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Can maintaining cognitive function at 65 years old predict successful ageing 6 years later? The PROOF study

Karine Castro-Lionard[1], Catherine Thomas-Antérion[2], Emilie Crawford-Achour[1], Isabelle Rouch[2], Béatrice Trombert-Paviot[3], Jean-Claude Barthélémy[4], Bernard Laurent[2], Frédéric Roche[4], Régis Gonthier[1]

[1]Department of Geriatrics, University Hospital of Saint-Etienne, 42055 Saint Etienne Cedex 2, France
[2]PRES Lyon – Neurology Department, Resources and Research Memory Centre, University Medical Hospital of Saint-Etienne, Saint Etienne, France
[3]Department of Public Health and Medical Informatics, University Hospital of Saint-Etienne, Saint Etienne, France
[4]PRES Lyon – SNA-EPIS Research Unit, Exercise and Clinical Physiology Laboratory, University Hospital and Jean Monnet University, Saint Etienne, France

Address correspondence to: K. Castro-Lionard. Fax: (+33) 477127157. Email: karine.castro_lionard@chu-st-etienne.fr

Abstract

Background: preservation of cognitive abilities is required to have a good quality of life. The predictive value of cognitive functioning at 65 years old on successful ageing 6 years later is not established.

Methods: nine hundred and seventy-six questionnaires were sent by mail to a sample of healthy and voluntary French pensioners. Successful ageing was defined through health status and well-being. Cognitive abilities had been assessed 6 years earlier according to an objective method (Free and Cued Selective Recall Reminding Test (FCSRT), the Benton visual retention test and the similarities subtest of the Wechsler Adult Intelligence Scale-Revised) and a subjective one (Goldberg's anxiety scale, Mac Nair's scale and a Visual Analogue Scale to evaluate memory abilities change in the last 5 years).
Results: six hundred and eighty-six questionnaires could be analysed. The mean age was 72.9 ± 1.2 years old with 59% of women and 99% lived at home. Well-being was negatively correlated with the FCSRT ($r = -0.08$, $P = 0.0318$) but positively related with the Benton ($r = 0.09$, $P = 0.0125$) and the similarities tests ($r = 0.09$, $P = 0.0118$). There is a negative correlation between anxious and cognitive complaints measured at baseline, and successful ageing indicators 6 years later.
Conclusion: preservation of cognitive abilities at the age of retirement can predict a successful ageing 6 years later. ClinicalTrials.gov Identifier: NCT00759304.

Introduction

What constitutes successful ageing is a complex concept and one that has evolved greatly over the last 30 years [1, 2]. Attention was directed towards this notion in the 1980s when Rowe and Kahn defined the three criteria required for successful ageing: a low probability of disease, maintaining a high level of physical and cognitive function and an active social life [3]. More recent studies have tried to determine the nature of the link between cognitive, physical and psychosocial behaviour within the framework of successful ageing [4–7]: the idea of quality of life has therefore joined that of functional ability. At the present time, Rowe and Kahn's approach appears too restrictive as few old people are completely disease-free. So, the focus is now on the patient, and his own idea of ageing [8]. Even people with chronic disease or physical incapacity may consider that they are ageing well [9]. A Dutch study has shown that in subjects aged >85 years, well-being and social interaction are more important to their conception of successful ageing than are their physical and psycho-cognitive abilities [10].

In France, the demographic aspect of ageing is accompanied by an increase in dementia with more than 750,000 cases of Alzheimer's disease and related disorders in people aged >75 [11]. It is important to better understand the impact of cognition on successful ageing in order to optimise the global care of the patients with cognitive impairment. Is this a factor which could compromise self-assessment of successful ageing? Is good cognitive performance necessary for a sense of well-being and being able to maintain a rich social network after retirement? Or should we consider that impaired cognitive abilities in newly retired people are correlated with a bad self-rated health status several years later?

To the best of our knowledge, very few studies have analysed the link between cognitive state and well-being.

Since 2001 we have been carrying out a survey of people of pensionable age to determine whether the cognitive abilities of people when they retire are predictive of successful ageing.

Materials and Methods

Study population

We studied people taking part in the PROOF study [12]. They formed part of the 1,011 volunteers who enrolled in the study in 2001, all aged 65 and living at home. The aim of the PROOF study was to prospectively assess the predictive value of autonomic nervous system activity level with regards to cardiovascular and cerebrovascular events.

