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Depression Moderates the Frailty–Subjective Health Link among Chinese Near Centenarians and Centenarians

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Objective: *Very old adults may be physically frail, but they do not necessarily experience poor subjective health. The authors hypothesized that the relationship between frailty and subjective health is moderated by depression for very old people.* **Methods:** *In a cross-sectional study, a survey administered was by a face-to-face interview to 129 community-dwelling older adults aged 95–108. Measurements included the five-item FRAIL scale, the Geriatric Depression Scale Short-Form (GDS), and a subjective health rating. Hierarchical multiple regressions were conducted to test the moderation effects, adjusting for age, gender, living arrangement, perceived socioeconomic status, and cognition.* **Results:** *The interaction effect between frailty and depression was significant. Inspection of the simple slopes revealed that those who were more depressed had a more negative frailty–subjective health relationship. There was no significant moderation effect for a withdrawal–apathy–vigor dimension of the GDS.* **Conclusion:** *Our findings suggest a protective psychological mechanism may enable very old adults to maintain an optimistic view of their health despite their increasing physical and functional limitations.* (Am J Geriatr Psychiatry 2016; 24:753–761)

Key Words: centenarians, frailty, depression, subjective health, Chinese

INTRODUCTION

Subjective health (or self-rated health) refers to the global evaluation of health.^{1–3} The construct is often efficiently evaluated by a single-item question on a four- or five-point scale, yet reliably predicts important

health outcomes including health complaints, treatment prognosis, healthcare utilization, and mortality,^{4–7} even among adults as old as nonagenarians and centenarians.^{8–11} However, based on the sociocultural conception of health, individuals may include multiple criteria they consider to be relevant to their health and well-being when judging their overall health. These

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criteria, such as health behaviors, positive and negative emotions, fulfillment of social roles, or financial security, may not correspond directly to the conventional, biomedical definition of "health."^{1,12,13} When evaluating the conditions of these criteria, individuals may compare their current conditions with those of other people (e.g., same-aged peers), with their own in the past (i.e., time), or with their expectation for the near future.^{2,14} The inclusion of psychosocial variables and the adoption of various frames of references in the subjective evaluation of health may entail a marked discrepancy between subjective health and "objective" indicators of physical and functional health (i.e., objective health; e.g., diseases, disability, physical performance).^{3,15,16} Based on the health congruence framework of Chipperfield,¹⁵ people may experience congruence (i.e., realists) or incongruence in their health evaluations. Those experiencing incongruence could be regarded as health optimists (appraising subjective health as good despite poor objective health) or health pessimists (appraising subjective health as poor despite good objective health). Relative to realists with poor objective and subjective health, health optimists had been found to enjoy better psychological well-being and perceived healthcare management, to be more physically active, and to experience fewer hospitalizations. Conversely, compared with realists with good objective and subjective health, health pessimists demonstrated poorer physical and psychological health outcomes.^{16,17} In other words, the discrepancy between subjective and objective health may provide important information about the well-being of older adults.

In addition to objective health indicators such as biomarkers, physical health complaints, and physical performance,^{7,8,18,19} psychological well-being variables such as depression and positive attitude to life are integral to one's overall evaluation of health.^{20,21} The nonagenarian and centenarian populations could be an especially relevant group to study the discrepancy between subjective and objective health.²² On one hand, Baltes²³ described the "fourth age" (85+) as a time of inevitable declines in biologic resources and functional capacities coupled with inefficient compensation by psychological and social resources. According to this view, "fourth-age" individuals are characterized by disability and dependency.^{23,24} On the other hand, studies have repeatedly documented similar levels of depression, subjective health, and subjective well-being

across old, old-old, and oldest-old populations.²⁵⁻²⁷ Termed as the "paradox of aging,"¹⁰ studies have witnessed the diversion of the trajectory of decline of subjective and objective health with increasing age, with physical and functional health indicators (i.e., objective health) showing a much sharper decline than subjective health.^{7,9,11,25,27,28} This can be partly explained by adaptive coping responses older people use to deal with their health decline.¹⁰ In other words, at the zenith of longevity, although subjective health continues to be a strong predictor of health and well-being outcomes (e.g., mortality, successful aging), the explanatory power of objectively measured health dimensions (e.g., disease, disability) on subjective health wanes.

