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ORIGINAL PAPER

Besides Depression, Number of Physiological Diseases is More Important than Physical Function on Mental Health of Elderly Adults in Taiwan

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Abstract This study contrasted the relative importance between the number of physiological diseases and activities of daily living (ADLs) to the mental health of elderly adults after controlling for mini-mental state exam (MMSE) scores and depression. Participants were 1342 elderly people with a mean age of 73.22 years and living in three communities in southern Taiwan. Age, gender, years of education duration, marital status, and MMSE and hamilton depression rating scale (HAMD) scores were control variables. The ability of the ADLs scale scores and number of physiological diseases to predict mental health, as measured by the 12-item Chinese health questionnaire, was compared using hierarchical regression analyses. The final hierarchical model indicated that only HAMD and the number of physiological diseases scores were significant and that the former was much more predictive than the latter. The results imply that the number of physiological diseases is more predictive of mental health than ADLs scores and that depression is a dangerous risk factor for elderly people.

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Introduction

As people age, they become more susceptible to cognitive decline (Dufouil et al. 2000) and depression (McKinney and Sibille 2013; Mezuk et al. 2012); however, those with more education know more strategies for maintaining their health (Etile 2014). After considering marital status, spousal age gap, and related variables, previous studies have found elderly women to be less healthy than elderly men (Choi and Vasunilashorn 2014) and widowers and widows to be less mentally healthy than married people (Choi and Vasunilashorn 2014; Hewitt et al. 2012). As people age, they face increasing physical risks that might interfere with healthy aging. We would like to know that aside from cognitive function and depression, which physical risk factors are particularly crucial for the mental health of elderly adults.

This question is not easy to answer. Health risk factors can be grouped into three main categories (Burton et al. 1999): (a) lifestyle, such as smoking and insufficient physical activity, which can lead to poor health; (b) perception, including perception of physical health, general satisfaction with life, and negative events that people might have encountered; and (c) biological, such as diabetes, high blood pressure, and other self-reported or clinical measurements. However, physical activity was found to be less significant than physical function in predicting mental health (Gessa and Grundy 2014). Therefore, the common scales for risk factors [i.e., activities of daily living scale (ADLs), mini-mental state examination (MMSE), and hamilton depression rating scale (HAMD)]

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and the number of physiological diseases an elderly person was affected by were considered in predicting mental health. The purpose of the present research was to explore the relative importance of both ADLs and the number of physiological diseases on an elderly person's mental health, with control for MMSE and HAMD scores.

Physiological diseases should not be neglected because they often reduce physical activity and mental function, thus radically harming the quality of life of elderly people. A 4-year follow-up study showed that diabetes could predict cognitive decline among elderly people, even after control for physical activity, depression, and baseline cognitive functions (Crowe et al. 2010). In addition, Burton et al. (1999) found that the presence of diseases resulted in a greater decline in productivity than the presence of the aforementioned grouped health risks. Hence, considering the number of physiological diseases as a predictor of mental health would be reasonable. In fact, a recent study showed that the number of chronic diseases was directly predictive of the perceived health of elderly people; it also indirectly affected perceived health through depression (Gonzalez et al. 2013). This meant that the number of physiological diseases an elderly person has is a relevant risk factor influencing perceived health, even after control for depression.

Physical function was also determined to be a relevant variable influencing health. In past studies, ADLs have most commonly been used to define physical function (Gessa and Grundy 2014; Gustafsson et al. 2013; Lee et al. 2009). In a nationally representative longitudinal study including data from Denmark, France, Italy, and England, functional limitation, measured by ADLs, predicted self-rated mental health, as defined by depression, in elderly people, even after adjustment for socioeconomic, demographic, and health-related variables at the baseline (Gessa and Grundy 2014). In the present study, we broadened the definition of mental health to a range wider than only depression, and contrasted the effect of ADLs with the number of physiological diseases in predicting self-perceived mental health.

Cognition and emotion can be considered two main facets of psychological function that influence mental health. In a 5-year mobility change study, O'Connor et al. (2010) found that cognitive impairment predicted a decrease in mobility (e.g., driving, life space) as elderly people aged. They suggested that cognitive function decline gradually leads to health loss. Depression is frequently used as the most critical psychological function index, especially for elderly people. Previous studies have also considered depression a health index indicating the health status of people with physiological ailments (Farroha et al. 2013; Gessa and Grundy 2014).

