Direct and indirect associations between self-rated health, objective health indicators and neuroticism in older adults

Meire Cachioni[1,2]
Flávia Silva Arbex Borim[2,3]
Gabriela Cabett Cipolli[2]
Vanessa Alonso[2]
Mônica Sanches Yassuda[1,2]
Anita Liberalesso Neri[2,4]

Abstract

Objective: to analyze the direct and indirect associations between self-rated health, objective health indicators and neuroticism in older adults. *Method:* Data were extracted from follow-up records (2016-2017) of the Study of Frailty in Brazilian Elderly (FIBRA Study), a population-based study of frailty and associated variables in old age. Three hundred and ninety-seven individuals aged 73 years and over at follow-up answered an item on self-rated health. Polimedication, chronic pain and multimorbidity were self-reported, fatigue was measured by CES-D, depression by GDS and neuroticism by NEO-PI-R. Path analysis was performed to verify direct and indirect associations between self-rated health, objective health indicators and neuroticism in the follow-up. *Results:* Neuroticism mediated the relationship between sex and age with self-rated health, and between depression and self-rated health. More robust relationships were observed between depression and neuroticism, pain and neuroticism, and sex and neuroticism; the least robust occurred between age and fatigue. Conclusion: Neuroticism is an important mediator of the relationship between self-rated health and objective health indicators. Longitudinal work is needed to explain the observed relationships.

Keywords: Elderly. Chronic Diseases. Pain. Neuroticism. Self-Assessment.

[1] Universidade de São Paulo, Escola de Artes, Ciências e Humanidades, Programa de Pós-graduação em Gerontologia. São Paulo, SP, Brasil.

[2] Universidade Estadual de Campinas, Faculdade de Ciências Médicas, Programa de Pós-graduação em Gerontologia. Campinas, SP, Brasil.

[3] Universidade de Brasília, Departamento de Saúde Coletiva, Faculdade de Ciências de Saúde. Brasília, DF, Brasil.

[4] Universidade Estadual de Campinas, Departamento de Psicologia Médica e Psiquiatria da Faculdade de Ciências Médicas. Campinas, SP, Brasil.

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Correspondence
Meire Cachioni
meirec@usp.br

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INTRODUCTION

Self-rated health is considered a multi-factorial construct[1] which reflects a number of different influences, ranging from genetic to environmental[2]. Also, self-rated health can be regarded as an important measure of global, physical and mental health of an individual and of a population. The measure has been widely used in epidemiological studies and in both medical and social sciences[3,4].

Previous studies have shown that negative self-rated health is associated with negative health outcomes such as depression[5], polypharmacy[6], fatigue[7] and multimorbidities[8]. Evidence has also shown that the presence of chronic diseases which develop with the process of aging can lead to a negative self-rated health and worsen depressive factors[9]. More specifically, the study by Lee et al.[9] found that negative self-rated health and pain were risk factors for depressive symptoms. A study by Krug et al.[10] assessing older adults aged 80 years or over, found that participants without depressive symptoms had higher self-rated health scores than individuals with depressive symptoms. In the studies cited above, self-rated health was associated with physical and mental health. More specifically, with regard to mental health, the neuroticism personality trait plays an important role.

Personality is an important psychological resource that can attenuate or exacerbate the impact of physical conditions on self-rated health[11]. The Big Five Personality Traits Model of Costa and McCrae[12], or so-called Big Five, constitutes an empirical generalization of the covariation of personality traits, a concept which seeks to explain what defines a person on an individual level[12]. The Big Five comprises the following five explanatory latent variables (traits) of the construct: neuroticism, introversion-extraversion, openness to experience, agreeableness and conscientiousness[12].

Neuroticism reflects the tendency of individuals to respond to threats with negative emotions[12]. Studies show that neuroticism is associated with deleterious health behaviors (smoking, alcoholism and sedentarism) that can result in depression[13] and chronic conditions[14]. Individuals who score highly on neuroticism tend to be more worried, nervous, emotional, insecure, feel inadequate, and hypochondriac, whereas those scoring low tend to be calm, relaxed, unemotional, engaged, secure and satisfied with themselves[12].

