Playing board games, cognitive decline and dementia: a French population-based cohort study

Jean François Dartigues,[1] Alexandra Foubert-Samier,[1] Mélanie Le Goff,[1] Mélanie Viltard,[2] Hélène Amieva,[1] Jean Marc Orgogozo,[1] Pascale Barberger-Gateau,[1] Catherine Helmer[1]

ABSTRACT

Objectives: To study the relationship between board game playing and risk of subsequent dementia in the Paquid cohort.

Design: A prospective population-based study.

Setting: In the Bordeaux area in South Western France.

Participants: 3675 non-demented participants at baseline.

Primary outcome measure: The risk of dementia during the 20 years of follow-up.

Results: Among 3675 non-demented participants at baseline, 32.2% reported regular board game playing. Eight-hundred and forty participants developed dementia during the 20 years of follow-up. The risk of dementia was 15% lower in board game players than in non-players (HR=0.85, 95% CI 0.74 to 0.99; p=0.04) after adjustment on age, gender, education and other confounders. The statistical significance disappeared after supplementary adjustment on baseline mini-mental state examination (MMSE) and depression (HR=0.96, 95% CI 0.82 to 1.12; p=0.61). However, board game players had less decline in their MMSE score during the follow-up of the cohort (β=0.011, p=0.03) and less incident depression than non-players (HR=0.84; 95% CI 0.72 to 0.98; p<0.03).

Conclusions: A possible beneficial effect of board game playing on the risk of dementia could be mediated by less cognitive decline and less depression in elderly board game players.

ARTICLE SUMMARY

Article focus
- Stimulating leisure activities are considered as possible protective factors against dementia and cognitive decline in elderly people, particularly due to enhancement of cognitive reserve.
- Previous papers have shown that playing games can improve cognitive performances in healthy elderly participants, but controversial results were obtained in dementia. Thus, playing board games could be a particularly relevant way to preserve cognition and to prevent cognitive decline or dementia, and could be recommended without any real drawbacks, provided the favourable relationship between playing games and dementia is confirmed.
- However, to our knowledge, few authors have studied the relationship between playing board games and the risk of subsequent dementia in prospective cohort studies.

Key messages
- Using the Paquid cohort data with 20 years of follow-up, we now show that board game players have a 15% lower risk of developing dementia than non-players.
- This reduced risk does not seem to be only a short-term effect, as previously reported, but is also a long-term effect with a reduction observed one or even two decades after baseline collection of this popular leisure activity. However, in our study, the relationship disappeared after adjustment for baseline cognition and depression, which are known to be strong predictors of dementia.
- A possible beneficial effect of board game playing on the risk of dementia could be mediated by less cognitive decline and less depression in elderly board game players.

Stimulating leisure activities are considered as possible protective factors against dementia and cognitive decline in elderly people, particularly due to enhancement of cognitive reserve.[1] [2] Cognitive reserve is considered to be one of the major explanations for differences between individuals in susceptibility to age-related brain changes and pathology related to Alzheimer's disease. Individuals with a large cognitive reserve can tolerate more of these changes than others and maintain their functions.[1] Playing board games is one of the most stimulating leisure activities for elderly people, even at an advanced age; it has specific advantages compared to other games or activities. Playing board games is a

[1]INSERM U 897, Université Bordeaux Ségalen, Bordeaux cedex, France
[2]IEEP, Institute for European Expertise in Physiology, Paris, France

Correspondence to
Dr Jean François Dartigues; jfd@isped.u-bordeaux2.fr

ARTICLE SUMMARY

Strengths and limitations of this study

- With 20 years of follow-up, the Paquid cohort study is one of the longest durations of follow-up in the world for a population-based cohort.
- Owing to the observational nature of our study, there is a possibility of residual or unmeasured confounding such as genetic factors.
- Although standard criteria and well-established procedures were used to make the diagnoses, misclassification is inevitable. Only reported regular activities were collected at baseline without direct measurement, although the history was checked by informants whenever possible. We had no precise data on the frequency and duration of board game playing.