The MMSE has been frequently used in previous studies for measuring cognitive function (Nilsson 2007; Tappen et al. 2012; van den Kommer et al. 2013; Wouters et al. 2010). Although it is not particularly sensitive to mild cognitive impairment, the MMSE is suitable for elderly people with a low education level. For measuring depression, the HAMD has been commonly used in previous studies (Istriana et al. 2013). We used the two aforementioned instruments as control variables in determining the influence of ADLs and the number of physiological diseases on the regression of mental health. We expected to find that the number of physiological diseases is more predictive than physical function on mental health, and that depression is the most important risk factor of mental health in the present research. The authors certify that there was no actual or potential conflict of interest in relation to this article. This study was approved by National Health Research Institutes in Taiwan.

Methods

This was a cross-sectional study in which a multistage random sampling technique was applied to the electoral lists of three selected communities for people aged 65 years and older in southern Taiwan. An official letter was first mailed to each of the initial 1500 selected representative participants. The letter stated the purposes of the study and provided information about the researcher. A research assistant visited the potential participants to explain the purpose of the study again, provide assurance that any information obtained in the interview would be confidential, and arrange an appropriate time for the research psychiatrist to interview them if they agreed to participate.

Of the 1500 potential participants, 127 refused and 1373 agreed to participate. However, 27 died before the formal interview; consequently, we were able to interview only 1346 participants. Four participants did not provide sufficient data, and thus 1342 valid sets of data on participants 65–101 years old were retained for subsequent statistical analyses.

Measures

The Chinese health questionnaire (CHQ-12) was developed in reference to the conceptual framework of Goldberg's (1972) general health questionnaire, with added Chinese cultural viewpoints on health (Cheng and Williams 1986). The CHQ-12 has been widely used in Asian countries (including Taiwan) to assess mental health. It consists of 12 items that concern somatic symptoms (four items), anxiety and worry (three items), depression and poor relationships

with family (four items), and sleep problems (one item). Each item is scored as 0 (feel little or no difference compared to the past usual time) or 1 (feel more or much more of a difference compared to the past usual time). Therefore, the maximum total score is 12; the higher the total score, the less mentally healthy a participant is. The cutoff point of the CHQ-12 is 2/3 (equal to or lower than two indicates mentally healthy). Cronbach's α reliability coefficient of the CHQ-12 was 0.82 in the present research.

The number of physiological diseases was calculated as the sum of diseases from the following 13 categories: arthritis or rheumatism, glaucoma, cataract, pulmonary emphysema or chronic bronchitis, hypertension, heart disease, circulation problems of the hands and feet, diabetes, gastrointestinal problems, liver diseases, kidney diseases, stroke and its sequelae, and Parkinson disease. These disease categories have frequently been used to identify potential diseases in patients in Taiwan.

ADLs was used to measure physical function. The Chinese version of the ADLs was modified to include "walking freely" and "combing or shaving" and by combining the "use of toilet" and "continence" as one item, yielding a total of seven items. Each item was scored on a 3-point scale from 0 to 2, in which 0 indicated complete disability with respect to a specific task, 1 referred to partial disability (requiring help from another person, special equipment, or a device), and 2 corresponded to a lack of reported disability. Therefore, the maximum total score is 14; the lower the total score, the less physical function a participant has. The Cronbach's α reliability coefficient of the ADLs was 0.94 in the present research.

The MMSE was developed to measure cognitive function (Folstein et al. 1975). A total of 11 items were designed to measure orientation, registration, attention, calculation, recall, and language. Each item is scored in a range of 0–5. Therefore, the maximum total score is 30; the higher the score, the greater the cognitive function a participant has. The Chinese version of the MMSE was translated by Guo et al. (1988). In addition, three easier items were added to enforce the discriminative power of the test for the lower-educated persons. The three items are two simple arithmetic items ("2 + 4 = ?" and "7 − 3 = ?") and one item stating, "write down your own name." Each of these three items are scored from 0 to 1. The maximum total score is 33 for the Chinese version. The cutoff point for low educational status was 15/16. In the present research, the Cronbach's α reliability coefficient of the MMSE was 0.80.

