Scandinavian Journal of Psychology, 2014, 55, 136–141 DOI: 10.1111/sjop.12107

Health and Disability

The relationship between memory complaints, activity and perceived health status

P.-L. LEE[1,2]

[1]*Department of Educational Psychology and Counseling, National Pingtung University of Education, Pingtung City, Taiwan*
[2]*Counseling Center, National Pingtung University of Education, Pingtung City, Taiwan*

Lee, P.-L. (2014). The relationship between memory complaints, activity and perceived health status. *Scandinavian Journal of Psychology* 55, 136–141.

Subjective memory complaints (SMC) is a possible symptom of mild cognitive impairment which may progress to dementia. The present study examines the relationship of physical activity (PA), cognitive activity (CA), social activity (SA), and perceived health status (HS) with SMC for middle age and older adults. Participants were from the MIDUS II study (Midlife in the United States) recruited in 2004–2006 (Mean age = 55.99; N = 3030). Hierarchical multiple regression was performed with SMC as the dependent variable, along with PA, CA, SA, and HS as the independent variables. The study revealed that SMC was strongly related to PA, CA, and HS, while controlling covariates. Further, HS had the strongest link with SMC among these predictors while interaction effects (PA × HS, CA × HS, and SA × HS) were insignificant. In addition, different results were achieved in younger versus older groups. Participants with more CA, PA and perception of better health had lower frequency of memory complaints.

Key words: Health status, physical activity, cognitive activity, social activity, subjective memory complains.

Pai-Lin Lee, Department of Educational Psychology and Counseling, National Pingtung University of Education. Rm. 1227, No.4–18 Minsheng Rd., Pingtung City, 90003, Taiwan. Tel: +886-8-7226141- 31356; fax: +886-8-7239850; e-mail: orientalpai@yahoo.com

INTRODUCTION

Preexisting studies have revealed that subjective memory complaints (SMC) in the elderly may hold value as a predictor of dementia (Abdulrab & Heun, 2008; Amieva, Le Goff, Millet *et al*., 2008; Frisoni, Fox, Jack, Scheltens & Thompson, 2010; Geerlings, Jonker, Bouter, Adèr & Schmand, 1999; Jessen, Wiese, Bachmann *et al*., 2010; Jonker, Dik, Van Kamp & Deeg, 2000; van Harten, Smits, Teunissen *et al*., 2013; Wang, van Belle, Crane *et al*., 2004). For example, Amieva *et al*. (2008) discovered, as early as 12 years before dementia, the decline in cognitive performance with the following memory complaints can be detected using measures of semantic memory and conceptual formation. Jessen *et al*. (2010) proposed that SMC are a possible pre-mild cognitive impairment condition in the clinical manifestation of Alzheimer disease. Frisoni *et al*. (2010) suggested SMC is likely a mild cognitive impairment symptom. In addition, van Harten *et al*. claimed that cerebrospinal fluid evidence of preclinical AD in patients with subjective complaints predicted cognitive decline over time. Elderly people with SMC seem to have 2.7 times higher risk to develop dementia than those without (Wang *et al*, 2004). Accordingly, SMC might be a good predictor of memory loss with possible links to dementia. Early evaluation of cognitive functioning, such as memory complaints, is essential to establish adequate preventive and intervention strategies to cognitive impairment (Juncos-Rabadán, Pereiro, Facal *et al*., 2013).

Factors such as decreased physical activity (PA) (Doaga & Lee, 2008; Flöel, Ruscheweyh, Krüger *et al*., 2010; Ghosh, Agarwal & Haggerty, 2011), decreased cognitive activity (CA) (Lachman, Agrigoroaei & Murphy, 2010; Verghese, Lipton, Katz *et al*., 2003; Wilson, Mendes De Leon, Barnes, 2005), and poor perceived health status (HS) (Bluestein & Rutledge, 2006; Kim & Kang, 1998) or objective health situation (Bartley, Bokde, Ewers *et al*., 2012; Comijs, Deeg, Dik, Twisk & Jonker, 2002; Doaga & Lee, 2008; dos Santos, Leyendecker, Costa, de Souza-Talarico, 2012) have all been associated with memory loss or dementia reported by patients or family members. For example, Ghosh *et al*. (2011) found that cognitive processing speed and memory retrieval speed decline as much as 20% by 40 years of age, whereas PA may be a potential factor for protecting and preventing cognitive decline. In addition, using modern magnetic resonance voxel-based morphometry, Flöel *et al*. (2010) showed a higher level of PA was associated with higher level of neurotrophin and increased cerebral gray matter volume in the human prefrontal and cingulate cortex. On the other hand, other studies claimed that the protective effects of PA on dementia or cognitive impairment may be overly optimistic (Morgan, Gallacher, Bayer, Fish, Ebrahim & Ben-Shlomo, 2012; Plassman, Williams, Burke, Holsinger & Benjamin, 2010).