recreational activity that promotes exposure to novelty, taking initiatives, planning, adaptation to winning or losing and brings immediate pleasure to participants. In addition, playing games is an activity that can be undertaken with family members or friends and even with strangers, and it promotes social interaction and exchange with different generations. Furthermore, it is an inexpensive leisure activity that involves a wide range of tasks from simple ones as in bingo to complex ones as in bridge, and such games can be adapted to the level of the players. Finally, elderly people with a physical disability, mild hearing or visual impairment can continue to participate in this stimulating leisure activity, irrespective of the season or the weather. Other stimulating leisure activities like reading, travelling, gardening, doing odd jobs or playing sports do not offer the same advantages and ease of practice. Thus, playing board games could be a particularly relevant way to preserve cognition and to prevent cognitive decline or dementia and could be recommended without any real drawbacks, provided the favourable relationship between playing games and dementia is confirmed.

Previous papers have shown that playing games can improve cognitive performances in healthy elderly participants,[3] but controversial results were obtained in mild cognitive impairment[4] or in dementia.[5][6] Playing games is known to enhance cognitive performances in working memory, executive function, semantic memory and logical reasoning.[3][7][8] However, to our knowledge, few authors have studied the relationship between playing board games and the risk of subsequent dementia in prospective cohort studies.

In a previous paper on the Paquid population-based cohort, we found that playing board games was significantly associated with a reduced risk of incident dementia 3 years later.[9] However, the results were obtained after a short follow-up and the significance disappeared after adjustment on cognitive performances at baseline. Similar results were obtained after 20 years of follow-up by Verghese et al[10] in the Bronx Aging Study. In contrast, in the MoVIES project, Hughes et al,[11] while studying different types of games, found that doing only crossword puzzles was associated with a reduced risk of dementia while other games like bridge, other card games and other board games were not. Thus, the relationship remains uncertain and more evidence is needed to support preventive recommendations to elderly people about playing board games.

With the prolonged follow-up of the Paquid study with repeated measures of cognition, depression and clinical dementia, we reanalysed the relationship between playing board games collected at the baseline screening of the participants and the occurrence of dementia during the 20 years of follow-up of the cohort. Moreover, we analysed whether depression and cognitive decline before dementia could mediate the relationship between playing board games and dementia.

METHODS

Study population

The data came from the Paquid cohort, an epidemiological prospective study on cerebral and functional ageing with over 20 years of follow-up. The methodology has been described previously.[12] In brief, the initial baseline sample included 3777 community dwellers, aged 65 or more, randomly selected from the electoral rolls in 75 different sites of two French administrative districts (Departments of Gironde and Dordogne). The participants were representative of the elderly community dwellers of the area in terms of age and sex. Since the baseline visit in 1988, the participants have been revisited at home by a dedicated neuropsychologist up to nine times over the entire follow-up. After 22 years, the Paquid cohort is still ongoing. The present analyses were conducted on the data collected over a 20-year period of follow-up.

Data collection

Leisure and social activities were collected at baseline by a standardised questionnaire during a face-to-face interview conducted by a psychologist. Ten activities were explored with the question: "Do you usually undertake this activity (at least once a week): yes or no?" The following activities were screened: reading, gardening, doing odd jobs or knitting, watching television, participating in sports, playing board games, looking after children, participating in group activities or associations, visiting friends or family members and travelling. Only playing board games was considered in this paper. Board games comprised card games, bingo, chess, draughts and other parlour games.

A neuropsychological battery was conducted at baseline and at each follow-up visit with assessment of visual memory, verbal memory, language, executive function and simple logical reasoning.[12] A French version of the mini-mental state examination (MMSE)[13] was used as an index of global cognitive performance. Scores range from 0 to 30. Depressive symptomatology was assessed at each follow-up screening using the French version of the

Centre for Epidemiological Studies Depression (CES-D) Scale.[14] This is a 20-item self-report scale developed for use in epidemiological studies in the community. Scores range from 0 to 60 according to the frequency of the depressive symptoms during the previous week. According to a previous validation study for the French population, CES-D cut-off scores of 17 for men and 23 for women indicate clinically relevant depression.[14] Participants were considered to have depression if they were treated by antidepressors or had a score above the cut-off score at the CES-D.

