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SEVEN-YEAR PREDICTORS OF SELF-RATED HEALTH AND LIFE SATISFACTION IN THE ELDERLY: THE PROOF STUDY

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Abstract: *Objectives:* To investigate the relationship between cognitive performance, affective state, metabolic syndrome and 7-year follow-up self-rated health (SRH) and perceived life satisfaction (PLS). *Design:* Analysis of a prospective cohort study. *Setting:* The PROOF study, including 1011 elderly community residents. *Participants:* Six hundred and fifty seven subjects completed metabolic syndrome (Met S) variables, neuropsychological and affective measurements at baseline, and then returned a 7-year follow-up questionnaire which included SRH and PLS. *Measurements:* The prospective association between cognitive function, Met S and each of its components, and affective disorders and subsequent subjective health and quality of life was examined. Covariates included educational level and use of tobacco. The analyses were made in men and women separately. *Results:* In multivariate models, the presence of Met S was significantly associated to weaker SRH (OR = 2.78, p = 0.009 in men and OR = 2.0, p = 0.02 in women). Higher triglycerides rate were associated with weaker SRH in men (OR = 2.23, p = 0.002) and higher fasting glucose in women (OR = 2.54, p = 0.006). Global Met S and abdominal obesity was significantly associated to weaker PLS in women only (respectively OR = 2.70, p = 0.0002 and OR = 1.9, p = 0.02). Depressive symptoms were significantly associated to both weaker SRH and PLS in men (OR = 1.30, p = 0.002; OR = 1.44, p < 0.0001 for SRH and PLS respectively) and in woman (OR = 1.09, p = 0.04; OR = 1.26, p < 0.0001 for SRH and PLS respectively). Anxiety was linked to both weaker SRH and PLS in women (OR = 1.17, p = 0.002 and 0R = 1.11, p = 0.03 for SRH and PLS respectively). Finally, lower executive function was associated with weaker PLS in men (OR = 0.43, p = 0.0005). *Conclusion:* metabolic syndrome and certain of its components, anxiety and depressive symptoms, are independent predictors of poorer subjective health and quality of life as assessed over a period of 7 years in a population of a non-demented aging community. Moreover, executive performance was linked to subsequent quality of life in men. Many of these factors being treatable, our findings point to the necessity of providing preventive care strategies by the management of cardiovascular risk factors and anxio-depressive symptoms.

Key words: Metabolic syndrome, subjective health, quality of life, elderly.

As aging populations increase worldwide, there is a growing interest to better identify the factors which contribute to successful aging (SA). At baseline, SA was a concept put forward by Rowe and Kahn (1). This related to avoidance of disease, maintenance of high cognitive and physical function, and sustained engagement in social and productive activities. More recently studies have tried to determine how cognitive, physical and psychosocial behaviour can influence SA (2-4). For the moment, Rowe and Kahn's approach appears over-restrictive as few old people are completely disease-free. The present concept of SA focuses on the patient's personal perception of aging, assessed using self-rated health and quality of life scales (5). These were found to be clearly linked to SA (6). Weaker self-reported health (SRH) has also been found to be related to a higher rate of adverse clinical outcomes over the long term (4, 7). Previous findings have demonstrated that perceived life satisfaction (PLS) can be associated to subsequent adverse outcomes and all-cause mortality (8). Cardio-vascular risk factors, depression and cognitive status have been identified as predictors of subsequent mortality (9). Past studies have shown that early recognition and intervention aimed at improving patients' PLS may help to prevent adverse outcomes and reduce premature mortality (10).

Cognitive impairment and affective disorders (anxiety and depression) have been shown to be linked to lower health related well-being (11). In a previous study on the PROOF cohort, we found a relationship between preserved baseline cognitive performance and SRH and PLS 6 years later (12).