The literature on the relationship of personality traits with self-rated health is vast[4], but little is known about the interaction of the neuroticism trait with self-rated health in older adults[11]. Some studies show that older individuals with high neuroticism scores tend to rate their health as poor[3,4]. Regarding development over the life span, neuroticism tends to increase over time[15]. Understanding the determinants and correlates of self-rated health can help professionals prioritize actions aimed at health promotion and disease prevention, positively impacting the lives of the older population.

In the present study, multi-morbidity, fatigue and polypharmacy were used as indicators of physical health, whereas depression and neuroticism were adopted as indicators of mental health. The hypothesis tested holds that sex and age influence the distribution of objective health indicators (multimorbidity, polypharmacy, fatigue, chronic pain and depression), as well as self-rated health and neuroticism, and that neuroticism mediates the relationship between objective health indicators and self-rated health.

METHODS

A longitudinal study was conducted whose initial data collection was performed between 1st September 2008 and 30th June 2009. This baseline sample comprised 1,284 older adults, born between 1st January and 31st December 1935, from Campinas city, São Paulo state and from Ermelino Matarazzo, a subdistrict of São Paulo city, all of whom participated in the first wave of measurements for the Frailty in Brazilian Older Adults (FIBRA) study. The sample included subsamples of men and women, representative of the respective age and sex segments, who resided in census sectors randomly selected from those within the urban area of the two study sites.

The second wave (follow-up) of measurements of the FIBRA study was carried out between 1st January 2016 and 30th June 2018 and centered on participants

born between 1st January 1936 and 31 December 1944. Of the initial total 1,284 individuals surveyed in the 1st wave, 543 were not included in the 2nd wave of measurements. Reasons for non-inclusion were: individual not found (57.9%), refusal to take part by respondent or family member (34.5%), exclusion based on study criteria (5.5%), session halted by family member or respondent (1.6%), and interview not conducted because venue posed a risk to psychological or physical well-being of interviewers (0.5%).

Thus, 549 participants with full baseline and follow-up records remained in the study. According to data from the Mortality System of Campinas and information furnished by family members and neighbors, 194 participants were no longer included in the database due to death during the follow-up period between the surveys. Therefore, 549 participants met the criteria for inclusion in the sample for the follow-up study. Of this follow-up group, 419 attained the score on Mini-Mental State Examination (MMSE) required for inclusion. The cut-off score in the study was based on the mean MMSE scores for each educational band minus 1 standard deviation: 17 for illiterate individuals or those with no formal schooling; 22 for participants with 1-4 years of education; 24 for 5-8 years; and 26 for participants with ≥ 9 years of study[16]. Conversely, 130 participants failed to meet MMSE performance criteria and were therefore not included in the part of the protocol that involved scales which placed higher cognitive demands, such as the measures of objective and subjective health and neuroticism, which were the focus of the present study. Of the participants that answered these items, 22 did not provide answers for all of the questions and were subsequently excluded. Therefore, the final sample for the present analysis of follow-up data comprised 397 participants.

Data for the variables sex, age, objective physical and mental health indicators (multimorbidity, polypharmacy, fatigue, chronic pain and depressive symptoms), self-rated health and neuroticism were measured. The follow-up study included additional variables of interest, namely: brachial circumference, skin fold measurements, nutritional behavior, marital status, religiosity, purpose in life, neuroticism, quality of life and sarcopenia. Sex and age were assessed by self-report questions, with the options male/female for gender, and date of birth information for age, calculated by subtracting birth date stated from the date of interview to give respondent age in years.

The number of clinically-diagnosed diseases in the past 12 months was obtained by presenting a list of nine descriptive items of the most common non-communicable conditions in older adults (cardiovascular diseases, hypertension, stroke, diabetes mellitus, cancer, arthritis or rheumatism, pulmonary diseases, depression and osteoporosis) and tallying the number of diseases reported (0=no and 1=yes). Multimorbidity was defined as the presence of ≥ 2 chronic diseases[17]. The number of medications prescribed by physicians or self-administered in the past 3 months was recorded. From this data, total number of medications was determined, where polymedication or polypharmacy was defined as daily use of ≥ 5 medications[18].