At baseline and at each follow-up visit, after the neuropsychological evaluation, the neuropsychologist filled in the Diagnostic and Statistical Manual of Mental Disorders, third edition revised (DSM-IIIR) to identify participants suspected of being demented. These cases and those with at least a three-point decline in the MMSE score since the previous visit were examined at home by a neurologist to confirm or not the diagnosis of dementia and specify the aetiology. All diagnoses of dementia were assigned at a case consensus conference attended by the study neurologist and two other dementia specialists according to the DSM-IIIR criteria. When evaluating cognitive status, the members of the consensus conference had no knowledge of leisure activities practiced by paticipants.

Statistical analyses

Descriptive and comparative analyses were conducted using appropriate tests (t test or χ^2 test). Kaplan-Meier curves for the risk of incident dementia were obtained for the two categories of participants according to their board game playing and compared with the logrank test.

To estimate the risk of dementia associated with game playing, incident cases of dementia occurring between baseline screening and the 20th year of follow-up were considered as an outcome variable. The time to event was defined as the time from baseline to the date of a diagnosis of dementia or to the last follow-up for participants without dementia. Participants were censored at the time of diagnosis of dementia or at the last follow-up for those non-demented. Adjustment on possible confounders was performed with the multivariate Cox proportional hazards model with delayed entry, taking age as the time scale. The multivariate model included the following covariates: gender, educational level (classified in five levels: high school, college, secondary level, primary school with diploma, primary school without diploma or no schooling), marital status, self-reported diabetes and stroke (model 1). Supplementary adjustment was made on self-reported visual, hearing impairment and ApoE 4 genotype on the subsample of the cohort with blood sampling (n=623).

We examined the influence of baseline cognitive performances on the MMSE score and the presence of depression at baseline (model 2). Risk of cognitive decline was analysed by a multivariate mixed model taking repeated values of the MMSE score during the 20 years of follow-up as the outcome. β-Transformation of the MMSE score was used to take into account the ceiling effect of the test in non-demented cases.[15] Board game playing was considered as a covariate with adjustment on confounders as in the previous multivariate model.

To estimate the risk of incident depression associated with board game playing, incident cases of depression occurring between baseline screening and the 20th year of follow-up were considered as the outcome variable. The time-to-event was defined as the time from baseline to the date of a diagnosis of depression or to the last follow-up for participants without depression. Participants were censored at the time of the first diagnosis of depression during the follow-up or at the last follow-up for those never depressed over the follow-up. Adjustment on possible confounders was performed with the multivariate Cox proportional hazards model using the same adjustments as previously.

The analyses were performed using SAS, V.9.2 (SAS Institute, Inc. Cary, North Carolina, USA).

RESULTS
Characteristics of board game players

Among the 3777 participants, 102 (2.7%) were classified as prevalent cases of dementia at baseline screening and excluded from the sample. Of the remaining 3675 participants, five had missing data for board game playing (0.1%). One thousand-one hundred and eighty-one participants reported regular board game playing (32.2%). Board game players were younger, more educated, more often married, less depressed and had better cognitive performances at baseline screening than non-players (table 1). However, the proportion of board game players remained high in very old age (18% in participants aged from 85 to 89 years, and even 12.5% in those older than 89 years) and even in non-demented participants with low cognitive performances (18.8% in participants with an MMSE between 20 and 23, 10.6% in participants with an MMSE lower than 20). In the subsample of 623 participants with blood sampling, the proportion of ApoE 4 carriers was the same in both groups (23.5% for non-players vs 21.2 for players %, p=0.5).