CA has been associated with cognitive function in previous studies. For example, Wilson *et al*. (2005) showed that CA was associated with better cognitive function, especially semantic memory and perceptual speed. Verghese *et al*. (2003) claimed increasing CA was significantly associated with a reduced risk of dementia. Though studies have shown that CA may affect semantic memory, episodic memory, or dementia (Lachman, 2010; Verghese *et al*., 2003; Wilson *et al*., 2005), studies directly exploring the relationship between CA and SMC are rare.

Social activity (SA) was also posited to relate to cognitive function (Wilson *et al*., 2007; Ybarra, Burnstein, Winkielman, Keller, Manis & Rodriguez, 2008). For example, Ybarra *et al*. (2008) suggested socializing was just as effective as more traditional mental exercises in boosting memory and intellectual performance. Their findings suggested that spending just 10 minutes a day talking to another person can help improve memory performance. However,

one German population survey did not find frequency of social contacts or social support to be related to risk of dementia (Bickel & Cooper, 1994). Similarly, one study claimed that emotional loneliness related to increased risk of cognitive decline in some analyses but not others (Tilvis, Kähönen-Väre, Jolkkonen, Valvanne, Pitkala & Strandberg, 2004).

Studies have also found SMC associated with depression (Grambaite, Hessen, Auning, Aarsland, Selnes, Fladby, 2013; Mowla, Ashkani, Ghanizadeh, Dehbozorgi, Sabayan & Chohedri, 2008; Singh-Manoux, Dugravot, Ankri *et al*., 2013; Van der Flier, van Buchem, Weverling-Rinjsburger *et al*., 2004; Vogel, 2008), or linked to either perceived health status (HS) (Bluestein & Rutledge, 2006; Kim & Kang, 1998) or to objective health status (Bartley *et al*., 2012; Comijs *et al*., 2002; Doaga & Lee, 2008; dos Santos *et al*., 2012). HS is the way people rate their own overall health, it usually matches well with objective health status (Hunt, McKenna, McEwen, Backett, Williams & Papp, 1980; Unden & Elofsson, 2001). Comijs *et al*. (2002) suggested that when older people complain about their memory while not showing actual cognitive decline, these complaints might actually reflect their psycho-affective or health problems.

As aforementioned, the relationship between frequent PA, CA, SA, and cognitive functions is debatable. The current study therefore chooses these variables, including HS, within one model to investigate their relative relationship to SMC and their interaction. This approach was not seen in previous studies. Dementia is currently a major healthcare challenge all over the world. Research exploring the relationship among these factors could possibly contribute to the prevention of this disease.

Accordingly, the goals of current study are to answer two research questions: (1) Are PA, CA, SA, and HS related to SMC? And (2) Would the magnitude of the relationship between HS and SMC be reduced for those with higher level of PA, CA, and SA? We predict that those with higher PA, CA, and SA, and lower health status would associate with a lower prevalence of SMC. We also expect the link between low HS and high SMC would be attenuated for those engaging in high levels of PA, CA, and SA (significant interaction effects). We expect these results to hold when adjusting for age, sex, financial condition, education level, and depression status.

METHODS

Study Sample

Data was drawn from the Midlife Development in the United States (MIDUS) surveys. Subjects constituted a nationally representative sample of noninstitutionalized, English-speaking adults within the coterminous United States in 1995 (wave I) (Ryff, David, Almeida, Ayanian, Carr & Cleary, 2012). A longitudinal follow-up, 10 years later in 2005, of the original MIDUS participants (wave II) yielded a sample of 3,053 consisting of those who had completed all measures used in this study. Twenty-three outliers (z score > = 3) on all measures were excluded, the resulting in a sample size of 3,030 for this study. This group ranged in age from 34 to 85 (Mean = 55.99, SD = 11.81).

Independent and Dependent Variables

All measures were collected via phone interview and extensive self-administered questionnaires.

Dependent variable

Subjective Memory Complaints. This is a 2-item variable, which inquires of participants about current memory function compared to 5 years ago (i.e., "How would you rate yourself today compared to five years ago on … memory?") and compared with others (i.e., "Compared to other people your age, how would you rate your memory?") Participants rated their subjective memory performance for both questions on a five-point scale ranging from 1 ("improved a lot") to 5 ("gotten a lot worse") and from 1 (excellent) to 5(poor), respectively. A lower score indicates better memory (less memory complaints) while a higher score indicates memory worsening (more memory complaints).