Fatigue was measured using the Center for Epidemiologic Studies - Depression Scale (CES-D)[19], with four possible answers for each question (most or all of the time, occasionally or a moderate amount of time, some or little of the time, and rarely or none of the time). Responses to either of the two items with *most or all the time* were taken to indicate fatigue. Chronic pain was evaluated by a question on type of occurrence in the past 12 months, with answers yes or no. Depression was assessed using the Geriatric Depression Scale, a screening instrument containing 15 dichotomous items describing dysphoric moods. A GDS score >5 was deemed suggestive of depression[20]. Self-rated health was measured by an item scored on a scale with 5 levels of intensity (1 = very poor, 2 = poor, 3 = fair. 4 = good, and 5 = very good) in response to the question: *How do you rate your health now?*

Neuroticism was measured by applying the Brazilian version of the neuroticism subscale, part of the personality test battery called the NEO-PI-R (Neuroticism, Extraversion, Openness to experience, Agreeableness and Conscientiousness), or the so-called Big Five Personality Factors[12]. Comprising 12 items scored on a Likert-type scale with 5 possible responses (ranging from 1 = totally disagree to 5 + totally agree) and a total score of 12-60 points, the scale has no pre-established cut-off relative to a gold-standard score nor normative values for the

Brazilian population aged 60 or over. Thus, the distribution of the values derived from its application among the participants was treated as a continuous variable. Agreement with 8 items indicated maximum neuroticism, whereas disagreement with the other 4 items indicated a calm and relaxed personality. Accordingly, these 4 items (1, 3, 6, and 7) were inverted for analysis. Thus, higher scores indicated greater intensity of neuroticism, while lower scores indicated lower intensity of neuroticism[21].

The sample was characterized by a descriptive analysis with categorical variables expressed as absolute and relative frequency, and quantitative variables as mean, median and standard deviation. The normality of the data distribution was checked using the Kolmogorov-Smirnov test, which showed most of the continuous variables had a non-normal distribution. In order to study the variables of interest, as per the theoretical model devised for the study (Figure 1), structural equation modelling was performed using path analysis. Path Analysis is an extension of multiple regression that goes further than regression in providing an analysis of complex models. Thus, path analysis is regarded as a statistical analysis of multiple regression used to assess causal models examining the relationships between 1 dependent variable and 2 or more independent variables. This method allows estimation of both the magnitude and significance of causal connections between variables (β coefficient). The model features straight arrows indicating direct and indirect associations, and elliptical arrows indicating covariance. After adjusting indicators and significance tests, the final model of the paths analysis is constructed, retaining or rejecting relationships from the previous theoretical model. The tests and acceptance values were: Goodness of Fit >0.05; Chi Square ratio (X2/DF) <2; SRMR (Standardized Root Mean Square Residual) ≤0.10; RMSEA (Root Mean Square Error of Approximation) ≤0.08; CFI (Comparative Fit Index) ≥0.90 and TLI (Tucker-Lewis Index) ≥0.90.

In order to analyze the goodness-of-fit of the data for the paths proposed, significance tests were performed for the path coefficients. Absolute values of t>1.96 indicate the path has a statistically significant coefficient.