Subjects from the PROOF study were randomly recruited from the electoral list of Saint Etienne. Two criteria had to be met for their inclusion: being of the required age (between 63 and 68 at inclusion) and giving their written informed consent to participate in the study. This entry age was selected as it coincides with the most frequent retirement age and consequently to the start of a new lifestyle allowing better quantification of the parameters of interest. The exclusion criteria were more numerous: prior myocardial infarction or stroke, heart failure, atrial fibrillation, insulin-treated diabetes mellitus, cardiac pacemaker, any disease limiting life expectancy to <5 years, a contraindication to brain MRI, living in an institution or intention to move out of the area in the next 2 years. A MMSE (Mini-Mental State Examination) was realised at the inclusion in the PROOF study in 2001, with an average score at 28.43 ($\pm$1.68).

Study schedule

The study began in October 2008 when 976 subjects of the PROOF cohort (those who had not died or just 'disappeared') received a questionnaire and an explanatory letter. Data were collected over a 3-month period until the end of December 2008. We did not chase up non-respondents but their socio-demographic and cognitive characteristics were studied from the initial file.

Cognitive performances assessed in 2002

Two approaches were used, one objective and the other subjective. Since this study investigated older subjects in

good health, only validated tests capable of discerning slight impairment in cognitive ability were used. All the following tests had been carried out in 2002 during the PROOF inclusion visits.

The objective evaluation therefore used the following three tests:

- The free and cued selective reminding (FCSR) memory test (adapted from Gröber and Buschke) included 16 items and was used to evaluate episodic memory [13]. The scores given here are those of the number of words recalled spontaneously or in response to the cues (score from 0 to 48).
- The Benton visual retention test (score from 0 to 15) was used to evaluate short-term visual memory [14]. We presented our subjects with 15 cards for 10 s each with an image that they had to select later from among four possibilities.
- The revised Weschsler Adult Intelligence Scale (WAIS) similarities subtest was used to test abstract reasoning [15]. Subjects were asked to find the categorical or functional similarity between two items. The test included 19 items for a maximal score of 33.

The subjective tests used for evaluating everyday memory performance, mood and perceived cognitive function were:

- A Visual Analogue Scale (VAS) to investigate changes in memory [16]. We asked our subjects to indicate what they felt to be the changes in their own memory over the last 5 years and to mark this on a visual scale scoring from 0 to 10: 0 indicated no change and 10 a very significant change.
- Anxiety was measured using the Goldberg's Anxiety Scale [17]; the total number of 'Yes' responses gave a score from 0 to 9.
- The simplified French version of the Mac Nair's scale was used to explore memory and concentration using 26 items and responses ranging from 0 (never) to 4 (very often) [18]. The maximal score was 104.

Description of the questionnaire sent in 2008

The questionnaire (see Supplementary data, available in *Age and Ageing* online) was on a single double-side sheet and included 17 mainly closed ended questions falling into several categories:

 (i) Socio-demographic data (age, sex, living conditions, family status etc.) (Questions 1–8)
 (ii) Subjective responses using VASs [19] graded from 0 to 10, for evaluating:
  (a) time spent on various activities (sport, DIY, family etc.) [20] (Questions 9–10)
  (b) health status ('How do you estimate your health status?' [21]) and well-being ('Are you basically satisfied with your life?' [22]) (Questions 11–12)
 (iii) Multiple choice questions were used to explore older people's perception of what constitutes successful

ageing and the current problems they had with everyday living (Questions 13–14)
 (iv) Multiple choice questions were also used to determine what subjects in relation to successful ageing could interest the respondents and the preferred method of obtaining such information (Questions 15–16) [23]
 (v) Question 17 asked whether or not the respondent had answered the questionnaire alone.

Ethics statement

The PROOF study was approved by the University Hospital and the IRB-IEC (CCPPRB Rhône-Alpes Loire). The National Committee for Information and Liberty (CNIL) gave its consent for data collection. All subjects signed an informed consent for the study. ClinicalTrials.gov Identifier NCT00759304.

Statistical analysis

The six cognitive scores obtained in 2002 were matched with the indicators of successful ageing from the 2008 questionnaire, i.e. the overall scores for self-estimated health status and well-being.