The Chinese version of the HAMD was translated to measure depression with high reliability and validity (Zheng et al. 1988), and some phrases were adjusted for Chinese culture-specific usage. The present research used the 24-item version of the HAMD. Each item is scored from either 0–2 or 0–4. Therefore, the maximum total score is 74; the higher the total score, the more severe the depression is. The cutoff points for mild, moderate, and severe depression were 8/9, 20/21, 35/36, respectively. The HAMD was assessed using an interview and observations for each participant and then recorded by research psychiatrists rather than through self-reporting. In the present research, the Cronbach's α reliability coefficient of the HAMD was 0.91.

Statistical Analysis

Descriptive statistics were used to analyze gender and marital status (with and without spouse) in percentages (%). For age (years), years of education, number of physiological diseases, and scores in the ADLs, MMSE, HAMD, and CHQ-12, the mean and standard deviation (SD) were used. In addition, multiple linear regression analyses were used to detect the independent and unique associations of the 13 categories of physiological diseases with the CHQ-12 scores. Furthermore, regression of the CHQ-12 scores on two sets of predictors using hierarchical methods was performed to formulate two models. Model 1 included age, gender, years of education, and marital status as control variables; "female" and "without spouse" were set as reference groups. Model 2 comprised Model 1 and two physical risk factors, the number of physiological diseases and ADLs scores, as well as two psychological risk factors, the MMSE and HAMD scores.

Results

As Table 1 shows, the mean age of the participants was 73.22 years (SD = 6.24). The participants were 50% men and 50% women, respectively. They had been born in Taiwan when fewer education opportunities were offered; consequently, the mean number of years of education was 3.32 (SD = 4.03). Of the participants, 62.9% were still with their spouse. On average, the participants had 1.76 physiological diseases (SD = 1.31). Of the 13 physiological disease categories, cataract (29.0%), hypertension (24.1%), and arthritis or rheumatism (24.0%) were the three leading diseases among the participants. Although 203 participants reported having none of the 13 disease categories, the mean ADLs score for all participants was 13.22 (SD = 2.48), showing that even in their old age, most participants still maintained their basic daily life function. Furthermore, the mean scores in the MMSE (25.21, SD = 6.55) and HAMD (6.32, SD = 7.94, median = 3.00) indicated that the participants had intact cognitive functioning and low depression levels (specifically, 71.5% of the participants were equal and lower than the cutoff point 8.0 of HAMD). Finally, the

Table 1 Descriptive statistics of participants

Variable	N	Mean or percentage	SD
Age, years	1342	73.22	6.24
Gender			
Male	671	50.0%	
Female	671	50.0%	
Education years	1337	3.32	4.03
Spouse			
With	844	62.9%	
Without	497	37.1%	
Number of diseases[a]	1339	1.76	1.31
Arthritis or rheumatism	321	24.0%	
Glaucoma	24	1.8%	
Cataract	388	29.0%	
Pulmonary emphysema or chronic bronchitis	53	4.0%	
Hypertension	323	24.1%	
Heart diseases	167	12.5%	
Circulation problems for hands and feet	52	3.9%	
Diabetes	136	10.2%	
Gastrointestinal problems	204	15.2%	
Liver diseases	46	3.4%	
Kidney disease	61	4.6%	
Stroke and its sequela	83	6.2%	
Parkinson's disease	12	0.9%	
ADLs	1342	13.22	2.48
MMSE	1309	25.21	6.55
HAMD	1304	6.32	7.94
CHQ-12	1311	1.44	2.26

[a]203 participants reported none of the 13 diseases categories

CHQ-12 scores (mean = 1.44, SD = 2.26, median = 0.00) indicated that the participants, in general, had good mental health (specifically, 77.8% of the participants were equal and lower than the cutoff point 2.0 of CHQ-12).

As Table 2 shows, a point-biserial correlation analysis showed that all diseases except glaucoma, pulmonary emphysema or chronic bronchitis, and diabetes were significantly correlated with the CHQ-12 scores, to at least a degree of $p < 0.05$. When all the diseases were input into a multiple regression model for predicting the CHQ-12 scores, hypertension, gastrointestinal problems, and liver diseases lost their predictive effects, and glaucoma, pulmonary emphysema or chronic bronchitis, and diabetes remained nonsignificant predictors. However, Crowe et al. (2010) reported that diabetes significantly predicted cognitive decline. Hence, it was deemed prudent to consider all diseases rather than to eliminate some that were not significant. At present, the variance of the CHQ-12 scores explained by all these physiological diseases was 6.0%, pertaining to a medium effect size (Cohen 1988).