Cronbach's alpha reliability of the two items is 0.63. An exploratory principal component factor analysis with varimax rotation yielded one factor with eigenvalues greater than one. The scree plot showed one factor which accounts for 73.53% of total cumulative variance.

Independent variables

Frequency of engaging in PA. Twelve questions assessing the participant's levels of vigorous (e.g., competitive sports such as running, vigorous swimming, high intensity aerobics) and moderate intensity (e.g., leisurely sports like light tennis, slow or light swimming, low impact aerobics, or brisk walking) PA were used. The questions referred to participants engaging in PA during summer and winter seasons while at the domains of job, home, or during leisure time. Based on their answers for each domain, scores of 1(never) to 6(several times a week) were coded. The questions for participant levels of PA are the same for all three domains and both seasons. That is, two questions (one for summer, the other for winter) in total for each level under each domain. The means across summer and winter in all three domains for both moderate and vigorous intensity were computed (Lachman *et al*., 2010). A higher value represents higher frequency of PA across all domain and intensity levels.

The sample question for probing vigorous (high) PA was: "How often do you engage in vigorous physical activity that causes your heart to beat so rapidly that you can feel it in your chest and you perform the activity long enough to work up a good sweat and are breathing heavily?" This question is asked twice (one for summer and one for winter) and asked for each domain.

Frequency of engaging in CA. The CA variable was created by averaging the self-reported frequencies of engaging in six common mental activities: reading books, magazines or newspapers; do word games such as crossword, puzzles, or scrabbles; play cards or other games such as bridge or chess; attending educational lectures or courses; do writing such as letters, stories, or journal entries; use computer to send email or search the internet on a six-point scale (e.g.,1 = never, 2 = once a month, 3 = several times a month, 4 = once a week, 5 = several times a week, 6 = daily).

The total amount of time and the number of times engaging in SC. The SC variable was created by averaging the self-reported amount of time (by hour) for four types of volunteer works (i.e., health related work; school or youth-related work; political organizations; any other organization, cause or charity) and the number of times attending various kind of meetings (unions or professional groups; sport or social groups; any other groups). Because the scale in both items are different, both the mean z-score of volunteer work and of attending meeting were created. So a higher mean z-score indicates more SC for the participants.

Health status. Participants rated their physical health on a five-point scale for two questions: 1. "In general, would you say your physical health is excellent, very good, good, fair, or poor (from 1: poor to 5: excellent)?" and 2. "In general, compared to most men/women your age, would you say your health is much better, somewhat better, about the same, somewhat worse, or much worse (from 1: much

worse to 5: much better)?" So a higher score indicates better overall health.

Covariates

Demographic variables. We examined age, sex (1 = male, 2 = female), education level (1 = no school, 12 = Ph.D. or professional degree) and financial situation (0 = the worst possible financial situation, 10: the best possible financial situation).

Depression. Those indicating having experienced or have been treated for an emotional disorder such as depression in the past 12 months were coded as 1(yes) or 0 (no).

General statistical analysis

All variables were computed for correlation coefficients. Hierarchical multiple regression analysis was performed by first entering the covariates, and second entering the other block of predictors (PA, CA, SA, and HS) to test our first hypothesis for the relationship of PA-SMC, CA-SMC, SA-SMC, and HS-SMC, while controlling covariates. In order to understand the potential moderators of PA, CA, and SA on the HS-SMC relationship, the interaction effects of (PA × HS), (CA × HS), and (SA × HS) were tested while controlling for age, sex, education, financial situation, and depression.

RESULTS

Descriptive characteristics and inter-correlations for all variables were shown in Table 1. All independent variables in the table were negatively related to SMC. In hierarchical multiple regression model 1, the covariates of education, financial situation, and depression were significantly related to SMC, adjusted R^2 change = 0.06, F (5, 2948) = 39.91, $p < 0.01$. In model 2, a step-2 analysis was conducted to evaluate whether the PA, CA, SA, and HS measures predicted SMC over and above the covariates. Excepting SA, the variables of PA, CA, and HS were significantly related to SMC even after controlling for the covariates, with adjusted R^2 change = 0.10, F (7, 2941) = 50.73, $p < 0.01$ (Table 2). These results suggest that more frequent engagement in PA/CA, and better self-perceived health conditions are related to less memory impairment. The interaction effects with perceived health status were not significant for all predictors (PA × HS, CA × HS, and SA × HS).