Board game playing and risk of incident dementia

Among the 3670 participants, 2987 (81.4%) were seen again at least once during the 20 years of follow-up. One hundred and forty-two persons died before the first screening (3.9%) and 541 refused to participate or were lost to follow-up (14.7%). The proportion of board game players was greater in those who were followed up at least once.

Eight hundred and thirty cases of incident dementia (27.8%) were observed during the 20 years of follow-up. The cumulative risk of dementia was significantly reduced in participants board game players versus non-players (logrank test=24.2, p<0.001). After 3 years of

Table 1 Characteristics of participants according to board game playing

	Players (n=1181)	Non-players (n=2489)	p Value
Gender (males)	501 (42.4)	1039 (41.7)	0.70
Age at inclusion (years): mean (SD)	73.6 (5.9)	76.0 (7.1)	<0.0001
Educational level (higher)			
Primary school without diploma or no schooling	302 (25.6)	976 (39.2)	<0.0001
Primary school with diploma	546 (46.2)	1058 (42.5)	
Secondary level	179 (15.2)	228 (9.2)	
College	77 (6.5)	127 (5.1)	
High school	77 (6.5)	100 (4.0)	
Marital status			
Married	708 (59.9)	1394 (56.0)	0.0305
Widowed	381 (32.3)	905 (36.4)	
Single	52 (4.4)	127 (5.1)	
Divorced	40 (3.4)	63 (2.5)	
Diabetes	87 (7.4)	219 (8.8)	0.14
Stroke	42 (3.6)	152 (6.1)	0.0012
MMSE score at inclusion: mean (SD)	26.9 (2.6)	25.3 (3.6)	<0.0001
Depression at inclusion	116 (9.9)	494 (20.4)	<0.0001
ApoE 4 genotype (carriers)*	48 (21.2)	93 (23.5)	0.5

Paquid Study n=3670.
Unless otherwise stated, values are numbers (%).
*n=623 (396 non-players and 227 players).
MMSE, mini-mental state examination.

follow-up, 3% of board players developed dementia versus 6% of non-players, 16% vs 27% after 10 years and 47% vs 58% after 20 years (figure 1).

After adjustment for age, gender, education, marital status, history of stroke and diabetes (table 2), the risk of dementia remained significantly reduced (HR=0.85, 95% CI 0.74 to 0.99; p=0.04). The relationship remained unchanged after supplementary adjustment on visual and hearing impairment. However, the relationship was no longer significant after supplementary adjustment on depression and MMSE score at baseline (HR=0.96, 95% CI 0.82 to 1.12; p=0.61). In the latter model, depression (HR=1.34, 95% CI 1.12 to 1.60; p=0.0011) and MMSE score at baseline (for one point fewer HR=1.10, 95% CI 1.08 to 1.12; p<0.0001) were strong predictors of dementia. In supplementary analyses, we found that after separated adjustment on MMSE and depression, the significant relationships between board game playing and dementia disappeared in both analyses, but most of the effect seems to be due to controlling for MMSE.