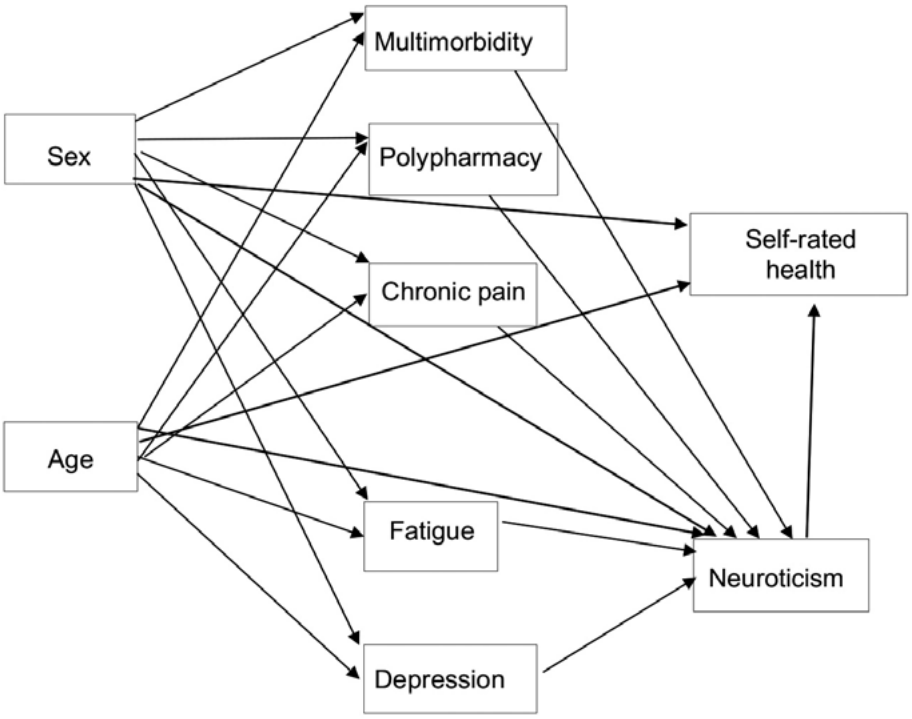

Figure 1. Theoretical model of associations between sex, age, objective health indicators, neuroticism and self-rated health. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo, Brazil, 2016-2017.

The data were collected at respondents´ homes by pairs of trained researchers who wore uniforms and were duly identified by the visual material of the study. The respondents participated on a voluntary basis. Prior to interview, all participants signed a free and informed consent form explaining the interview aims and contents, the confidential nature of the data, participants´ rights and obligations, and the ethical code of the researchers. The research projects were approved by the Research Ethics Committee of the State University of Campinas on 23/11/2015, under permit 1.332.651, CAAE 49987615.3.0000.5404 and permit 2.847.829, of 27/08/2018, CAAE 92684517.5.1001.5404.

RESULTS

The sample comprised 397 older adults, of whom 44.5% were aged 72-79 years (mean = 80.3 ± 4.64) and 55.5% aged ≥80 years. There was a predominance of women in the sample, with a ratio of 70.0% female to 30% male. The majority of participants were classified as exhibiting multimorbidity (≥3 diseases) and 41% as polypharmacy. Overall, 20.1% of participants scored above the cut-off on the depression screening scale. Most participants rated their health positively (good and very good). Over half (56.1%) of respondents reported chronic pain, whereas only 29.2% had fatigue. Participant scores on the neuroticism scale were generally low, reflected in the mean of 26 (standard deviation of 8.4) points obtained on each item and the total scale (Table 1).

Goodness-of-fit measures were calculated to check the fit of the variable to perform the path analysis. The first revision suggested exclusion of the following direct associations: age with multimorbidity, sex with fatigue, age with chronic pain, age, fatigue and multimorbidity with neuroticism, plus exclusion of the polypharmacy variable. Also at the first stage, the direct associations of sex and age with self-rated health and age and sex with depression were excluded. The second revision added the reciprocal relation between fatigue and chronic pain, the direct association between multimorbidity and chronic pain, and of each of these with depression, and the direct association between multimorbidity and fatigue, and both with neuroticism. The third revision included the association of chronic pain with morbidity, fatigue with depression, fatigue with multimorbidity, and multimorbidity with self-rated health. Results are shown in Table 2.

The directions of the statistically significant ($p<0.05$) direct relations between pairs of variables, together with their respective β coefficients indicating strength of these associations, are shown in Figure 2. The most robust relations were found between depression and neuroticism, pain and neuroticism, and sex and neuroticism. These results suggest that: individuals with high depression scores also scored higher for neuroticism; there were more participants who scored for chronic pain among those who scored high for neuroticism; and more women than men scored for neuroticism. In addition to these relations, negative associations were evident between pain and self-rated health, between neuroticism and self-rated heath, as well as positive associations between pain and multimorbidity, and between multimorbidity and depression. The least robust relations were between age and fatigue, suggesting there were fewer reports of vitality loss among the group containing more oldest-old individuals. The association between sex and multimorbidity suggests there was a high proportion of women in the group reporting multiple diseases. The relationship between chronic pain and depression may indicate a higher number of individuals with chronic pain among those with higher depression scores.