A secondary statistic analysis was conducted to explore if different results would be achieved in younger (age < 65) groups, as opposed to older groups. In the younger group, the results showed that only CA and HS were significantly related to SMC, with $p < 0.01$, after controlling for the covariates (Table 3). For

Table 2. *Multiple regressions with subjective memory complains as dependent variables, after adjusting for covariates (age, sex, education, finance situation, and depression)*

IV	B	Beta	t	*p* value
Model 1	DV = SMC			
Age	0.00	0.00	0.23	0.82
Gender	0.03	0.01	0.63	0.53
Education	–0.07	–0.11	–5.96	0.00
Finance	–0.07	–0.11	–5.64	0.00
Depression	0.58	–0.17	9.08	0.00
Model 2	DV = SMC			
Age	0.00	0.03	–1.37	0.17
Gender	0.09	0.03	1.79	0.07
Education	–0.01	–0.02	–0.81	0.42
Finance	–0.02	–0.03	–1.88	0.06
Depression	0.41	0.12	6.68	0.00
HS	–0.24	–0.30	–16.11	0.00
PA	–0.04	–0.04	–1.93	0.05
CA	–0.22	–0.13	–7.01	0.00
SA	0.01	0.02	0.914	0.36
PA x HS	–0.01	–0.01	–0.74	0.46
CA x HS	–0.01	–0.01	–0.60	0.55
SA x HS	0.00	0.00	0.18	0.86

Notes: SMC = subjective memory complaints, IV = Independent Variable, PA = physical activity, CA = cognitive activity, SA = social activity (z–score), HS = perceived health status, SMC = subjective memory complains. B = unstandardized multiple regression coefficient, β = standardized multiple regression coefficient, t = t test.

Table 1. *Means, standard deviations, and intercorrelations between all covariates and independent and dependent variables*

	M	SD	Age	Sex	Education	Finance	Depression	PA	CA	SA	HS
Age[a]	55.99	11.82									
Sex	–	–	–0.04*								
Education[b]	7.37	2.51	–0.11*	–0.11*							
Finance[c]	6.45	2.12	0.15*	–0.08*	0.16*						
Depression[d]	–	–	–0.05*	0.16*	–0.03	–0.18*					
PA	3.14	1.29	–0.29*	–0.15*	0.10*	0.02	–0.02				
CA	3.06	0.82	–0.05*	0.12*	0.35*	0.11*	–0.03	0.09*			
SA	0	1	0.02	0.02	0.16*	0.07*	–0.03	0.09*	0.23*		
HS	2.32	1.69	–0.03	–0.04*	0.21*	0.26*	–0.20*	0.18*	0.13*	0.11*	
SMC	2.93	1.36	–0.01	0.06*	–0.14*	–0.15*	0.19*	–0.10*	–0.18*	–0.06*	–0.36

Notes: M = Mean, SD = standard deviation, PA = physical activity (1: never, 6: several times a week), CA = cognitive activity (1: never, 6: daily), SA = social activity (z–score), HS = perceived health status (1:poor, 5: excellent), SMC = subjective memory complains (1: low complains, 5:high complains), *Correlation is significant at 0.01 level (2–tailed), N = 3030.

[a]Age: 75.50% of participants under age of 65.

[b]Education = 7 (equal to 3 or more years of college, no degree yet).

[c]Finance scale: 0 = worst possible finance, 10 = best possible finance.

[d]Depression: 1 = Yes, 0 = No.

Table 3. *Multiple regression on group comparison with subjective memory Complaints as dependent variable, after adjusting for covariates (age, sex, education, finance situation, and depression)*

IV	B	Beta	t	*p* value
Young (N = 2,289)	DV = SMC			
HS	–0.25	0.02	–13.75	0.00
PA	–0.04	–0.02	–1.62	0.11
CA	–0.23	0.04	–6.05	0.00
SA	–0.01	0.02	–0.28	0.78
PA x HS	–0.01	0.01	–0.64	0.52
CA x HS	–0.01	0.02	–0.38	0.71
SA x HS	0.00	0.01	–0.39	0.70
Old (N = 741)	DV = SMC			
HS	–0.21	0.03	–6.75	0.00
PA	–0.03	–0.02	–0.65	0.52
CA	–0.19	0.06	–3.32	0.00
SA	0.07	0.03	2.63	0.01
PA x HS	–0.03	–0.02	–1.18	0.24
CA x HS	–0.01	–0.03	–0.47	0.64
SA x HS	0.02	0.01	1.68	0.09

Notes: IV = Independent Variable, PA = physical activity, CA = cognitive activity, SA = social activity (z–score), HS = perceived health status, SMC = subjective memory complains. B = unstandardized multiple regression coefficient, β = standardized multiple regression coefficient, t = t test.

older adults, CA, SA, and HS were all significantly related to SMC, with $p < 0.01$, $p = 0.01$, and $p < 0.01$, respectively. These findings indicated that when further analyzed by two age groups (young and old), the results differed from the original heterogeneous sample.