Elsewhere, a number of associations have been reported between metabolic syndrome (Met S) and its components with reduced health related quality of life (HRQoL) (13, 14). Certain authors however, reported a relationship between MetS and reduced HRQoL in women only but not men (15, 16). The physiopathological hypothesis of this relationship is based on obesity-related insulin resistance inducing hyperinsulinemia, and the increasing risk of diabetes, as well as atherosclerosis and related complications. These complications of Met S are known to affect HRQoL, as well as functional ability and survival (13). Most of these studies related to middle-aged subjects, usually without comorbidities. On the other hand, to our knowledge, only one other study has systematically questioned an aging cohort, despite the fact that Met S is more

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prevalent in such groups. No association was observed between Met S and worse HR QoL among populations aged 75 and over (17). This issue is relevant as elderly populations are increasing worldwide, and Met S, as well as cognitive and affective disorders are more frequent with age so preventive strategies need to be developed.

In this purpose, it is useful to better identify factors leading to lower SRH and PLS. To the best of our knowledge, most of the previous studies were cross sectional but these failed to demonstrate the causality between successful aging and other related factors.

The aim of the present study was to assess the relationship between cognitive performance, affective state, metabolic syndrome and its components, and 7-years follow-up SRH and PLS.

Methods

Population

The present population was selected from the PROOF study, a population-based cohort of 1011 community-dwellers aged 65.6 (+-0.8) years, recruited in 2001 from the electoral lists of the city of Saint-Etienne, France and followed up for ten years.

The study was designed to assess the prognostic value of autonomic nervous system activity (ANS) indicators on brain and cardiac morbidity and mortality. Subjects with previous serious cardiac events (myocardial infarction, heart-disease), type 1 diabetes, Parkinson's disease, Alzheimer's disease or associated disorders, persons with a life expectancy of less than 5 years, dependent persons or those living in institutions were excluded from the study. A general survey was conducted by research physicians to obtain information on demographics, past medical history and co-morbidities, cardiovascular risk factors, mood disorders and medication. Information about any drug use was obtained by self-report on the part of the subject and confirmed by a physician's prescription if and when available. The detailed design of the study has been previously described in the literature (18).

Among the 1011 PROOF participants, 895 participants completed the whole neuropsychological battery and were assessed for each Met S components at baseline.

Nine hundred and seventy six subjects received a questionnaire in 2008 assessing SA.

Ethics statement

The PROOF study was approved by the Hospital and the IRB-IEC (CCPPRB Rhone-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.

Clinical assessment

Detailed clinical assessment was focused on cardiac and cerebrovascular disease, hypertension, diabetes, and respiratory, neurological, and psychiatric disorders. Current medication was analyzed with regard to antihypertensive, hypnotic, anxiolytic, and/or antidepressant therapy. Subjects were defined as normo-tensive if they did not report history of hypertension and antihypertensive treatment and if at ambulatory blood pressure monitoring they did not have a mean systolic blood pressure >130 mmHg and a mean diastolic > 85 mmHg.

Biochemical analysis

Venous samples were drawn from the right antecubital vein after 12-hour fasting. Standard enzymatic methods were used for serum total cholesterol, triglycerides and high-density lipoprotein cholesterol (HDL-c). HDL-c was calculated using the Friedewald formula (CLDL = Cplasma-CHDL-TG/5). Glucose concentrations were analysed enzymatically.

Measurements of metabolic risk factors

During the clinical evaluation, the height in stocking feet and weight in light clothing were measured and the body mass index (BMI) was calculated as weight (in kilograms)/height squared (in kilograms per square meters). Waist circumference (WC) was measured midway between the lower rib margin and the iliac crest. Systolic (SBP) and diastolic (DBP) blood pressures were measured by a physician using a standard mercury sphygmomanometer on the right arm while the subject was quietly seated after at least 5 minutes rest.

Definition of the metabolic syndrome

Metabolic syndrome was defined according to National Cholesterol Education Program criteria (19) as three or more of the following metabolic risk factors: WC >102 cm for men and > 88 cm for women, fasting plasma glucose concentration level > 6.1 mmol/l (110 mg/dl) or on medication, SBP >130 mmHg or DBP >85 mmHg or on medication, HDL concentration <1.03 mmol/l (40 mg/dl) if men and <1.29 mmol/l (50 mg/dl) if women, and fasting or non-fasting triglyceride concentration >1.69 mmol/l (150 mg/dl).