Physical Frailty

Physical frailty represents one of the key indicators of objective health in old age. The gradual loss of physiologic reserve in multiple systems, such as loss of muscle mass and strength, decreased balance and gait, and weakening of multiple bodily systems (e.g., immune system, brain, and endocrine system), precipitate individuals to greater susceptibility to various age-related diseases and speed up the aging process. The loss is accelerated among physically frail elderly, resulting in systematic and cumulative vulnerability to adverse outcomes (e.g., mortality, disability) even with minor stressor events, such as a fall or inflammation.^{29,30} Because physical frailty is an important medical syndrome that is detectable with simple, rapid screening tests and reversible by comprehensive interventions (e.g., exercises, protein-calorie supplementation, vitamin D, and reducing polypharmacy), it has been suggested that all persons aged 70 years or with significant weight loss due to chronic disease should be screened for physical frailty.³⁰

The prevalence of physical frailty tends to increase remarkably with age, especially among nonagenarians and centenarians. Depending on the frailty assessment, the prevalence of frailty ranges from 4.0% to 59.1% among community-dwelling individuals aged 65 or above and raises from 4% among individuals aged 65-69 years to 26% for elders aged above 85.²⁹ The syndrome tends to be very prevalent among the centenarian population. In the Oporto Centenarian Study, 60.0% of participants were frail, with another 36.0% being prefrail.³¹ Using the world's largest sample

of centenarians from the Chinese Longitudinal Healthy Longevity Survey, Gu and Feng¹⁹ reported that centenarians were significantly frailer than their younger counterparts (aged 65–79, 80–89, or 90–99). Despite the high mean cumulative deficits, the centenarian group exhibited the largest heterogeneity. In other words, advanced age does not necessarily confer physical frailty.

Depression as a Moderator for the Physical Frailty–Subjective Health Relationship

A depressive outlook may affect how very old adults evaluate their health beyond the effect of their actual capabilities. First, depressed individuals may be more pessimistic about the progression of their health problems, perceive less control over their objective health, and foresee a poorer prognosis of their current health complaints.^{22,32} Second, most individuals, including older adults, tend to use lateral (compared with similar) or downward comparisons to maintain a favorable perception of their general health, especially when experiencing an increasing number of physical symptoms.¹⁴ Such favorable social comparison processes may be stifled by depression. Depression may disrupt the disregard of physical limitations in the evaluation of health, especially among very old adults who are prone to physical frailty.

Hong et al.²² found that among their samples with a mean age of 90 and poor objective health (more diseases and health complaints), health optimists reported fewer depressive symptoms than poor health realists. Kempen et al.³³ also reported that the changes in subjective health and in performance-based physical functioning were more congruent among nonagenarians with worsening depression. However, Galenkamp et al.¹⁰ reported an opposite pattern based on the Vitality 90+ data, such that poor functioning tended to be more detrimental to the subjective health of those who were nondepressed. Nonetheless, the two former studies^{22,33} applied depression scales (the Hospital Anxiety and Depression Scale and the Center for Epidemiologic Studies Depression Scale) to assess a graded level of depression, whereas Galenkamp et al. assessed depression with a single item on self-reported diagnosis.