Figure 1 Probability of survival without dementia according to regular board game playing. Kaplan-Meier estimates.
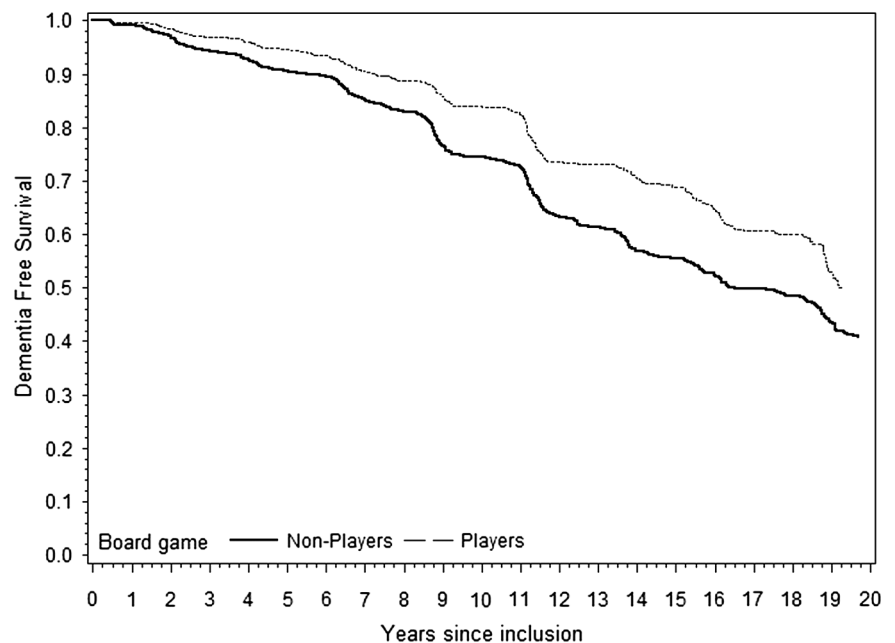
Table 2 Risk of dementia according to board game playing in the Paquid cohort

	Model 1*			Model 2†		
	HR	95% CI	p Value	HR	95% CI	p Value
Board game (players vs non-players)	0.85	0.74 to 0.99	0.04	0.96	0.82 to 1.13	0.62
Gender (female vs male)	1.29	1.10 to 1.52	0.002	1.23	1.04 to 1.46	0.01
Education (higher vs lower)						
Primary school with diploma	0.65	0.56 to 0.76	<0.0001	0.85	0.72 to 1.01	0.07
Secondary level	0.58	0.45 to 0.74	<0.0001	0.84	0.64 to 1.11	0.22
College	0.50	0.36 to 0.71	0.0001	0.76	0.53 to 1.09	0.13
High school	0.38	0.25 to 0.58	<0.0001	0.57	0.37 to 0.88	0.01
Marital status						
Widowed vs married	0.89	0.76 to 1.05	0.16	0.85	0.72 to 1.00	0.05
Single vs married	1.28	0.93 to 1.75	0.12	1.20	0.86 to 1.68	0.28
Divorced vs married	1.16	0.77 to 1.74	0.49	1.06	0.70 to 1.61	0.78
History of stroke (yes vs no)	1.55	1.17 to 2.05	0.0016	1.31	0.97 to 1.78	0.08
Diabetes (yes vs no)	1.10	0.84 to 1.46	0.48	1.05	0.79 to 1.40	0.72
MMSE score				0.91	0.89 to 0.93	<0.0001
Depression (yes vs no)				1.34	1.12 to 1.59	0.001

Multivariate Cox model.
*Adjustment on age, gender, education, marital status, history of stroke and diabetes.
†Adjustment on age, gender, education, marital status, history of stroke, diabetes, mini-mental state examination (MMSE) score and depression.

Finally, we made a supplementary adjustment for the ApoE 4 genotype on a subsample of the Paquid cohort of 618 participants. In this subsample of participants, after adjustment for the ApoE 4 genotype (carriers vs no carriers), the HR for dementia related to playing board games decreased to 0.74 but was no more significant (p=0.06).

Board game playing, cognitive decline and risk of incident depression

Board game players had less cognitive decline in the MMSE score than non-players after adjustment for age, gender, education, marital status, history of stroke and diabetes (β=0.011, p=0.03). The relationship remained unchanged after supplementary adjustment for depression at baseline (β=0.010, p=0.04). Cognitive decline may begin several years before the diagnosis of dementia as shown by us.[16] To explore a possible reverse causation, we studied the relationship between board game playing and cognitive decline, eliminating those who became demented over the first 10 years of follow-up and over the entire period. The β-coefficients decrease slightly (from 0.01 to 0.008) but become non-significant (p=0.07 and p=0.15, respectively). However, a decrease in statistical power and a selection of the sample could explain these results. On the whole, this supplementary analysis is more in favour of a reverse causation from outcome to exposure.