Assessment of cognitive performance and affective state

The PROOF participants underwent a neuropsychological battery at baseline, exploring various cognitive functions:

Memory: the French version of the Free and Cued Selective Reminding test (FCSR) (20,21) was used to explore episodic memory. This test allows the encoding phase to be checked by inducing semantic processing and combines free and cued recall trials. The test comprises 3 successive free and cued recall trials of a 16-word list, followed by a recognition task for the target words presented among distracters. Then a delayed recall of the list is asked 20 minutes later. Five measurements were used in the following analyses: total immediate recall, the sum of the 3 free recalls, recognition, total delayed recall and free delayed recall.

Attention and speed of exploration: Attention and speed of

exploration was further explored by the Digit Symbol Substitution Test (DSST) (22) and the Digit spans explored working memory (23). The Trail Making Test (TMT) A and B (24) also assessed attention, speed of exploration (version A), and also shifting capacity in part B.

Executive function: The tracking Baddeley dual task assessed working memory and executive functions (25). The Stroop test (26) was performed to investigate the inhibition processes. Verbal fluencies and WAIS Similarities also explored executive functions and semantic knowledge (22, 23, 27).

For each of the three cognitive domains, we used summary measures of cognitive function by converting the individual test results to Z scores and computing the average of the scores within each domain. For each of the three scores, two groups were defined: 'normal performance' when the score was located in the 4 upper quintiles of the distribution, and 'weak performance' when the score was in the lowest quintile of the distribution.

Affective state

Affective state was assessed by the "Questionnaire de Dépression Abrégé" (QD2A – Short Depression Questionnaire) (28) for depression and the French version of the Goldberg scale (29) for anxiety.

Self-rated health and perceived life satisfaction

Self-rated health (SRH) and perceived life satisfaction (PLS) were assessed using visual analogic scales (30) graded from 0 to10, for evaluating health status ('How do you estimate your health status?') and well-being ('Are you basically satisfied with your life?'). The questions concerning SRH and PLS were limited to present life. As 'subjective health' and 'well being' were not normally distributed, they were dichotomized into 2 binary variables: the values in the last quartile of the distribution were considered as 'low' subjective health or well being, and the three upper quartiles of the distribution were considered as 'normal'.