The investigation on the psychosocial factors moderating the objective–subjective health link remains scarce, especially in the very old (see Galenkamp et al.¹⁰

for an exception). More importantly, the effect of depression has also not been isolated from that of the withdrawal–apathy–[lack of] vigor (WAV) dimension of depression.³⁴ Gallo et al.³⁵ concluded that a significant proportion of older adults tend to experience “depression without sadness”. Previous studies have repeatedly found that older adults are more likely to endorse WAV symptoms such as lack of hope, lack of interest, not wanting to go out, and social withdrawal than symptoms related to depressed moods including feeling sad, blue, helpless, and so on.^{26,34,35} Stipulated by the disengagement theory of aging,³⁶ gerotranscendence theory,³⁷ and socioemotional selectivity theory,³⁸ such a tendency could be the manifestation of a normal trajectory of aging, characterized by the narrowing of the older adult’s social space and reprioritization of resources to nurturing close relationships and self-reflection. WAV symptoms are often associated with advanced age and physical frailty and could be indicative of a depletion or disengagement syndrome that prevails in very old adults rather than dysphoric mood and negative cognitions.^{26,34,39} To delineate the effect of WAV as a result of the normal aging trajectory from that of dysphoric moods, the current study investigated and compared the moderating effect of depression and WAV symptoms on the relationship between physical frailty and subjective health among a group of Hong Kong Chinese near centenarians (age 95–99) and centenarians (age 100 or above).

METHODS

Sampling and Procedures

The Hong Kong Centenarian Study recruited Chinese near centenarians and centenarians who were born in 1905–1915. No other exclusion criterion was imposed. Participants signed written informed consent before their in-home or center-based face-to-face interviews. At least one family member and/or registered social worker was present to ensure a reassuring environment for the interview. This study used a sample of 129 participants from the Hong Kong Centenarian Study dataset who provided valid responses on all concerned items (see [supplementary appendix S1](#) for details on sampling method and procedure; available online).

MEASURES

Physical frailty was evaluated by the FRAIL scale,⁴⁰ which consists of five items: fatigue, resistance, mobility (ambulation), illnesses, and loss of weight (Table 1). The FRAIL scale has a possible range of 0–5. Participants scoring 0 were considered as nonfrail. Participants who scored between 1 and 2 were prefrail, and those who scored between 3 and 5 were frail. These levels of frailty (nonfrail, prefrail, and frail) were recoded as 0, 1, and 2, respectively, in the regression models.

Depression was measured by 14 items on the Chinese version of the Geriatric Depression Scale (GDS-14) after excluding the fatigue item.⁴¹ To measure WAV, we constructed a two-item WAV subscale based on the findings of Adams³⁴ (“Prefer to stay at home, rather than going out and doing new things,” “dropped many of your activities and interests”). The internal consistencies of GDS-14, WAV and GDS-12 are good (GDS-14: $\alpha = 0.79$; WAV: $\alpha = 0.84$; GDS-12: $\alpha = 0.81$). Subjective health was measured by one item, “How do you rate your current health?” using a five-point scale, ranging from 1 = very poor to 5 = very good. Control variables included gender (0 = female, 1 = male), age, living arrangement, cognition, and perceived socioeconomic status (see supplementary appendix S2 for details of the measures; available online).

TABLE 1. Items on the FRAIL Scale

Variable	Item
Fatigue	Answering “no” to “Feel full of energy” from the Chinese version of the GDS
Low resistance	Having difficulty or not being able to perform “crouch-and-stand” three times
Low mobility	Having difficulty or not being able to walk for 400 m
Illnesses	Suffering from more than five diseases on a list of 30 chronic diseases (i.e., stroke, coronary heart disease, hypertension, parkinsonism, cancer, arthritis, multiple sclerosis, chronic obstructive pulmonary disease, diabetes mellitus, etc.)
Loss of weight	Weight loss of more than 3 kg or more in the past 6 months

Notes: A score of 1 was assigned to each item if the deficit was present. The FRAIL scale has a possible range of 0–5.