Among the 2987 participants, 2464 were classified as non-depressed at baseline. Of those, 718 developed incident depression (29.1%) during the 20 years of follow-up. The risk of incident depression was significantly reduced in board game players after adjustment for age, gender, education, marital status, history of stroke and diabetes (HR=0.84, 95% CI 0.72 to 0.98; p<0.03). This relationship remained almost unchanged but was only borderline significant after adjustment for MMSE score at baseline screening (HR=0.87, 95% CI 0.74 to 1.02; p=0.08).

DISCUSSION

Playing board games is a common stimulating leisure activity in elderly French people since one-third of participants older than 65 in the general population have reported regularly practising it. The rate of such activity remained high even in very old age and in participants with cognitive deficit. Using the Paquid cohort data with 20 years of follow-up, which is one of the longest durations of follow-up in the world for a population-based cohort, we now show that board game players have a 15% lower risk of developing dementia than non-players. This reduced risk does not seem to be only a short-term effect, as previously reported,[9] but is also a long-term effect with a reduction observed one or even two decades after the baseline collection of this popular leisure activity. The association between board game playing and the risk of dementia remained robust after adjustment for confounding variables such as age, gender, educational level, marital status and presence or absence of stroke or diabetes.

Our results are in accordance with the findings from the Bronx Aging Cohort[10] conducted in a different population in the USA. However, in our study, the relationship disappeared after adjustment for baseline cognition and depression, which are known to be strong predictors of dementia. This means that the reduced risk of dementia could be related to the fact that board game players had better cognitive performances and

were less depressed at baseline screening than non-players. In contrast, the baseline MMSE score and depression appeared to be significantly related to the subsequent risk of dementia.

To test whether cognitive decline and the occurrence of depression were mediating factors in the relationship between playing board games and dementia, we studied non-demented participants with regard to the risk of cognitive decline and incident depression in board game players versus non-players. Board game players had significantly less cognitive decline and less incident depression than non-players. Thus, cognitive decline and depression have the following three statistical conditions which are considered as mediating factors[17]: cognitive decline and depression were associated with an increased risk of dementia; board game playing was associated with a reduced risk of cognitive decline and depression; and after multivariate analysis, playing board games was no longer significantly associated with dementia, unlike MMSE score and depression at baseline. This means that playing board games seems to have a favourable effect on cognition and depression before dementia and could therefore have a favourable effect on the risk of dementia. Of course, we cannot exclude that an unmeasured cognitive decline before baseline could precede the discontinuation of board game playing. The relationship could be bidirectional. Only repeated measures of board game playing along with repeated measures of depression and cognition could disentangle this relationship.

Several explanations could be given to explain the relationship between board game playing, cognitive decline, depression and dementia. Less board game playing might be an early marker or an early consequence of dementia that precedes the decline in the MMSE score and the occurrence of depression before dementia. Another explanation could be that board game playing is a marker of behaviour that promotes successful ageing, and this could be the real non-specific factor protecting against cognitive decline, depression and dementia.[18]

Alternatively, board game playing might increase or preserve cognitive reserve, thereby delaying the clinical onset of dementia[1] or slowing the pathological process of the disease.[10]

Owing to the observational nature of our study, there is a possibility of residual or unmeasured confounding. For example, we did not adjust for genetic factors, which are available only in a small number of the Paquid participants. However, to our knowledge, there is no evidence showing that ApoE 4 carriers play board games less than non-carriers, and there is no obvious plausible biological explanation for such an association. The observed association between board game playing and dementia appears to be independent from educational level and marital status, which may influence people's involvement in board game playing.

Our study has other limitations. Although standard criteria and well-established procedures were used to make the diagnoses, misclassification is inevitable. Only reported regular activities were collected at baseline without direct measurement, although the history was checked by informants whenever possible. We had no precise data on the frequency and duration of board game playing. The refusal rate during the follow-up of the cohort was quite low, but many more participants died than became demented. However, the risk of death was lower in players than in non-players. Even if a competitive risk between death and dementia might occur, it would lead to an underestimation of the risk of dementia in non-players.