Covariates

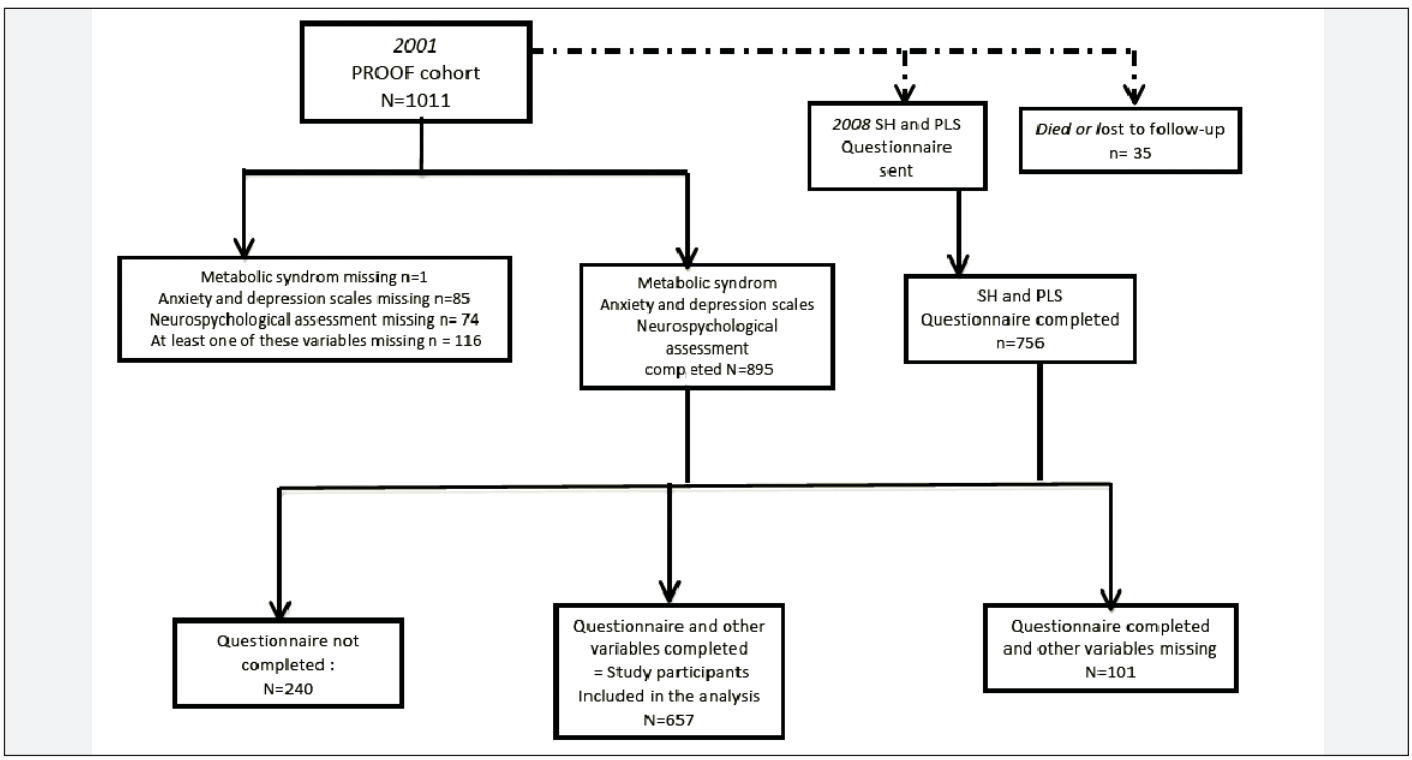
The following covariates, which are known to relate to cognitive performance or Met S or subjective health or well-being, were assessed in the analyses: gender, educational level (<5 years, 5-8 years, 9-11years and >11 years of education) and tobacco use (regular smokers, former smokers and non smokers).

Statistical analysis

The cognitive scores, anxiety and depression level and Met S status of the subjects included in the present analysis ('participants') were compared to those of subjects who did not fulfil successful aging questionnaires ('non-participants'). Descriptive characteristics were then compared between study participants according to subjective health and well being status. Student t-test and $\chi 2$ test were used as appropriate. Each of the three cognitive scores ('Memory', 'Attention and Speed' and 'Executive Functioning') was individually compared

Figure

Flow chart of the study participants



between groups as a function of Met S, using a $\chi 2$ test. The association between each of the potential confounding variables and cognitive performance was also assessed with ANOVA or $\chi 2$ tests. The cognitive performance which were significant in univariate analyses were then included in a logistic regression model. Means with their 95% confident intervals (CI) were adjusted for potential confounding covariates. Only confounding variables which were significantly associated to neuropsychological performances in the univariate analyses were included in the multivariate model. A p value < 0.05 was considered statistically significant.

Statistical analyses were performed with SPSS version 16 (SPSS Software, Chicago, USA).

Results

Of the 976 questionnaires sent out, 756 (77.5%) were returned. 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%. Finally 657 subjects completed baseline neuropsychological assessment, anxiety and depression scales, concomitant diseases and Met S measurement. The flow chart of the study participants is given in Figure 1.

Met S was more frequent in the 'non participants' group (n=341) than in the 'participants' group (21.2% vs 15.0 %, $\chi 2$: p= 0.049). Episodic memory mean Z scores were weaker in the 'non participants' group (- 0.12 ± 0.97) than in the 'participants' group (0.05 ± 0.66), F=4.87, p=0.03.