In addition, as Table 3 shows, the CHQ-12 scores were correlated with age ($r = .069$, $p = 0.013$) and years of education ($r = -0150$, $p < 0.001$) according to Pearson product-moment correlation. The CHQ-12 scores were correlated with gender ($r_{pb} = -0168$, $p < 0.001$) and marital status ($r_{pb} = -0077$, $p = 0.005$) according to point-biserial correlation. These results indicated that older participants had worse mental health than that of younger participants, that male participants were mentally healthier than female participants, and that those receiving more years of education or having a spouse had better mental health. In addition, a significant correlation of the CHQ-12 scores

Table 2 Correlation with CHQ-12 and multiple regression of CHQ-12 on 13 disease categories

Variables	Correlation with CHQ-12		Multiple regression		
	r	*p*	B	β	*p*
Constant			0.885		<0.001
Arthritis or rheumatism	0.091	0.001	0.385	0.073	0.008
Glaucoma	0.016	0.553	0.163	0.010	0.721
Cataract	0.134	<0.001	0.450	0.091	0.001
Pulmonary emphysema or chronic bronchitis	0.011	0.696	0.166	0.014	0.600
Hypertension	0.079	0.004	0.224	0.043	0.123
Heart diseases	0.129	<0.001	0.644	0.094	0.001
Circulation problems for hands and feet	0.103	<0.001	0.994	0.085	0.002
Diabetes	0.023	0.399	−0.031	−0.004	0.880
Gastrointestinal problems	0.055	0.047	0.213	0.034	0.209
Liver diseases	0.077	0.006	0.565	0.045	0.098
Kidney disease	0.084	0.002	0.623	0.058	0.034
Stroke and its sequela	0.092	0.001	0.838	0.086	0.002
Parkinson's disease	0.091	0.001	2.064	0.087	0.001
Adjusted R^2 for multiple regression			0.060		<0.001

Table 3 Correlation with CHQ-12 and hierarchical regression of CHQ-12 on background, psychological and physical factors

Variables	Correlation with CHQ-12		Model 1			Model 2		
	r	*p*	B	β	*p*	B	β	*p*
Constant			1.009		0.231	0.183		0.841
Age	0.069	0.013	0.012	0.034	0.257	−0.007	−0.019	0.445
Gender	−0.168	<0.001	−0.556	−0.123	<0.001	−0.051	−0.011	0.668
Edu. yrs	−0.150	<0.001	−0.047	−0.084	0.007	−0.026	−0.046	0.102
Spouse status	−0.077	0.005	−0.068	−0.015	0.629	−0.059	−0.013	0.606
HAMD	0.608	<0.001				0.171	0.599	<0.001
MMSE	−0.181	<0.001				0.009	0.025	0.437
Disease no.	0.239	<0.001				0.118	0.066	0.004
ADLs	−0.160	<0.001				0.035	0.030	0.241
Adjusted R^2			0.034			0.377		

Female as a reference group in gender variable. Without spouse as a reference group in marital status variable

with the number of physiological diseases ($r=0.239$, $p<0.001$), ADLs score ($r=-0160$, $p<0.001$), MMSE score ($r=-0181$, $p<0.001$) and HAMD score ($r=0.608$, $p<0.001$) indicated that participants with fewer diseases, higher physical function, higher cognitive function, and less depression were mentally healthier.

In a hierarchical regression analysis, only gender and years of education were significant in predicting the CHQ-12 scores in Model 1. In Model 2, no background variables were significant, and the HAMD scores (standardized regression coefficient $\beta=0.599$, $p<0.001$) and the number of physiological diseases ($\beta=0.066$, $p=0.004$) both had significant unique associations with the CHQ-12 scores, but the MMSE ($\beta=0.025$, $p=0.437$) and ADLs ($\beta=0.030$, $p=0.241$) scores did not.

Discussion

In the present study, the major findings was that, as expected, number of physiological diseases was more predictive than ADLs scores on CHQ-12, and depression was the most predictive risk factor of CHQ-12.