DISCUSSION

Summary of the key study findings

Participants who engaged in more PA, CA and had better HS had less SMC. Interaction effects were not found in the present study (PA × HS, CA × HS, and SA × HS).

Contribution of this study to the existing literature

Previous studies have demonstrated the possible link between PA, CA, SA, HS, and cognitive impairment (mostly dementia or mild cognitive impairment). However, few studies have directly examined these relative relationships with SMC in one model. In addition, the present study is rare in that it examined randomly selected national (US) representative community dwelling middle age or older adult samples. The study focused on the link between the PA domains (including work-related PA, household PA, leisure-time PA) and SMC, between the six different cognitive activities (reading, do word games, play cards, attend lecture, writing, search internet) and SMC, and between SA (volunteer work and attend social/professional/sport club) and SMC all in one model. Accordingly, this approach allows readers to see the relative strength of the links in the comprehensive dataset. The results revealed that PA, CA, and HS associated to SMC after adjusting for covariates, with HS having the strongest link to SMC, followed by CA, then PA. Surprisingly, SA was not related to SMC. However, the secondary analysis of the present study for older adults (age > = 65) revealed that SA is significantly related to SMC.

Further, this study provided the interaction terms for PA × HS, CA × HS, and SA × HS. This allows testing of the possible moderator between HS and SMC for PA, CA, and SA. Such interaction effects are rarely examined by other studies.

Research question 1: Are PA, CA, SA, and HS related to SMC?

Yes, they were all related to SMC save for SA.

In addition to many positive effects of PA on health (Lee, 2013; Lee, Lan & Lee, 2012; Lee, Lan & Yen, 2011), our findings showed that PA was related to SMC. Many studies suggested that PA was associated with reduced risk for cognitive impairment in older adults (Larson, Wang, Bowen, McCormick, Teri & Kukull, 2006), though not 100% consistent (Morgan *et al*. 2012). In addition, one study claimed that exercise increased hippocampal volume by 2%, effectively reversing age-related loss by 1 to 2 years (Erickson, Voss, Prakash *et al*., 2011). Accordingly, active seniors possibly had a lower risk of SMC, given the close relationship between SMC and mild cognitive impairment (MCI).

CA also related to SMC in our study. Supported by imaging evidence, CA was shown to positively alter the responsiveness of brain neural mechanisms in middle-aged and older adults (Stern, 2006). In another follow-up prospective study of 4.5 years, frequency of participation in common cognitive activities (e.g., reading a newspaper, magazine, books) was assessed at baseline for 801 elderly Catholic nuns, priests, and brothers without dementia (Wilson et al, 2002). The findings suggest that frequent participation in cognitively stimulating activities are associated with reduced risk of AD by 33%.

Surprisingly, SA did not relate to SMC in the present study, which contradicts some findings (Wilson *et al*., 2007; Ybarra *et al*., 2008), and is consistent with Bickel and Cooper (1994). The broad definitions of SA among studies (e.g., frequency of social contacts or volunteer works, within and outside the family circle, standard of social support, and living in single person household) and the measures of different dependent variables (SMC in our study and cognitive function in others), may contribute to the inconsistent findings on relationships. Even though the benefits of SA was not found in the present study for the broad age range, there are links to many other benefits (such as life satisfaction) in literature (Jang, Mortimer, Haley & Borenstein, 2004; Liang, Shaw, Krause, Bennett, Kobayashi & Sugihara, 2005).

Similar to previous studies (Bartley *et al*., 2012; Comijs, 2002; Doaga & Lee, 2008), our findings showed there is a negative relationship between HS and SMC. HS has the strongest relationship to SMC compared to the other three predictors in the present study. Haley, Hoth, Gunstad *et al*. (2009) claimed that some patients with cardiovascular disease appear to be at high risk for cerebrovascular complications and cognitive decline, and this decline seems to be captured by patient subjective reports of relative decrements in their cognitive function.

Research question 2: Would the magnitude of the relationship between HS and SMC be reduced for those with higher level of PA, CA, and SA?