Mean executive Z scores were weaker in the 'non participants' group (- 0.12 ± 0.62) than in the 'participants' group (0.04 ± 0.87), F=12.03, p=0.001. No significant difference was observed between the above groups concerning Z attention scores (p=0.19). Moreover, the 'non participants' group provided a lower anxiety score (3.32 ± 2.9) than the participants (3.96 ± 2.9), F = 8.41, p = 0.004. Finally, the 'non participants' group had a lower depression score (3.05 ± 2.80) than the participants (3.32 ± 2.86), F = 6.1, p = 0.01.

The characteristics of the subjects included in the study are described in Table 1

Female gender was significantly linked to lower SRH and PLS. Lower education level was linked to weaker PLS, but not related to SRH. Tobacco use was not associated to SRH or PLS. Moreover, women had higher memory mean z scores than men (0.25 ± 0.73 and -0.30 ± 0.97 respectively, Mann Whitney test p < 0.0001). Concerning executive function, women tended to have lower z scores (mean 0.03; SD 0.61) than men (mean 0.06; SD 0.65) but this difference was not significant (Mann Whitney test p = 0.62).

As gender was linked to PLS and SRH and to cognitive scores, it can be considered as a confounding factor; the further analysis will be therefore made separately for men and women.

The results of univariate associations between each of the predictive factors and SRH and PLS are given in Table 2. Lower executive functions, anxiety and depressive symptoms were significantly associated with subsequent weaker SRH and PLS in men and women. Global Met S was linked to weaker SRH in men and PLS in women. Low HDL cholesterol was associated with poorer SRH and PLS in men. Higher rate of triglycerides was linked to poorer SRH in men, high blood pressure to weaker PLS in men. Finally, fasting glucose and abdominal obesity were associated with subsequent weaker PLS in women and fasting glucose with poorer SRH in women.

The results of the multivariate analysis are shown in Table 3.

In 3.96 multivariate models including global Met S, presence of Met S and depressive symptoms were significantly linked to weaker SRH in men and women. Moreover, anxiety was significantly linked to weaker SRH in women (model 1). Lower executive function and depressive symptoms were significantly linked to weaker PLS in men. Presence of Met S, depressive symptoms and anxiety were linked to weaker PLS in women. Moreover, anxiety was significantly linked to weaker SRH in

Table 1

Baseline descriptive characteristics of the subjects according to 7-year subjective health and quality of life status (n=657)

	Self-rated health			Perceived life satisfaction			Total
	Low	Normal	p	Low	Normal	p	
Gender							
Women, n (%)	115 (69.7)	282 (57.3)	0.006 (1)	122 (73.5)	275 (56)	< 0.0001 (1)	397 (60.4)
Education, n (%)							
<5 years	73 (44.2)	215 (43.9)		79 (47.6)	209 (42.7)		288 (44)
5-8 years	17 (10.3)	27 (5.5)	0.08 (1)	17 (10.2)	27 (5.5)	0.04 (1)	44 (6.7)
9-11years	50 (30.3)	144 (29.4)		46 (27.7)	148 (30.3)		194 (29.6)
>11 years	25 (15.2)	104 (21.2)		24 (14.5)	105 (21.5)		129 (19.7)
Tobacco use, n (%)							
Current	14 (8.5)	27 (5.6)		16 (9.6)	25 (5.2)		41 (6.3)
Past	46 (27.9)	129 (26.5)	0.35 (1)	40 (24.1)	135 (27.8)	0.10 (1)	175 (26.9)
Never	105 (63.6)	330 (67.9)		110 (66.3)	325 (67)		435 (66.8)

(1) Pearson $\chi 2$ test

women (model 2). The results of multivariate models including Met S components showed that depressive symptoms were linked to weaker PSH and PLS in men and women (models 3 and 4). Anxiety was linked to weaker SHR and PLS in women only (models 3 and 4). Moreover, higher triglycerides rate were associated with weaker SRH in men (model 3). Higher fasting glucose was linked to weaker SHR in women (model 3), and abdominal obesity to weaker PLS in women (model 4) Finally, lower executive function was linked to weaker PLS in men (model 4).

Discussion

In our study, we found that metabolic syndrome and some of its components alongside anxiety and depressive symptoms independent predictors of 7-year weaker subjective health and quality of life in a population of non-demented aging community dwellers. Moreover, cognitive executive performance was linked to subsequent quality of life in men but not in women.