RESULTS

Sample Characteristics

Of the 129 participants included in the current analysis, 96 (74.4%) were women, with an age range of 95–108 (mean: 97.6; standard deviation: 2.2). Most participants were living in the community, with 67 (51.9%) living with family and/or friends and 41 (31.8%) living alone. For frailty, 29 participants (22.5%) were nonfrail, 72 (55.8%) were prefrail, and 28 (21.7%) were frail. The mean GDS-14 score was 2.40 (standard deviation: 3.30). Fifty-two participants (40.3%) scored 0, whereas 51 (39.5%) scored between 1.00 and 4.00. The mean score of subjective health was 3.26 (standard deviation: 0.93), with 52 participants (40.3%) reporting their health as “good” or “very good” and 54 (41.9%) reporting “average” health.

Table 2 provides the sample characteristics, and Table 3 presents the frequencies of levels of frailty

TABLE 2. Sample Characteristics

Variable	No. of Cases (N = 129)	Percent
Female gender	96	74.4
Mean age, yr	97.6	2.2 ^a
Living arrangement		
Alone	41	31.8
With family and/or friends	67	51.9
In institutions	21	16.3
Mean MMSE score	24.3	4.6 ^a
Perceived SES as “better off”	44	34.1
Frailty phenotype		
Nonfrail (code 0)	29	22.5
Prefrail (code 1)	72	55.8
Frail (code 2)	28	21.7
Frailty items		
Fatigue	30	23.3
Low resistance	86	66.7
Low mobility	48	37.2
Illnesses > 5	12	9.3
Weight loss ≥ 3 kg in 6 months	27	20.9
Mean GDS-14 score	2.40	3.30 ^a
Score 0	52	40.3
Score 1–4	51	39.5
Score > 4	26	20.2
Mean subjective health	3.26	0.93 ^a
Very good	10	7.8
Good	42	32.6
Average	54	41.9
Poor	18	14.0
Very poor	5	3.9

Notes: SES: socioeconomic status.

^aValue is standard deviation.

TABLE 3. Distribution of Frailty Phenotypes in Good Versus Poor Subjective Health

	Nonfrail	Prefrail	Frail	Total
Poor subjective health (very poor/poor/ average)	13 (10.1)	40 (31.0)	24 (18.6)	77
Good subjective health (very good/good)	16 (12.4)	32 (24.8)	4 (3.1)	52
Total	29	72	28	129

Notes: Values in parentheses are percents.

(nonfrail, prefrail, and frail) across two aggregated levels of subjective health (very good/good = good subjective health; very poor/poor/average = poor subjective health). The percentages of participants reporting good subjective health were 55.2% (16/29), 44.4% (32/72), and 14.3% (4/28), respectively, for the nonfrail, prefrail, and frail groups.

Moderating Effect of Depression

The moderation effects were tested by hierarchical multiple regression. We first tested the effects of control variables on subjective health in Step 1. In Model 1, physical frailty and GDS-14 were centered and entered in Step 2 to test if depression and physical frailty predict subjective health above and beyond the effects of control variables. Finally, an interaction variable indicating the physical frailty \times depression effect was entered into Step 3 to test for the moderation effect above and beyond the main effects. In Models 2 and 3, WAV subscale score and GDS-12 subscale score, respectively, replaced the GDS-14. The direction of significant moderation effect was examined using slope analysis.

Table 4 presents the regression results with GDS-14 as the predictor. Controlling for the effects of age, gender, living arrangement, cognition, and perceived socioeconomic status, the level of physical frailty and depression provided significant incremental explanatory power to subjective health, $\Delta F(2, 120) = 14.88$, $\Delta R^2 = 0.17$, $p < 0.001$. Participants who had a higher GDS-14 score ($B = -0.06$, standard error [SE] = 0.03, $t = -2.42$, $df = 120$, $p = 0.017$) and were more physically

frail ($B = -0.42$, $SE = 0.12$, $t = -3.42$, $df = 120$, $p = 0.001$) tended to have worse subjective health. Results also show that the interaction effect was significant ($B = -0.08$, $SE = 0.04$, $\Delta F(1, 119) = 5.31$, $\Delta R^2 = 0.03$, $p = 0.023$). Figure 1 shows the direction of the moderating effect. Participants with higher scores on the GDS-14 possessed a more negative relationship between physical frailty and subjective health. In other words, physical frailty tended to have a more negative impact on subjective health among centenarians who were more depressed.