Concerning descriptive data, mean and standard deviation were computed for quantitative variables. The various activities undertaken by our subjects were classified in relation to the average time spent on them. An analysis of variance was used to compare self-estimated health status and well-being with educational level and family situation; education was also compared with the neuropsychological tests. A χ^2 test was used to determine correlations between family situation and mood disorders, memory and relationships. Pearson's coefficient was used to find correlations between the subject's perception of successful ageing (health status and well-being), activities undertaken on one hand and the neuropsychological tests on the other. To examine the longitudinal association between cognitive function in 2002 and successful ageing in 2008, tests were completed by using multivariate regression analysis (PROC GLM, SAS), concerning variables associated in univariate analysis with a correlation coefficient of ≥ 0.1. A χ^2 test and an analysis of variance were used to compare the gender distribution and baseline cognitive function between respondents and non-respondents to the 2008 questionnaire.

The level of significance was set at 5% ($P = 0.05$).

The statistical analyses were carried out using SAS V8.2 software (SAS Institute, Inc., Cary, NC, USA).

Results

Of the 976 questionnaires we sent out, 756 (77.5%) were returned. The difference was due to death of the subjects and various reasons for abandoning the study. Of those we received, only 720 included the global evaluations of health status and well-being, meaning that our global response rate for the 2008 questionnaire was 73.8%. However, we could

only analyse questionnaires for which we also had complete neuropsychological data from 2002. Consequently only 686 (70.3%) questionnaires could be analysed. The number of non-respondents, who corresponded to people who underwent the six cognitive tests in 2002 and who received the questionnaire in 2008 but did not answer it, was 220.

The mean age of our study population was 72.9 ± 1.2 years with 59.2% of women. A large majority of these subjects (99%) lived at home and a quarter (24.5%) lived alone. Regarding the educational level, only 9.8% of the people questioned had no educational qualifications. Of those who had worked, the average period since retirement was 13.7 ± 4.1 years previously. Most of these subjects did not report any particular problems with actually retiring as 71.8% had a VAS of ≥8/10 (remembering that 0 = adapted very badly and 10 = adapted very well).

These people could be considered as 'active' since 85.4% of them declared having regular activities (at least once a week) outside the home. To reduce statistical bias due to missing data, the weighted averages per activity were calculated; this clearly puts activities within the family sphere in first place. It should be noted that only 25 subjects said they were in some kind of paid employment which was an important activity for less than half of them (VAS ≥ 8/10).

The distribution of the VAS responses for health status and general well-being showed that most subjects fell within the upper third of this spread (Figure 1). The lowest scores for these two items came from women, but it should be noted that it is those who more often lived alone.

Finally, among those who answered the question regarding everyday problems (Question 13), 18.5% of people considered that they had mood disorders, 19.9% problems with their memory and 8.8% problems with relationships.

The subjects had high performances on the objective neuropsychological tests (with averages of 46 ± 2.6 for

Figure 1. Distribution of the VAS answers to the questions regarding self-estimated health status and well-being among the 686 subjects investigated in 2008. Visual Analogue Scale (VAS) self-estimated health status (How do you estimate your health status?) scoring from 0 = very bad to 10 = excellent. VAS well-being (Are you basically satisfied with your life?) scoring from 0 = never satisfied to 10 = always satisfied.

FCSR, 12.4 ± 1.7 for Benton test, 17 ± 5.5 for similarities test) and generally had few subjective complaints (with averages of 2.8 ± 1.9 for VAS about changes in memory, 3.3 ± 2.8 for Goldberg's Anxiety Scale, 28.7 ± 12.3 for Mac Nair's scale)

Self-estimated health status and well-being were significantly correlated with the VAS results for the various activities and subjective cognitive indicators; no significant correlation was found between the self-estimated health status, on the one hand, and the education and objective cognitive tests, on the other (Tables 1 and 2). After adjustment on sex and family status using multivariate regression analysis, Goldberg's Anxiety Scale was still correlated with self-estimated health status ($P < 0.0001$) and well-being ($P < 0.0001$) whereas Mac Nair's scale was only correlated with well-being ($P = 0.0009$). After consideration of the missing data, multivariate regression analysis concerned 607 subjects.

In 2008, people who lived alone had a worse self-estimated health status ($P = 0.0254$), were less satisfied with their lives ($P < 0.0001$), had more problems of morale ($P < 0.0001$) and more problems with relationships ($P = 0.0028$) but they did not have more complaints of memory loss ($P = 0.9360$) than the others.

A higher educational level was correlated with higher scores for the FCSR ($P = 0.0043$), Benton ($P = 0.0001$) and similarities tests ($P < 0.0001$) but lower VAS scores for problems with memory ($P = 0.0121$), Goldberg anxiety scale ($P < 0.0001$) and Mac Nair scale ($P = 0.0378$).