This concerns if the potential modifiable behaviors (PA, CA, and SA) makes any difference on SMC (interaction effect) for those with lower HS than for those with higher HS. The present study may be the first in exploring such interaction effects on SMC. However, significant effects are not found in the present study. The insignificant interaction results indicate that the relationships between PA/CA/SA and SMC were not stronger in people with lower HS than in people with better HS.

For better understanding, a secondary analysis was conducted and revealed the distinction between the young vs. old age groups. This finding echoes previous research regarding the association between SA and SMC (Wilson *et al*., 2007; Ybarra *et al*., 2008; Yeh & Liu, 2003), while disagreeing from the others (Bickel & Cooper, 1994). SA participation has been considered as one of the main factors for successful aging (Bowling, 2006, Lee, Lan & Yen, 2011), which suggests that social interaction with others may be particularly important for aging people. It has been claimed that there is an association between social activity and cognitive function among the elderly. This connection might be even more apparent when their physical health declines.

Studies have found self-perceived cognitive difficulties relate to objectively measured cognitive decline over time. Accordingly, they may provide important clinical information about early neurodegenerative processes that should be carefully monitored (Haley *et al*., 2009). The current study also has some limitations. The cross-sectional study only offers current relationships but no prediction of future memory impairments. The results concern a group from 34 to 85 years old, which may be too heterogeneous and should deserve more attention when applying to future research. In addition, all measures were collected via phone interviews and no objective cognitive testing was performed. It might be that some cognitive impairment subjects had reduced insight concerning their own health.

The study results raise the possibility that PA, CA, and HS might have neuroprotective effects. However, more randomized trials are needed to support this hypothesis. In addition, future studies are also needed to determine whether frequently engaging in PA or CA have a protective effect for mild cognitive impairment or dementia among those lower or higher HS. The specific domains of PA and what daily type of CA is related to (or even predict to) SMC also deserves to be investigated in future study.

Implication of current research

Though age is related to memory deterioration, keeping active both physically and psychologically is one way to lower individual memory complaints.

In conclusion, awareness of subjective memory impairment is important as it may be an indicator for mild cognitive impairment which often leads to dementia. PA, CA, and HS deserve further exploration because they are all significantly related to memory complaints.

REFERENCES

Abdulrab, K. & Heun, R. (2008). Subjective memory impairment: A review of its definitions indicates the need for a comprehensive set of standardized and validated criteria. *European Psychiatry*, *23*, 321–330.

Amieva, H., Le Goff, M., Millet, X., Orgogozo, J. M., Pérès, K., Barberger-Gateau, P., *et al*. (2008). Prodromal Alzheimer's disease: Successive emergence of the clinical symptoms. *Annals of Neurology*, *64*, 492–498.

Bartley, M., Bokde, A. L., Ewers, M., Faluyi, Y. O., Tobin, W. O., Snow, A., *et al*. (2012). Subjective memory complaints in community dwelling healthy older people: The influence of brain and psychopathology. *International Journal of Geriatric Psychiatry*, *27*, 836–43.

Bickel, H. & Cooper, B. (1994). Incidence and relative risk of dementia in an urban elderly population: Findings of a prospective field study. *Psychological Medicine*, *24*, 179–192.

Bluestein, D. & Rutledge, C. M. (2006). Perceived health and geriatric risk stratification Observations from family practice. *Canadian Family Physician*, *52*, 626–627.

Bowling, A. (2006). Lay perceptions of successful ageing: Findings from a national survey of middle aged and older adults in Britain. *European Journal of Ageing*, *3*, 123–136.

Comijs, H. C., Deeg, D .J. H., Dik, M. G., Twisk, J. W. & Jonker, C. (2002). Memory complaints; the association with psycho-affective and health problems and the role of personality characteristics. A 6-year follow-up study. *Journal of Affective Disorder*, *72*, 157–165.

Doaga, D. & Lee, T. (2008). What could be behind your elderly patient's subjective memory complaints? *Journal of Family Practice*, *57*, 333–334.

dos Santos, A. T., Leyendecker, D. D., Costa, A. L. & de Souza-Talarico, J. N. (2012). Subjective memory complain in healthy elderly: influence of depressive symptoms, perceived stress and self-esteem. *Revista da Escola de Enfermagem da USP*, *46*, 24–29.

Erickson, K. I., Voss, M. W., Prakash, R. S., Basak, C., Szabo, A., Chaddock, L., *et al*. (2011). Exercise training increases size of hippocampus and improves memory. *Proceedings of the National Academy of Sciences*, *108*, 3017–3022.