We repeated the moderation analysis twice (See supplementary appendix S3 for detailed results; available online). First, we substituted GDS-14 with the two-item WAV subscale. The interaction effect between physical frailty and WAV was not significant ($B = -0.24$, $SE = 0.15$, $\Delta F(1, 118) = 2.60$, $\Delta R^2 = 0.02$, $p = 0.109$).¹ Next, we replaced the WAV subscale with GDS-12. The interaction effect was significant ($B = -0.13$, $SE = 0.05$, $\Delta F(1, 119) = 7.38$, $\Delta R^2 = 0.04$, $p = 0.008$). The direction of the moderating effect by these 12 items was the same as that by GDS-14, such that participants with a higher GDS-12 score showed a more negative physical frailty–subjective health relationship.

DISCUSSION

Centenarians fulfill the basic criteria for longevity: age. However, their pathways to good health tend to be different from those of their younger counterparts.^{9,11,25,27} In the light of the popular use of subjective health as a proxy for an individual's health in gerontology research and the widening discrepancy between subjective and objective health at advanced age, this study examined how depression moderated the relationship between physical frailty and subjective health among a group of Hong Kong Chinese near centenarians and centenarians. Results show that physical frailty tends to be more detrimental to the subjective health of individuals with a higher level of depression. The WAV dimension alone, however, did not moderate the physical frailty–subjective health relationship. In other words, WAV, which may reflect normal aging trajectories, does not tend to predispose

¹The regression analysis with the two GDS fatigue items was conducted on 128 participants.

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TABLE 4. Results of the Hierarchical Multiple Regression with GDS-14

	Step 1		Step 2		Step 3	
	B (SE)	95% CI	B (SE)	95% CI	B (SE)	95% CI
Constant	3.61 (0.17)	3.28, 3.94	3.52 (0.15)	3.22, 3.82	3.64 (0.16)	3.32, 3.95
Gender (reference class: female)	0.00 (0.19)	-0.38, 0.38	-0.14 (0.18)	-0.48, 0.21	-0.10 (0.17)	-0.44, 0.25
Age	0.02 (0.04)	-0.05, 0.10	0.02 (0.03)	-0.04, 0.09	0.02 (0.03)	-0.05, 0.08
Cognition	0.01 (0.02)	-0.03, 0.04	0.00 (0.02)	-0.03, 0.04	0.00 (0.02)	-0.03, 0.03
Perceived SES (reference class: average/relatively worse off/worse off)	-0.39 ^a (0.17)	-0.73, -0.05	-0.31 (0.16)	-0.62, 0.00	-0.35 ^a (0.16)	-0.66, -0.04
Living arrangement						
Living alone (reference class: living with family and/or friends)	-0.41 ^a (0.18)	-0.77, -0.05	-0.31 (0.17)	-0.64, 0.03	-0.36 ^a (0.17)	-0.70, -0.03
Living in institution (reference class: living with family and/or friends)	0.27 (0.23)	-0.20, 0.73	0.37 (0.21)	-0.05, 0.79	0.34 (0.21)	-0.08, 0.76
GDS-14			-0.06 ^a (0.03)	-0.11, -0.01	-0.02 (0.03)	-0.08, 0.04
Physical frailty level			-0.42 ^b (0.12)	-0.66, -0.18	-0.45 ^c (0.12)	-0.69, -0.22
Interaction (GDS-14 × physical frailty level)					-0.08 ^a (0.04)	-0.16, -0.01
ΔF		2.85 ^a		14.88 ^c		5.31 ^a
Degrees of freedom		6, 122		2, 120		1, 119
ΔR ²		.12		.17		.03
Adjusted R ²		.08		.25		.28
p		.012		<.001		.023

Notes: Hierarchical multiple regression was conducted. N = 129. SE: standard error; CI: confidence interval; SES: socioeconomic status. Probability values are from t statistics with df = 120.