Various surveys have reported a relationship between Met S

Table 2

Association between Met S, Met S components, cognitive performance, affective status and self-rated health– univariate separate logistic regression models (n= 657 subjects)

	Poor Self-rated health, Men (n=260)			Poor Self-rated health, Women (n=397)		
	OR	95% CI	P	OR	95% CI	P
Metabolic syndrome	2.73	1.42 – 5.56	0.006	1.61	0.93 – 3.76	0.08
Components of metabolic syndrome						
Blood pressure ≥ 130/85	1.54	0.82 – 3.84	0.35	1.36	0.85 – 2.17	0.19
Low HDL Cholesterol (1)	3.21	1.55 – 6.64	0.002	1.37	0.81 – 2.19	0.27
Triglycerides ≥ 150 mg/dl	2.40	1.27 – 4.52	0.006	1.45	0.89 – 2.37	0.14
Fasting glucose ≥ 110 mg/dl	1.45	0.74 – 2.84	0.28	2.25	1.23 – 4.10	0.008
Abdominal obesity	1.54	0.62 – 3.84	0.35	1.36	0.85 – 2.17	0.20
Cognitive functions						
Memory	1.07	0.78 – 1.47	0.67	1.07	0.79 – 1.43	0.68
Attention – speed	0.74	0.39 – 1.44	0.38	1.41	0.86 – 2.31	0.17
Executive functions	0.56	0.35 – 0.92	0.02	0.68	0.47- 0.96	0.03
Affective state						
QD2A depression scale	1.30	1.11– 1.51	0.001	1.19	1.10– 1.27	< 0.0001
Goldberg anxiety scale	1.21	1.08– 1.36	0.002	1.22	1.13– 1.32	< 0.0001

(1) HDL concentration <1.03 mmol/l if men and <1.29 mmol/l if women

Association between Met S, Met S components, cognitive performance, affective status and and perceived life satisfaction – univariate separate logistic regression models (n= 657 subjects)

	Poor perceived life satisfaction, Men(n=260)			Poor perceived life satisfaction, Women(n=397)		
	OR	95% CI	P	OR	95% CI	P
Metabolic syndrome	1.87	0.87 – 4.03	0.11	2.45	1.44 – 4.17	0.001
Components of metabolic syndrome						
Blood pressure ≥ 130/85	1.67	1.06 – 2.64	0.03	1.54	0.62 – 3.84	0.35
Low HDL Cholesterol (1)	2.44	1.14 – 5.23	0.02	1.45	0.88 – 2.36	0.14
Triglycerides ≥ 150 mg/dl	1.48	0.75 – 2.91	0.26	1.69	0.95 – 3.02	0.08
Fasting glucose ≥ 110 mg/dl	1.33	0.66 – 2.70	0.43	2.04	1.12 – 3.72	0.02
Abdominal obesity	2.19	0.90 – 5.31	0.08	1.67	1.06 – 2.63	0.03
Cognitive functions						
Memory	1.12	0.80 – 1.57	050	0.87	0.66 – 1.16	0.88
Attention – speed	0.62	0.31 – 1.26	0.18	1.37	0.84 – 2.22	0.21
Executive functions	0.33	0.20 – 0.58	< 0.0001	0.70	0.49 - 0.99	0.04
Affective state						
QD2A depression scale	1.43	1.22 – 1.69	< 0.0001	1.34	1.24 – 1.45	< 0.0001
Goldberg anxiety scale	1.29	1.14 – 1.46	< 0.0001	1.30	1.17 – 1.37	< 0.0001

(1) HDL concentration <1.03 mmol/l if men and <1.29 mmol/l if women

Table 3

Association between Met S, cognitive performance, affective status, and self-rated health (model 1) and perceived life satisfaction (model 2) multivariate separate logistic regression models (n= 657 subjects), stepwise descendant method, final models