Four variables were identified as mediators of the associations of the variable pairs assessed: neuroticism, depression, multimorbidity and chronic pain. Neuroticism proved a mediator of the associations of the variables sex, age, depression, chronic pain and multimorbidity with self-rated health. Depression mediated the association of fatigue, chronic pain and multimorbidity with neuroticism, and likewise of fatigue, chronic pain and multimorbidity with self-rated health. Multimorbidity mediated the relationship of sex, fatigue and pain with neuroticism, and also of chronic pain with self-rated health. Lastly, chronic pain mediated the associations of sex with multimorbidity, depression and neuroticism (see Table 3).

Table 1. Sociodemographic characteristics, health indicators, self-rated health and neuroticism. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

	n (%)
Sociodemographics	
Sex	
Male	119 (30.0)
Female	278 (70.0)
Age	
73-79	177 (44.5)
≥ 80	220 (55.5)
Health indicators	
Multimorbidity	
No	127 (33.2)
Yes	255 (66.8)
Medications used	
0-4	215 (59.0)
≥ 5	149 (41.0
Fatigue	
No	281 (70.8)
Yes	116 (29.2)
Chronic pain	
No	174 (43.9)
Yes	223 (56.1)
Depression	
No	317 (79.8)
Yes	80 (20.1)
Self-rated health	
Very poor (1)	8 (2.0)
Poor (2)	23 (5.8)
Fair (3)	156 (39.3)
Good (4)	160 (40.3)
Very good (5)	50 (12.6)
Neuroticism	26 (8.4)*

*Representing mean and standard deviation

Table 2. Goodness-of-fit measures for variables investigated in Path Analysis. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

	Theoretical model	After 1st revision	After 2nd revision	After 3rd revision
Chi-square test for goodness-of-fit	<0.001	<0.001	<0.001	0.764
Chi-Square Ratio (χ2/GL)	<0.001	<0.001	<0.001	<0.001
TLI-Tucker-Lewis Index	0.012	0.580	0.911	1.000
CFI - Comparative Fit Index	0.690	0.765	0.782	1.032
SRMR - Standardized Root Mean Square Residual	0.103	0.104	0.064	0.018
RMSEA - Root Mean Square Error of Approximation	0.163	0.119	0.082	<0.001

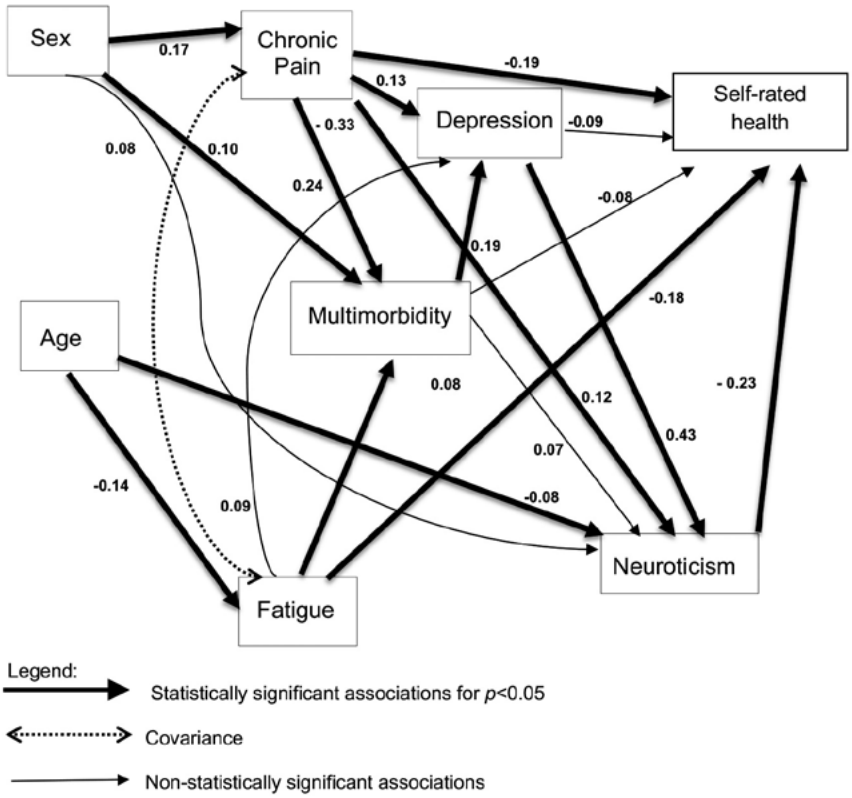

Figure 2. Direct associations between sex, age, objective health indicators, neuroticism and self-rated health. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