Flöel, A., Ruscheweyh, R., Krüger, K., Willemer, C., Winter, B., Völker, K., *et al*. (2010). Physical activity and memory functions: Are neurotrophins and cerebral gray matter volume the missing link? *Neuroimage*, *49*, 2756–2763.

Frisoni, G .B., Fox, N. C., Jack, C. R. Jr., Scheltens, P. & Thompson, P.M. (2010). The clinical use of structural MRI in Alzheimer disease. *Nature Reviews Neurology*, *6*, 67–77.

Geerlings, M. I., Jonker, C., Bouter, L. M., Adèr, H.J. & Schmand, B. (1999). Association between memory complaints and incident Alzheimer's disease in elderly people with normal baseline cognition. *American Journal of Psychiatry*, *156*, 531–537.

Ghosh, K., Agarwal, P. & Haggerty, G. (2011). Alzheimer's disease: Not an exaggeration of healthy aging. *Indian Journal of Psychological Medicine*, *33*, 106–114.

Grambaite, R., Hessen, E., Auning, E., Aarsland, D., Selnes, P. & Fladby, T. (2013). Correlates of subjective and mild cognitive impairment: Depressive symptoms and CSF biomarkers. *Dementia Geriatric Cognition Disorder Extra*, *3*, 291–300.

Haley, A.P., Hoth, K.F., Gunstad, J., Paul, R.H., Jefferson, A.L., Tate, D.F., *et al*. (2009). Subjective cognitive complaints relate to white matter hyperintensities and future cognitive decline in patients with cardiovascular disease. *American Journal of Geriatric Psychiatry*, *17*, 976.

Hunt, S. M., McKenna, S. P., McEwen, J., Backett, E. M., Williams, J. & Papp, E. (1980). A quantitative approach to perceived health status: A validation study. *Journal of Epidemiology Community Health*, *34*, 281–286.

Jang, Y., Mortimer, J. A., Haley, W. E. & Borenstein, G. A. R. (2004). The role of social engagement in life satisfaction: Its significance among older individuals with disease and disability. *Journal of Applied Gerontology*, *23*, 266–278.

Jessen, F., Wiese, B., Bachmann, C., Eifflaender-Gorfer, S., Haller, F., Kölsch, H., *et al*. (2010). Prediction of dementia by subjective memory impairment: effects of severity and temporal association with cognitive impairment. *Archives of General Psychiatry*, *67*, 414–422.

Jonker, C., Dik, M. G., Van Kamp, G. J. & Deeg, D. J. (2000). Apolipoprotein E4 and memory decline in the elderly. *Tijdschrift voor Gerontologie en Geriatrie*, *31*, 198–202.

Juncos-Rabadán, O., Pereiro, A. X., Facal, D., Lojo, C., Caamaño, J. A., Sueiro, J., *et al*. (2013). Prevalence and correlates of mild cognitive impairment in adults aged over 50 years with subjective cognitive complaints in primary care centers. *Geriatrics & Gerontology International*, doi:10.1111/ggi.12157.

Kim, J. H. & Kang, H. S. (1998). Relationships between health, depression, memory, self–efficacy, and metamemory in adults. *Korean Journal Rehabilitaion Nursing*, *1*, 61–72.

Lachman, M. E., Agrigoroaei, S. & Murphy, C. (2010). Frequent cognitive activity compensates for education differences in episodic memory. *American Jouirnal of Geriatric Psychiatry*, *18*, 4–10.

Larson, E. B., Wang, L, Bowen, J. D., McCormick, W. C., Teri, L & Kukull, W. (2006). Exercise is associated with reduced risk for incident dementia among persons 65 years of age and older. *Annals of Internal Medicine*, *144*, 73–81.

Lee, P. L. (2013). Depressive symptoms negate the beneficial effects of physical activity on mortality risk. *International Journal of Aging and Development.*, *76*, 167–181.

Lee, P. L., Lan, W. & Lee, C.-L. C. (2012). Physical activity related to depression and predicted mortality risk: Results from Americans' changing lives study. *Educational Gerontology*, *38*, 678–690.

Lee, P. L., Lan, W. & Yen, T. W. (2011). Aging successfully: A four-factor model. *Educational Gerontology*, *37*, 210–227.

Liang, J., Shaw, B.A., Krause, N., Bennett, J.M., Kobayashi, E. & Sugihara, Y. (2005). How does self-assessed health change with age? A study of older adults in Japan. *Journal of Gerontology B Psychological Science Social Science*, *60*, S224–S232.