	Self-rated health, Men (n=260)			Self-rated health, Women (n=397)		
	OR	**95% CI**	**P**	**OR**	**95% CI**	**P**
Model 1		*Model 1- Men*			*Model 1- Women*	
Met S	2.78	1.30 – 6.25	0.009	2	1.09 – 3.70	0.02
QD2A depression scale	1.31	1.11 – 1.56	0.001	1.11	1.02 – 1.20	0.02
Goldberg anxiety scale-	-	-		1.16	1.05 - 1.27	0.003
	Perceived life satisfaction - Men			**Perceived life satisfaction - Women**		
Model 2		*Model 2 - Men*			*Model 2 - Women*	
Met S -	-	-	2.70	1.42 - 4.95	0.0002	
Executive function	0.43	0.24 - 0.77	0.0005			
QD2A depression scale	1.44	1.20 – 1.73	<0.0001	1.26	1.15 – 1.39	< 0.0001
Goldberg anxiety scale	-	-	-	1.11	1.01 – 1.23	0.03

Multivariate logistic regressions –- covariate: educational level, anxiety, depressive symptoms and tobacco use – (1) HDL concentration <1.03 mmol/l if men and <1.29 mmol/l if women

Association between Met S components (models 3 and 4), cognitive performance, affective status and self-rated health (model 3) and perceived life satisfaction (model 4) – multivariate separate logistic regression models (n= 657 subjects), stepwise descendant method, final models

	Self-rated health – Men (n=260)			Self-rated health – Women (n=397)		
	OR	**95% CI**	**P**	**OR**	**95% CI**	**P**
Model 3		*Model 3 - Men*			*Model 3 - Women*	
Fasting glucose ≥ 110 mg/dl	-	-	-	2.54	1.30 – 4.93	0.006
Triglycerides ≥ 150 mg/dl	2.23	1.13 – 1.54	0.002			
QD2A depression scale	1.30	1.12 – 1.54	0.002	1.09	1.00 - 1.19	0.04
Goldberg anxiety scale	-	-	-	1.17	1.06 – 1.29	0.002
	Perceived life satisfaction - Men			**Perceived life satisfaction - Women**		
Model 4		*Model 4 - Men*			*Model 4 - Women*	
Abdominal obesity	-	-	-	1.90	1.11 – 3.24	0.02
Executive function	0.40	0.22 – 0.71	0.002	-	-	-
QD2A depression scale	1.44	1.20 – 1.72	< 0.0001	1.26	1.14 – 1.39	< 0.0001
Goldberg anxiety scale	-	-	-	1.11	1.01– 1.23	0.03

Multivariate logistic regressions –- covariate: educational level, anxiety, depressive symptoms and tobacco use – (1) HDL concentration <1.03 mmol/l if men and <1.29 mmol/l if women

and health related quality of life in younger adult populations. Few studies however have included elderly individuals.

The results concerning the association between Met S and its components, SRH and PLS are similar to a number of results of previous studies (13, 31, 32). In a cross sectional study including 1859 adults aged ±20 years, people with Met S had reduced health-related quality of life (measured as a higher risk of experiencing physically, mentally unhealthy days than people without Met S , respectively OR = 1.94, 1.97 and 3.20) (13). In a cross sectional study including 4480 healthy workers aged 18-69 years, the number of Met S components was negatively linked to general subjective health, measured with scales of the SF-36 (33). On the other hand, other studies found no association between Met S and health related QoL (34).The authors explain the difference with other findings by a difference in study design and criteria for Met S definition, but also by a different perception of QoL in the Iranien socio-cultural context.