Table 3. Indirect association between pairs of variables and corresponding mediating variables. FIBRA study, participants from Campinas and Ermelino Matarazzo, São Paulo state, Brazil, 2016-2017.

Indirect associations	Mediating variables	β Coefficient	s.e	*p-value**
Sex → Multimorbidity	Chronic pain	0.042	0.015	0.005
Sex → Depression	Chronic pain	0.043	0.014	0.002
Sex → Neuroticism	Chronic pain	0.968	0.297	0.001
Sex → Self-rated health	Chronic pain	-0.149	0.038	<0.001
Chronic pain → Depression	Multimorbidity	0.038	0.012	0.003
Fatigue → Neuroticism	Multimorbidity → depression	0.095	0.433	0.022
Chronic pain → Neuroticism	Depression	1.58	0.440	<0.001
Multimorbidity → Neuroticism	Depression	1.49	0.421	<0.001
Fatigue → Self-rated health	Depression	-0.213	0.024	<0.001
Age → Self-rated health	Neuroticism	0.088	0.028	0.002
Chronic pain → Self-rated health	Neuroticism	-0.148	0.036	<0.001
Multimorbidity → Self-rated health	Depression → neuroticism	-0.098	0.031	0.002
Depression → Self-rated health	Neuroticism	-0.213	0.052	<0.001

s.e = standard error

*Statistically significant for p <0.05

DISCUSSION

The present study is relevant in elucidating the relationship between self-rated health, objective health indicators and neuroticism in community-dwelling older adults. This study is probably the first of its kind investigating the strength of association between these variables in the Brazilian milieu.

Neuroticism proved a mediator of the associations of the variables sex, age, depression, chronic pain and multimorbidity with self-rated health. Depression mediated the association of fatigue, chronic pain and multimorbidity with neuroticism, and likewise of fatigue, chronic pain and multimorbidity with self-rated health. Multimorbidity mediated the relationship of sex, fatigue, and pain with neuroticism, and also of chronic pain with self-rated health. Lastly, chronic pain mediated the associations of sex with multimorbidity, depression and neuroticism.

It is known that health conditions, such as pain secondary to chronic diseases, are associated with negative self-rated health[11]. The present study found a positive correlation between multimorbidity and chronic pain, corroborating the results of the study by Cai et al.[22]. These authors noted the presence of chronic diseases can result in pain and physical disability, leading to negative self-perceived health and increased levels of depression in older adults. The study by Jang et al.[23] concluded that chronic diseases and functional disability were strongly associated with a negative rating of health and with depressive symptoms in Chinese Americans and Korean Americans aged over 60 years. A study involving Swiss older adults found a positive association of fatigue with self-rated health[24].

In the present study, depression mediated the association of fatigue, pain and multimorbidity with neuroticism, and of fatigue, pain and multimorbidity with self-rated health. The prevalence of depression was 20.1%, similar to the 17% rate reported by Leite et al.[25] in community-dwelling elderly from Cuiabá (Mato Grosso state). Depression is a disease that can manifest at any point in the life course and represents a leading cause of disability, increasing the risk of premature death, negatively impacting quality of life and placing a burden on health systems[26]. In the present study, depression had a positive direct correlation with multi-morbidities (66.8%). Similarly, Read et al.[27] found depression to be 2-3 times more likely in individuals with multi-morbidities than those without multi-morbidities or chronic physical conditions.

However, depression was negatively associated with self-rated health in the present study, suggesting that older individuals with depressive symptoms rated their health as poor or very poor. The prevalence of chronic pain in the study was 56.1%, higher than the 48.1% rate found by Carvalho et al.[28]. This disparity might be explained by racial, ethnic or cultural factors. In the study of IsHak et al. (2018), a positive reciprocal correlation was found between depression and chronic pain, and also between recovery time and symptoms duration[29].