In Model 2, compared with the number of physiological diseases, the ADLs scores did not significantly affect mental health when depression and the MMSE scores were controlled for. This result showed that among the elderly people, the number of physiological diseases was a more important physical factor than the ADLs scores for predicting mental health. However, before such a conclusion was made, multicollinearity needed to be considered. Absolute values of the correlation coefficients between HAMD, MMSE and ADLs scores were ranging from 0.29 to 0.43, indicating an approximately medium effect size (Cohen 1988). Furthermore, the MMSE scores correlated with age, years of education, and gender with coefficients of −0.41, 0.56, and 0.42, respectively, which was consistent with similar previous research in valence. Nonetheless, the variation inflation factors (VIF) of these predictors in Model 2 were within 1.13–2.12 (lower than the VIF standard of ten), thus showing no noteworthy multicollinearity. However, the HAMD includes six items concerning physical factors (Items 7, 11–14, 16) and one item (Item 8) concerning a cognitive factor, which might have affected the abilities of the ADLs and MMSE scores to predict mental health. The seven items were excluded from the HAMD; however, the reanalyzed outcomes were still similar to the aforementioned results. Specifically, in Model 2, no background variables were significant, and the HAMD scores ($\beta=0.579$) and number of physiological diseases ($\beta=0.080$) had significant unique associations with the CHQ-12 scores, but the MMSE ($\beta=0.001$) and ADLs ($\beta=0.015$) scores did not.

In addition, depression was entered as a control variable, and it still had a very large predictive effect for mental health. An age-by-disease interaction hypothesis (McKinney and Sibille 2013) posits that "the presentation of late-life depression (LLD) is the integrated output of specific biologic processes that are pushed in LLD-promoting directions by changes in gene expression naturally occurring in the brain during aging" (p. 418). Therefore, depression is a more comprehensive characteristic than any specific disease or number of physiological diseases in predicting mental health among elderly people.

In addition, that the HAMD scores had a stronger predictive effect than that of the number of physiological diseases was consistent with the findings of Gonzalez et al. (2013). However, the ratio of the standardized regression coefficient of depression to that of the number of physiological diseases was 9.08 in the present research, which is

much larger than the 2.52 observed among Mexican elderly adults by Gonzalez et al. (2013). One reason might be the similar but not identical content of the health scale was used. In Gonzalez et al. (2013), the short form (12) health survey (SF-12), a brief version of the SF-36, was used to define health; the 12 items measure physical, social, emotional, mental, and general health (Ware et al. 1996). The CHQ-12 is more suitable for measuring mental health than the SF-12; therefore, depression accounted for more variance and the number of physiological diseases accounted for less variance in mental health in the present research than those in Gonzalez et al. (2013). Another reason might be different cultural dispositions between the east and the west. Despite Mexican culture also being characterized by collectivism like Chinese culture, Mexicans are generally more extroversive and open than Chinese in disposition. Therefore, introversive traits, such as depression, have a relatively larger effect on elderly people in Taiwan. Although modern Taiwanese have received a less conservative education and thus follow a more Western type of thinking than before, traditional Chinese culture that emphasizes implicit behavior has remained influential in the expression of the attitudes of the elderly people in Taiwan.

One limitation in the present research was that the severity of physiological diseases was not considered. This limitation might explain the lack of significant correlations between three disease categories, glaucoma, pulmonary emphysema or chronic bronchitis, and diabetes, and the CHQ-12 scores. Another limitation was that given that the CHQ-12 includes a measure of depression, it is not surprising that there was a strong correlation between HAMD scores and CHQ-12. Therefore, other possible mental health indices or constructs such as quality of life (e.g., Rojo-Perez et al. 2015), psychological well-being (e.g., Li's 2014 shortened version for elderly people) and the like may be considered in the future research. Although these limitations affected the results, the current authors believe that the effects of the number of physiological diseases on the mental health of elderly people should not be underestimated.

Conclusions

The number of physiological diseases was less emphasized than physical function in mental health field in the past. In the present research, we broadened the definition of mental health to a range wider than only depression that was frequently used; after control for the effect of depression and MMSE scores, the number of physiological diseases was more effective than ADLs scores in predicting the mental health of elderly people. In addition, depression was a noteworthy risk factor for the mental health of elderly people in the past and the present research.

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