Those with high VAS scores for memory complaints in 2002 still had similar complaints in 2008 ($P < 0.0001$) but now also complained of mood disorders ($P = 0.0306$). In general, women complained more of mood disorders than did men ($P < 0.0001$).

Finally, there were significant correlation between the things people complained about and the subject proposed in Question 15: for 'Smile and remember: a way to keep good', people the more interested were those who complained of memory loss ($P = 0.0005$) or mood disorders ($P = 0.0127$).

When we compared non-respondents subpopulation with respondents, there were no significant differences for the gender distribution; concerning cognitive tests, non-respondents had lower scores for Benton ($P = 0.0381$) and similarities tests ($P = 0.0145$), but higher score for Goldberg's anxiety scale ($P = 0.0118$).

Discussion

Our study suggests that the preservation of cognitive abilities in newly-retired people living at home is a predictive factor of successful ageing several years later. Subjects with high baseline scores for neuropsychological tests such as the Benton and similarities tests reported higher levels of well-being 6 years later. Similarly, those with few mood or cognitive abilities complaints in 2002 were considered to be ageing successfully in 2008. Furthermore, a good educational level and an active life appear necessary if people
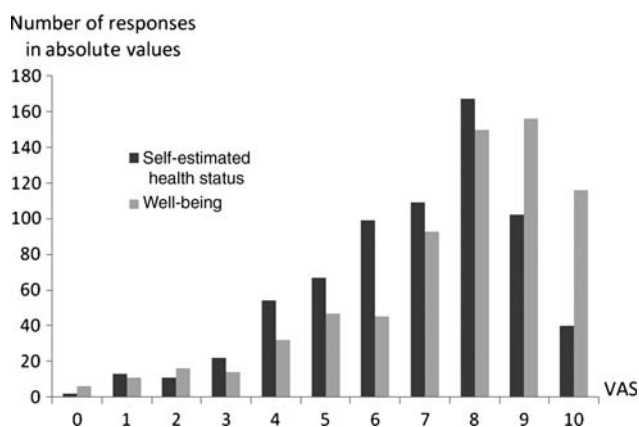
Table 1. Correlations by Pearson coefficient between activities and successful ageing scales for the 686 subjects investigated in 2008

	Cultural activities	Sport	Volunteer work/clubs	DIY/gardening	Friends	Family	Self-estimated health status[a]	Well-being[b]
Cultural activities	1	0.43**	0.24**	NS	0.31**	0.21**	0.24**	0.23**
Sport		1	0.23**	0.12*	0.22**	0.14**	0.28**	0.24**
Volunteer work/clubs			1	NS	0.35**	0.19**	0.19**	0.17**
DIY/gardening				1	0.25**	0.24**	0.16**	0.16**
Friends					1	0.49**	0.21**	0.26
Family						1	0.25**	0.32**
Self-estimated health status[a]							1	0.65
Well-being[b]								1

NS, not significant.

[a]Self-estimated health status assessed by the question: How do you estimate your health status?

[b]Well-being assessed by the question: Are you basically satisfied with your life?

*$P < 0.05$.

**$P < 0.001$.

Table 2. Correlations by Pearson coefficient between cognitive tests assessed in 2002 and successful ageing scales for the 686 subjects investigated in 2008

	VAS memory	Goldberg	Mac Nair	FCSR	Similarities	Benton	Self-estimated health status[a]	Well-being[b]
VAS Memory	1	0.22**	0.42**	NS	NS	−0.12*	−0.14**	−0.19**
Goldberg		1	0.27**	NS	−0.21**	−0.19**	−0.29**	−0.34**
Mac Nair			1	−0.11*	NS	−0.11*	−0.14**	−0.23**
FCSR				1	0.19**	0.19**	NS	−0.08*
Similarities					1	0.32**	NS	0.09*
Benton						1	NS	0.09*
Self-estimated health status[a]							1	0.65**
Well-being[b]								1

NS, no significant; FCSR, the free and cued selective reminding.

[a]Self-estimated health status assessed by the question: How do you estimate your health status?

[b]Well-being assessed by the question: Are you basically satisfied with your life?

*$P < 0.05$.

**$P < 0.001$.

want to see themselves as ageing successfully. This study also shows that living alone is clearly correlated with lower scores at self-estimated health status and well-being.