Higher levels of neuroticism have been associated with chronic pain[30], sex and age[31]. Results of the study by Banzonic et al.[32] found an association between neuroticism and experimentally-induced pain in the laboratory, showing that in situations such as pain, neuroticism can influence the way in which a person can construe pain as a threat. Individuals with high neuroticism can interpret stressors such as pain and functional limitation in a more intense and problematic way because they exhibit a greater tendency to worry about health, report numerous symptoms and ruminate over problems than people with low neuroticism[32].

The present study confirmed the hypothesis that neuroticism is negatively associated with objective and subjective health variables. This finding is similar to the results found by Cachioni et al.[3] in a study involving Portuguese older adults. The present study revealed that chronic pain mediated the relationship between sex and multimorbidity and between sex and depression. Women appear to be more sensitive to pain, exhibit more negative responses to it, be involved in pain behaviors for longer periods, show a tendency to dwell on the negative emotions associated with pain [30] . A more recent study by Peng et al.[33] found similar results to those of the present investigation, showing pain acted as a mediator of the adverse effects of multimorbidity on disability and on impairment of physical performance in women.

The study of Velly & Mohit[34] suggested pain and depression are reciprocally related, i.e. one can increase the risk and severity of the other. This co-occurrence is defined as comorbidity or concomitant occurrence of 2 or more clinically-diagnosed disease in the same individual[34]. The prevalence of depression in individuals with chronic pain is generally high, as seen in a Brazilian study in which 56.1% of the older adults experiencing chronic pain suffered from depression[35]. Chronic pain also moderated the relationship between sex and neuroticism. Moreover, women are more likely to experience negative emotions and have higher neuroticism scores than men[31].

Although the cross-sectional design of the present study precludes drawing meaningful conclusions regarding the cause and effect relationships for the associations between self-rated health, objective health and neuroticism, particularly for the type and analyses presented in the study, it can be confirmed that they are influenced by shared genetic variables[2]. Evidence points to a genetic overlap between neuroticism and objective health conditions such as coronary heart diseases, smoking and high Body Mass Index (BMI)[2].

The present study has several limitations. The first involves the fact that the variables were assessed based on self-report, introducing a risk of memory, social desirability and comprehension bias. Secondly, although the rate of attrition was not sufficiently high so as to weaken the data, fewer sample losses would have been more desirable. Thirdly, the long period elapsed between baseline and follow-up may have contributed to the losses observed. Lastly, it is important to note that the lack of reliable psychometric data for the Brazilian version of the neuroticism scale weakens the conclusions somewhat, since no parameters are available to judge whether the respondents deal with the items and scale in a uniform manner.

Nevertheless, conducting a study that involved the neuroticism variable was valid in drawing attention to aspects relevant in the diagnosis and management of chronic pain, disability, and depression that are often overlooked in older patients. Another strength of this investigation was the application of path analysis using the structured equations modeling, a modality of multivariate analysis acknowledged as an important tool for promoting advances in theory. The fact the study centered on a sample of oldest old (>70 years) puts it in step with the sociodemographic and economic needs of Brazilian elderly, constituting a valuable contribution in addressing the problems of the population.

CONCLUSIONS

The study showed the mediating role of neuroticism in the relationship between chronic pain, multimorbidity, depression and self-rated health in community-dwelling older adults.

Understanding the determinants and correlates of self-related health can help professionals involved in the area of aging to prioritize strategies aimed at promoting health and implementing effective interventions. Furthermore, optimistic attitudes towards objective health, perceptions and more positive beliefs can help individuals better maintain or improve their subjective health status and establish strategies to optimize the physical and mental health conditions of older individuals. In this respect, intervention strategies which reduce levels of neuroticism can help older adults prevent the negative effects of subjective health, given that self-rated health is an important tool for promoting the health of this population.

Objective and subjective health should be analyzed while taking into account level of neuroticism, since older individuals who exhibit high neuroticism rate their health as poor. This study is relevant in the area of human aging given the importance of multi-dimensional assessment of older individuals, serving to help Geriatric and Gerontology professionals devise better health promotion and intervention strategies.

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