six months, reduction in functional capacity (measured by the level of independence to perform daily life activities) and cognitive deficit.¹⁸

In the present study, the FCI was the main factor of risk of mortality among the elderly individuals studied. As regards the analysis previously performed,¹⁸ which used the MMSE (cut-off point below 18) and ADL (dependence on seven or more ADLs) separately, the FCI predictive ability was greater, with adjusted relative risks reaching higher values.

In addition, the FCI overcame a great methodological difficulty, namely, to associate ADL functional capacity and the cognitive state, represented by the MMSE, in which cut-off points to indicate cognitive impairment vary according to level of education. Another advantage of the FCI is the possibility of separating sub-groups with higher risk of death, which show greater cognitive and functional impairment.

Table 6. Multiple analysis of predictive factors of mortality in the elderly and relative risks adjusted by Poisson regression. City of São Paulo, Southeastern Brazil, 1991-2001.

Variable	Model 1 ^a			Model 2 ^b			Model 3 ^c		
	RR	95% CI	p	RR	95% CI	p	RR	95% CI	p
Age (years)									
65 to 69	1			1			1		
70 to 74	1.25	1.00;1.57	0.048	1.23	0.98;1.54	0.071	1.18	0.94;1.48	0.136
75 to 79	1.51	1.22;1.88	<0.001	1.48	1.19;1.85	<0.001	1.39	1.11;1.73	0.003
80 and more	2.05	1.66;2.52	<0.001	2.04	1.66;2.52	<0.001	1.93	1.56;2.38	<0.001
Sex									
Female	1			1			1		
Male	1.59	1.40;1.81	<0.001	1.59	1.40;1.82	<0.001	1.63	1.42;1.86	<0.001
Funcional Cognitive Index ^d									
00	1			1			1		
01, 02, 10, 20	1.20	1.02;1.40	0.023	1.11	0.95;1.31	0.177	1.09	0.93;1.28	0.275
11	1.59	1.20;2.10	0.001	1.45	1.10;1.91	0.008	1.37	1.03;1.83	0.030
21	1.78	1.28;2.47	0.001	1.74	1.25;2.40	0.001	1.71	1.24;2.37	0.001
12	2.13	1.67;2.71	<0.001	1.83	1.41;2.39	<0.001	1.76	1.35;2.28	<0.001
22	2.03	1.66;2.47	<0.001	1.79	1.44;2.22	<0.001	1.64	1.30;2.06	<0.001
Relationship with relatives									
Annual/never				1			1		
Monthly				0.84	0.70;1.01	0.073	0.83	0.69;1.00	0.054
Health									
Excellent				1			1		
Good				1.32	1.03;1.70	0.024	1.31	1.01;1.68	0.035
Fair				1.56	1.20;2.02	0.001	1.48	1.13;1.93	0.003
Poor				1.58	1.15;2.19	0.005	1.55	1.11;2.15	0.009
Hospitalization									
No							1		
Yes							1.45	1.22;1.73	<0.001
Diabetes									
No							1		
Yes							1.20	1.00;1.44	0.043
Presence of teeth									
All/most of them							1		
Only some							1.23	0.98;1.56	0.070
None							1.34	1.09;1.66	0.005

RR: Relative risk

^a Adjusted RR for sociodemographic variables and Functional Cognitive Index (FCI) or orientation to time and executive functions.^b Adjusted RR for sociodemographic variables, life habits, social support and Functional Cognitive Index of orientation to time and executive functions.^c Adjusted RR for sociodemographic variables, morbidity, life habits, social support and Functional Cognitive Index of orientation to time and executive functions.^d FCI scores are in Table 1.

The combination between questions about orientation to time and executive functions has the advantage of showing a reduced number of questions (only seven). The results found reveal that orientation to time and executive functions act together to provide a protective effect on risk of death, one compensating the other. This

phenomenon was shown by the combination of categories, where one of these categories (functional capacity or cognitive state) was entirely preserved (10, 20, 01, 02). Findings from the present study are similar in several aspects to those found by other authors who investigated predictive factors of mortality in the elderly.