In the present study, high blood pressure was linked to weaker SRH in men, higher fasting glucose was linked to weaker SRH in women and abdominal obesity to worse PLS in women. Some of these findings are consistent with those of previous studies: among Met S components, health related quality of life has been observed to be influenced by high blood

pressure and obesity in a large survey of adult US community dwellers (35). HR QoL was also linked to obesity in a population of 361 over-weight adults included in a weight loss clinical trial. Concerning results on cognitive and affective disorders, our results are partially in line with the findings of Vahia et al, who observed that in a sample of older women, living in the community, self-rated successful aging showed correlations with psycho-social protective factors, physical and mental/emotional status but not with cognitive ability (36). In our study, lower executive performance was related to poorer SRH and PLS in univariate analysis, as described in our previous paper (12). Furthermore, in multivariate analysis lower executive scores were linked to weaker PLS in men only. Previous studies showed that anxiety can induce lower executive functioning (37). As anxiety was linked to poorer SRH and PLS in women in univariate analysis, we can hypothesise that lower executive performance could be at least partly due to anxiety in women. In a previous cross-sectional study relating to 88 community-dwellers, anxiety and depressive symptoms were shown to be linked to SRH and quality of life. However, the authors did not measure health status in their study (38). Conversely, in a previous study examining data from 4400 healthy workers in Japan, Met S components were positively associated with mental health (33).

Depression and anxiety have also been identified as risk markers for Met S, as shown by Tzillas et al. (14) and Skilton et al. (39). Interestingly, in our study, anxiety and depressive symptoms have been found as predictors of poor SRH and PLS independently from Met S or its components.

Our results have to be interpreted in the light of certain limitations. Firstly, SRH and PLS were not assessed at baseline, therefore the evolution of these measurements in relation to Met S, affective and cognitive baseline status could not be assessed. Secondly, as the design of our study excluded subjects with initial dementia or cardio-vascular risk factors, most of the subjects had high cognitive performance. A ceiling effect could explain the lack of association between neuropsychological scores and SA and PLS in the multivariate results. Moreover, comparison of the cognitive scores between the subjects included in these analyses and the individuals excluded from them showed better memory and executive scores among included participants. The cognitive scores of the subjects included in the present analysis are higher than those of other French population-based cohort participants. The 3-city study one of the main French cohorts including elderly community dwellers and assessing cognitive aging. Concerning for example memory scores, the mean total FCSR score is about 2 points higher in the present sample than in 3-Cities Bordeaux population (40). This may have led to an underestimation of the association between SRH, PLS and lower cognitive performance in our study, in particular for memory scores. Our findings should not then be generalized to populations which include cognitively impaired individuals. Finally, SRH and PLS were measured with different skills, possibly explaining the divergent results observed. Most studies have adopted SF-36 to assess quality of life. However, this scale yielded separate questions to explore physical and mental health. Some studies observed divergent association between general and mental health and Met S (41). On the opposite, the SRH questionnaire assessed both general and mental health. Moreover, in our study, we used VAS as the means to formulate questions regarding perception and some elderly people would find this type of scale difficult to understand and complete satisfactorily. VAS can also permit floor and ceiling effect for extreme values (12, 42).

Our study has a number of strengths. Firstly, it included a homogenous population of non-demented subjects of the same age at baseline, i.e., 65 years, presenting only a few vascular risk factors, meaning that the potential confounding effect of age found in other studies was removed by the design of the PROOF study. Secondly, as most previous studies were cross-sectional, our study, given its prospective design, could better explore the causal relationship between risk factors at baseline, and subsequent subjective health and quality of life. Finally, in previous studies, it has not been customary to evaluate different factors which may influence SRH and PLS in the same analysis. Combining them together in the present study enabled us to assess the relative weight of the different variables in predicting SRH and PLS, and thus to identify the best predictors of SRH and PLS.

The association between Met S, affective disorders, executive functioning and SRH and PLS has numerous clinical implications. As the elderly population is increasing worldwide, it appears crucial to identify remediable determinants for successful aging. Met S and its components as well as affective disorders are known to influence the main aging related diseases, such as cardio vascular and cerebro-vascular diseases, but also Alzheimer's disease and disorders. These factors have been shown to predict longevity in women (9). Met S and affective disorders must therefore be taken into account as determinants for both successful aging in elderly but healthy community dwellers and other age related diseases.

Our findings point to the importance then of elaborating preventive care strategies to manage and treat cardiovascular risk factors and anxio-depressive symptoms. Further intervention studies are equally imperative as the means to determine the impact on successful aging of this treatment and management.

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