With a long follow-up, this epidemiological study suggests that playing board games has a protective effect on cognitive decline, depression and dementia. But this effect appears to be based on cognitive loss at the time of baseline assessment in those who were becoming demented. A reverse causation remains possible. Only controlled studies could truly establish whether playing board games is beneficial and could rule out a reverse causation.

However, such a trial appears almost impossible to organise without the possibility of blinding. Even if the evidence is not completely documented, the immediate pleasure procured by playing board games, the advantages that social interaction offers and the ease of applying such a measure in the real world without any drawbacks mean that this activity could be promoted for successful ageing.

REFERENCES

1. Stern Y. Cognitive reserve in ageing and Alzheimer's disease. *Lancet Neurol* 2012;11:1006–12.

2. Akbaraly TN, Portet F, Fustinoni S, *et al*. Leisure activities and the risk of dementia in the elderly: results from the Three-City Study. *Neurology* 2009;73:854–61.
3. Stern Y, Blumen HM, Rich LW, *et al*. Space Fortress game training and executive control in older adults: a pilot intervention. *Neuropsychol Dev Cogn B Aging Neuropsychol Cogn* 2011;18:653–77.
4. Barnes DE, Yaffe K, Belfor N, *et al*. Computer-based cognitive training for mild cognitive impairment: results from a pilot randomized, controlled trial. *Alzheimer Dis Assoc Disord* 2009;23:205–10.
5. Cohen GD, Firth KM, Biddle S, *et al*. The first therapeutic game specifically designed and evaluated for Alzheimer's disease. *Am J Alzheimers Dis Other Demen* 2008;23:540–51.
6. Bosch-Domenech A, Nagel R, Sanchez-Andres JV. Prosocial capabilities in Alzheimer's patients. *J Gerontol B Psychol Sci Soc Sci* 2010;65B:119–28.
7. Clarkson-Smith L, Hartley AA. The game of bridge as an exercise in working memory and reasoning. *J Gerontol* 1990;45:P233–8.
8. Nouchi R, Taki Y, Takeuchi H, *et al*. Brain training game improves executive functions and processing speed in the elderly: a randomized controlled trial. *PLoS* 2012;7:e29676.
9. Fabrigoule C, Letenneur L, Dartigues, *et al*. Social and leisure activities and risk of dementia: a prospective longitudinal study. *J Am Geriatr Soc* 1995;43:485–90.
10. Verghese J, Lipton RB, Katz MJ, *et al*. Leisure activities and the risk of dementia in the elderly. *N Engl J Med* 2003;348:2508–16.
11. Hughes TF, Chang C-CH, Vander Bilt J, *et al*. Engagement in reading and hobbies and risk of incident dementia: the MoVIES project. *Am J Alzheimers Dis Other Demen* 2010;25:432–8.
12. Dartigues JF, Gagnon M, Michel P, *et al*. The Paquid research program on the epidemiology of dementia. Methods and initial results. *Rev Neurol (Paris)* 1991;147:225–30.
13. Folstein MF, Folstein SE, McHugh PR. 'Mini-mental state'. A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* 1975;12:189–98.
14. Fuhrer R, Antonucci TC, Gagnon M, *et al*. Depressive symptomatology and cognitive functioning: an epidemiological survey in an elderly community sample in France. *Psychol Med* 1992;22:159–72.
15. Proust-Lima C, Dartigues JF, Jacqmin-Gadda H. Misuse of the linear mixed model when evaluating risk factors of cognitive decline. *Am J Epidemiol* 2011;174:1077–88.
16. Amieva H, Le Goff M, Millet X, *et al*. Prodromal Alzheimer's disease: successive emergence of the clinical symptoms. *Ann Neurol* 2008;64:492–8.
17. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol* 1986;51:1173–82.
18. Dartigues JF, Feart C. Risk factors for Alzheimer disease: aging beyond age? *Neurology* 2011;77:206–7.