Ginsberg et al⁶ found an independent effect of difficulty on more than one instrumental activity of daily living ADL, cognitive deficit and the fact of having been in bed in the previous two weeks, after control for sex, comorbidities, income, social support and smoking. All study participants (mean age of 70 years) with cognitive deficit and incapacity in more than two IADLs died, suggesting that the use of measures combining cognitive state and functional capacity can be an effective and low-cost method to identify elderly individuals at high risk of death.

Bassuk et al² found a greater effect of cognitive loss on risk of death among younger elderly individuals than among those aged more than 80 years. This study emphasizes the selection of the “going shopping” and “taking medication correctly” executive functions, once they are daily life activities of younger elderly individuals.

Blazer et al,³ while assessing the effect of depression on risk of death, found that depression lost its effect when cognitive loss, functional incapacity, comorbidities and social support were included in the model, suggesting that the association between depression and mortality occurs through several mechanisms, among which is loss of functional and cognitive capacity.

Ansley et al,¹ Landi et al⁹ and Nguyen et al¹⁵ found an independent effect of cognitive loss and functional capacity on risk of death, even in the presence of co-morbidities. Ganguli et al⁵ observed a more important effect of functional capacity than that of the cognitive state to predict risk of death.

Nybo et al,¹⁷ by analyzing mortality above 90 years of age, identified that sociodemographic factors, smoking and obesity lost their effect, whereas functional incapacity, cognitive loss and low self-perception of health remained as independent factors of risk of death.

According to Lieto & Schmidt,¹⁰ not to use medication correctly increases the risk of hospitalization of elderly individuals and is associated with cognitive loss. This IADL can be useful to detect cognitive loss in the elderly.

McGuire et al¹² concluded that cognitive deficits lead to higher probability of death or show dependence. In

addition, they found statistically significant association between anatomical-pathological injuries typical of Alzheimer’s disease and time and spatial orientation impairment.

In the literature review, only the study by Njegovan et al¹⁶ was found. This study classified daily life activities in hierarchical levels and showed that certain hierarchically higher functions among IADLs (going shopping, taking care of finances, cooking) are lost before (on higher cognitive levels) basic ADL functions (eating, getting dressed, walking). Cognitive loss was associated with a specific pattern of loss of functional capacity, enabling the pattern of functional reduction and, as a result, their health care needs to be predicted.¹⁶

The FCI compares information obtained from interviews (BOMFAQ/OARS) with that obtained from testing (MMSE), thus increasing reliability of results.

In the present study, elderly individuals with partial or total loss of teeth had significant higher risk, independent from death, than those with little or no dental loss. This finding is in agreement with studies that associate poor dental health and higher morbimortality by all causes in the elderly.^{13,14} In the present analysis, as well as in the study by Ramos,¹⁸ level of education lost statistical significance and was excluded in the multiple model, thus not being a risk factor of mortality that was independent from the cognitive state and functional capacity in this population. One possible explanation for this fact would be the low variability of participants’ level of education, once, in the area studied, middle-class residents predominated. Income also lost its predictive ability of mortality, when controlled by the remaining variables.

In conclusion, the FCI of orientation to time and executive functions was the most important changeable predictor of risk of death. Moreover, this index can help clinicians and health planners to promote health in the elderly, aiming to reduce mortality by coherently allocating the necessary resources to maintain and rehabilitate cognitive state and functional (executive) capacity. The FCI is simple and it can be used by higher and secondary education health professionals, in addition to tele-health services.

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Article based on the doctoral thesis by Xavier AJ, presented to the *Programa de Pós-Graduação em Informática em Saúde, Escola Paulista de Medicina, Universidade Federal de São Paulo*, in 2007.