These results confirm those of other studies. The Manitoba longitudinal study showed in the cohort of 3,573 subjects aged between 65 and 84 years that self-rated health status was clearly linked to successful ageing, which negative predictive factors were: having one's spouse die or enter a nursing home, cognitive difficulties (RR = 1.6; 95% CI 1.1–2.4), cancer, diabetes or forced early retirement due to illness [24]. This study also showed that results differed with sex and that men met the criteria for successful ageing more often than did women (32.7 versus 18%; $P = 0.006$) in the 75–84 baseline age group. This cohort has recently been the subject of further analyses, which have shown that everyday activities are positively correlated with well-being 6 years later [25]. Other authors have validated a self-administered cognitive screening tool among 182 well-educated and community-dwelling older adults, aged from 58 to 99, with the aim of subjectively studying successful ageing. The results have been significantly correlated with the educational level ($r = 0.25$, $P < 0.01$), cognitive complaints ($r = 0.20$, $P < 0.05$) and self-rating of successful ageing ($r = 0.15$, $P < 0.05$) [26]. An American study of 129 subjects between 65 and 89 years has demonstrated that cognitive function was positively correlated with subjective well-being (sr^2 unique = 0.04, $P = 0.008$), independently of education level and income [27]. More recently, Theeke, in a study concerning 13,812 older adults, found that chronically lonely people reported less exercise, more tobacco use, less alcohol use, a greater number of chronic illnesses, higher depression scores and greater average number of nursing home stays [28]. These results confirm ours as people who live alone are frailer than others.

Our results should be regarded with circumspection. First, our study has a selection bias since the cohort was principally constituted of volunteers in good health as proved by the fact that the large majority (96%) answered the questionnaire alone. Consequently, the cognitive tests could have been skewed by a ceiling effect linked to the high cognitive performance of the subjects. In hindsight printing the questionnaire on both sides was not a good idea since numerous people ($n = 105$) only completed the front page resulting in a considerable amount of missing data. We could also criticise our use of a VAS in response to questions regarding perception; some older people find

this type of scale difficult to understand and complete unsatisfactorily. VAS can also permit floor and ceiling effects for extreme values [29]. Then, in spite of the good rate of answer to the questionnaire, our study lacks representativeness because non-respondents were more cognitively impaired than others. Finally, we could question the interpretation of the correlations we found. Paradoxically, we demonstrated a negative correlation between the FCSR test and the well-being indicators; this means that the more the subject has lapses of memory the better he presents a high level of well-being. It would be necessary to use a battery of short-term memory tests to give a more meaningful interpretation of this correlation.

As with other studies, ours has underlined the importance of prevention to age successfully [30]. It clearly showed that people with health problems were looking for ways to counterbalance their perceived difficulties. It seems important to encourage such preventative gerontological approach and support those organisations offering help to newly retired persons. Some authors have clearly shown the positive effect of this type of action in turning 'normal' ageing into 'successful' ageing [23].

So, well-being is clearly an essential component for successful ageing, but if well-being can be considered as the maintenance of a person's cognitive capacities, then this must be both objective (as confirmed by neuropsychological tests) and subjective (as seen by complaints of memory loss and depression). This naturally leads us to the health care challenge of the early diagnosis of cognitive difficulties to maintain good quality of life for as long as possible.

Key points

- Well-being and self-rated health status are very important criteria of successful ageing.
- Subjects with good baseline scores for neuropsychological tests reported higher levels of well-being 6 years later.
- Those with few complaints of their mood or cognitive capacities in 2002 were considered to be ageing successfully in 2008.
- A good educational level and an active life appear necessary if people want to see themselves as ageing successfully.
- Living alone is clearly correlated with lower scores for self-estimated health status and well-being.

Conflicts of interest

None declared.

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Supplementary data

Supplementary data mentioned in the text is available to subscribers in *Age and Ageing* online.

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Predicting who will use intensive social care: case finding tools based on linked health and social care data

Martin Bardsley[1], John Billings[2], Jennifer Dixon[1], Theo Georghiou[1], Geraint Hywel Lewis[1], Adam Steventon[1]

[1]The Nuffield Trust, 59 New Cavendish Street, London W1G 7LP, UK
[2]New York University—Robert F. Wagner Graduate School of Public Service, New York, NY, USA

Address correspondence to: G. H. Lewis. Tel: +(44) 020 7631 8450; Fax: +(44) 020 7631 8451; Email: geraint.lewis@nuffieldtrust.org.uk

Abstract

Background: the costs of delivering health and social care services are rising as the population ages and more people live with chronic diseases.
Objectives: to determine whether predictive risk models can be built that use routine health and social care data to predict which older people will begin receiving intensive social care.