^ap < 0.05.

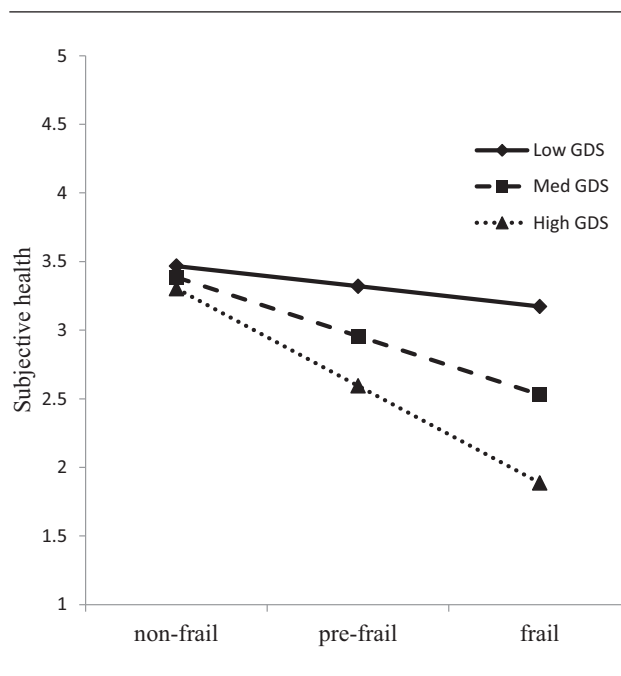
^bp < 0.01.

^cp < 0.001.

physically frail elderly to poor self-evaluation of health. However, depressed moods and negative cognitions, such as feelings of sadness, helplessness, and feeling blue, may aggravate poor health perceptions among physically frail elderly.

The current findings help reveal the inner structure of subjective health and the cognitive process of aggregating information of distinct health domains, namely physical frailty and depression, to arrive at a coherent evaluation of total health. For very old adults, the notion of health tends to encompass components beyond the scope of the biomedical model, such as psychological well-being. In the light of the “paradox of aging,”¹⁰ psychosocial underpinnings of subjective health may act as a buffer for the adverse effects of physical and functional deteriorations on overall health and well-being. Hence, very old adults are able to preserve favorable appraisals of their health despite increasing functional limitations and physical decline. Based on the health congruence model,¹⁵ the current findings underscore the role of depression in modulating the congruence between subjective and objective health among very old adults.

FIGURE 1. Moderation by GDS-14 on the frailty-subjective health relationship.



Depression tends to be prevalent among the oldest-old population and are often underdiagnosed and undertreated, because of complexities introduced by the deteriorating physical, cognitive, and functional conditions of the elderly.⁴² Depression may moderate the relationship between physical frailty and subjective health through influencing inter- and intrapersonal comparison processes underlying their self-evaluation of health.^{9,14,32} The social comparison theory postulates that as individuals age, they are more likely to witness the poor health of their peers and to adjust their evaluations of health accordingly.²⁸ In our interviews, many centenarians remarked that they believed they were in good health, because many of their younger peers were confined in wheelchairs or had passed away. However, such lateral or downward social comparison process could be impeded by depression.^{14,32} Depressed individuals may have difficulty discounting unfavorable social information or using favorable social information and make harsher evaluations on their health. In terms of intrapersonal comparison processes, compared with their nondepressed peers, depressed individuals may also perceive less control and are less optimistic over a physical health issue, which in turn may render a poor subjective health judgment. Therefore, future studies may explore what aspects of the social comparison process are being compromised by depression.