Morgan, G. S., Gallacher, J., Bayer, A., Fish, M., Ebrahim, S. & Ben-Shlomo, Y. (2012). Physical activity in middle-age and dementia in later life: Findings from a prospective cohort of men in Caerphilly, South Wales and a meta-analysis. *Journal of Alzheimer's Disease*, *31*, 569–580.

Mowla, A., Ashkani, H., Ghanizadeh, A., Dehbozorgi, G. R, Sabayan, B. & Chohedri, A. H. (2008). Do memory complaints represent impaired memory performance in patients with major depressive disorder? *Depress Anxiety*, *25*, E92–96.

Plassman, B.L., Williams, J. W., Burke, J. R., Holsinger, T. & Benjamin, S. (2010). Systematic review: Factors associated with risk for and possible prevention of cognitive decline in later life. *Annals of Internal Medicine*, *153*, 182–193.

Ryff, C., David, M., Almeida, J. S., Ayanian, D. S., Carr, P. D. & Cleary, C. C. (2012). *National survey of Midlife Development in the United States (MIDUS II), 2004–2006*. CPSR04652–v6. Ann Arbor, MI: Inter–university Consortium for Political and Social Research.

Singh-Manoux, A., Dugravot, A., Ankri, J., Nabi, H., Berr, C., Goldberg, M., *et al*. (2013). Subjective cognitive complaints and mortality: Does the type of complaint matter? *Journal Psychiatric Research*, *48*, 73–78.

Stern, Y. (2006). Cognitive reserve and Alzheimer disease. *Alzheimer Disease and Associated Disorders*, *20*, 112–117.

Tilvis, R. S., Kähönen-Väre, M. H., Jolkkonen, J., Valvanne, J., Pitkala, K. H. & Strandberg, T. E. (2004). Predictors of cognitive decline and mortality of aged people over a 10-year period. *Journal of Gerontol: A Biological Science Medicine Science*, *59*, 268–274.

Unden, A. L. & Elofsson, S. (2001). Health from the patient's point of view. How does it relate to the physician's judgment? *Family Practice*, *18*, 174–180.

van der Flier, W. M., van Buchem, M. A., Weverling-Rijnsburger, A. W., Mutsaers, E. R., Bollen, E. L., Admiraal-Behloul, F., *et al*. (2004). Memory complaints in patients with normal cognition are associated with smaller hippocampal volumes. *Journal of Neurology*, *251*, 671–675.

van Harten, A. C., Smits, L. L., Teunissen, C. E., Visser, P. J., Koene, T., Blankenstein, M. A., *et al*. (2013). Preclinical AD predicts decline in memory and executive functions in subjective complaints. *Neurology*, *81*, 1409–1416.

Verghese, J., Lipton, R.B., Katz, M.J., Hall, C.B, Derby, C.A., Kuslansky, G., *et al*. (2003). Leisure activities and the risk of dementia in the elderly. *New England Journal of Medicine*, *348*, 2508–2516.

Vogel, A. (2008). Subjective memory complaints in older people. Is it a symptom of dementia? *Ugeskr Laeger*, *170*, 1728–33.

Wang, L., van Belle, G., Crane, P. K., Kukull, W. A., Bowen, J. D. & Larson, E. B. (2004). Subjective memory deterioration and future dementia in people aged 65 and older. *American Geriatrics Society*, *52*, 2045–2051.

Wilson, R. S., Barnes, L. L., Krueger, K. R, Hoganson, G., Bienias, J. L. & Bennett, D.A. (2005). Early and late life cognitive activity and cognitive systems in old age. *International Neuropsychological Society*, *11*, 400–407.

Wilson, R. S., Krueger, K. R, Arnold, S.E., Schneider, J. A., Kelly, J. F., Barnes, L. L., *et al*. (2007). Loneliness and risk of Alzheimer disease. *Archives of General Psychiatry*, *64*, 234–240.

Wilson, R. S., Mendes, De Leon, C. F., Barnes, L. L., Schneider, J, A., Bienias, J. L., *et al*. (2002). Participation in cognitively stimulating activities and risk of incident Alzheimer disease. *JAMA*, *287*, 742–8.

Ybarra, O., Burnstein, E., Winkielman, P., Keller, M. C., Manis, M. & Rodriguez, J. (2008). Mental exercising through simple socializing: Social interaction promotes general cognitive functioning. *Personality and Social Psychology Bulletin*, *34*, 248–259.

Yeh, S. C. J. & Liu, Y. Y. (2003). Influence of social support on cognitive function in the elderly. *BMC Health Services Research*, *3*, 1–9.

Received 15 September 2013, accepted 13 December 2013