Previous studies have remarked the more frequent reports of WAV symptoms, as compared with symptoms of depressed moods, among samples of older adults.^{26,34,35} Such observations are in line with frameworks of aging theories including gerotranscendence theory³⁷ and socioemotional selectivity theory.³⁸ Accordingly, WAV could be the manifestation of narrowing of social space and rearrangement of priorities in life as a result of the normal aging trajectories and is distinguishable from depressed moods and cognitions. Our findings underscore this distinction, such that depressed mood but not WAV influenced the integration of physical frailty information to the self-evaluation of health. The current findings therefore provide support to distinguishing WAV from depressed moods and cognitions in research and clinical practice related to individuals of advanced age.

Understanding the cognitive mechanisms behind subjective health judgments is particularly important for facilitating successful aging among very old adults, such as nonagenarians and centenarians. These exceptional

survivors are likely to experience various degrees of physical disabilities and comorbidities. As a result, the conventional definition of “health,” which depends heavily on intact physical and functional capacities, may be less realistic and applicable to them as to their younger counterparts. To facilitate their overall well-being, instead of confronting very old adults head-on with their unbearable physical and functional declines, it may be more profitable to capitalize on their psychological resilience and enhance their psychosocial well-being. In other words, instead of “adding years to life,” “adding life to years” may be more relevant to the well-being of these very old adults.

Notwithstanding their physical limitations, studies have found that oldest-old adults apply various coping strategies to maintain a peace of mind.^{43,44} In our previous qualitative study with six healthy Hong Kong Chinese centenarians,⁴⁵ we found that maintaining good relationships with family and friends, having a collection of fond memories of early life, possessing peace of mind, and being content with what one has were considered the keys to happiness in the 10th decade of life. These elements of happiness are also antidotes to depressive symptoms, which the current study has found to regulate the subjective–objective health relationship.⁴⁶ In the light of the interactive nature of subjective (e.g., depressive mood) and objective (e.g., physical frailty) components of health, an interdisciplinary approach that facilitates active aging and quality of life could be particularly relevant to individuals of advanced age. A multifactorial interdisciplinary intervention that combined comprehensive geriatric assessment with case management, exercises, mental health counseling, and nutritional consultation was found to be useful in facilitating physical performance of elderly.⁴⁷ Another recent trial of a healthy aging intervention combining physical and social activity demonstrated effectiveness in enhancing health, social function, and engagement among community-dwelling older adults.⁴⁸

The analyses of the current study relied on a cross-sectional dataset. Although currently we assumed that a bottom-up process was involved in people’s evaluation of their health,² a top-down process was also possible. Better subjective health could be conducive to greater physical activity and in turn slow down the frailty trajectory.^{12,30} Thus, analysis with longitudinal data is needed to clarify the temporal order of changes. Next, the current dataset was homogenous in terms of

age group. With multiple distinctive age groups (e.g., sexagenarians, octogenarians), future studies may examine whether the magnitude of the moderating effect of depression changes across age groups, as the findings of some other studies have postulated.^{9,28} Third, cognition was not used as a screening criterion but a control variable. Our sample included participants who provided valid answers on all items. Hence, our sample may be healthier and more cognitively fit than the general population of similar age. Similar issues have been highlighted by Poon et al.⁴⁹ as common methodologic difficulties in conducting centenarian studies. Fourth, the standard deviation of the GDS-14 score for the current sample was relatively large compared with the mean scale score. This implies a large interpersonal variability in depression, which may in turn result in increased difficulties in achieving consistent results for this population.

The current results revealed that depression, but not WAV, is associated with a more negative relationship between physical frailty and subjective health. This finding underscores the psychological protective mechanism for very old adults to cope with the declines in physical performance.

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APPENDIX: SUPPLEMENTARY MATERIAL

Supplementary data to this article can be found online at [doi:10.1016/j.jagp.2016.05.014](https://doi.org/10.1016/j.jagp.2016.05.014).

References

1. Idler EL, Hudson SV, Leventhal H: The meanings of self-ratings of health: a qualitative and quantitative approach. *Res Aging* 1999; 21:458–476
2. Jylhä M: What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Soc Sci Med* 2009; 69:307–316
3. Maddox GL, Douglass EB: Self-assessment of health: a longitudinal study of elderly subjects. *J Health Soc Behav* 1973; 14:87–93
4. Benyamini Y, Leventhal EA, Leventhal H: Self-assessments of health: what do people know that predicts their mortality? *Res Aging* 1999; 21:477–500
5. Hunt SM, McKenna SP, McEwen J, et al: The Nottingham Health Profile: subjective health status and medical consultations. *Soc Sci Med* 1981; 15:221–229
6. Lenze EJ, Miller MD, Dew MA, et al: Subjective health measures and acute treatment outcomes in geriatric depression. *Int J Geriatr Psychiatry* 2001; 16:1149–1155
7. Shmotkin D, Shrira A, Eyal N, et al: The prediction of subjective wellness among the old-old: Implications for the “fourth-age” conception. *J Gerontol B Psychol* 2014; 69:719–729
8. Cho J, Martin P, Margrett J, et al: The relationship between physical health and psychological well-being among oldest-old adults. *J Aging Res* 2011; 2011:605041
9. French DJ, Sargent-Cox K, Luszcz MA: Correlates of subjective health across the aging lifespan: understanding self-rated health in the oldest old. *J Aging Health* 2012; 24:1449–1469
10. Galenkamp H, Degg DJH, Huisman M, et al: Is self-rated health still sensitive for changes in disease and functioning among nonagenarians? *J Gerontol B Psychol Sci Soc Sci* 2013; 68:848–858
11. Jang Y, Poon LW, Martin P: Individual differences in the effects of disease and disability on depressive symptoms: the role of age and subjective health. *Int J Aging Hum Dev* 2004; 59:125–137
12. Benyamini Y, Idler EL, Leventhal H, et al: Positive affect and function as influences on self-assessments of health expanding our view beyond illness and disability. *J Gerontol B Psychol Sci Soc Sci* 2000; 55:107–116
13. Yu LC, Zhang AY, Draper P, et al: Cultural correlates of self perceived health status among Chinese elderly. *J Cross Cult Gerontol* 1997; 12:73–89

14. Cheng ST, Fung H, Chan A: Maintaining self-rated health through social comparison in old age. *J Gerontol B Psychol* 2007; 62:277-285
15. Chipperfield JG: Incongruence between health perceptions and health problems: implications for survival among seniors. *J Aging Health* 1993; 5:475-496
16. Ruthig JC, Chipperfield JG: Health incongruence in later life: implications for subsequent well-being and health care. *Health Psychol* 2007; 26:753-761
17. Ruthig JC, Hanson BL, Pedersen H, et al: Later life health optimism, pessimism and realism: psychosocial contributors and health correlates. *Psychol Health* 2011; 26:835-853
18. Franke WD, Margrett JA, Heinz M, et al: Handgrip strength, positive affect, and perceived health are prospectively associated with fewer functional limitations among centenarians. *Int J Aging Hum Dev* 2012; 75:351-363
19. Gu D, Feng Q: Frailty still matters to health and survival in centenarians: the case of China. *BMC Geriatr* 2015; 15:159
20. Kato K, Zweig R, Schechter CB, et al: Positive attitude toward life, emotional expression, self-rated health, and depressive symptoms among centenarians and near-centenarians. *Aging Ment Health* 2016; 20:930-939
21. Jopp DS, Park MKS, Lehrfeld J, et al: Physical, cognitive, social and mental health in near-centenarians and centenarians living in New York City: findings from the Fordham Centenarian Study. *BMC Geriatr* 2016; 16:1
22. Hong TB, Zarit SH, Malmberg B: The role of health congruence in functional status and depression. *J Gerontol B Psychol* 2004; 59:151-157
23. Baltes PB: On the incomplete architecture of human ontogeny: selection, optimization, and compensation as foundation of developmental theory. *Am Psychol* 1997; 52:366-380
24. Neugarten BL: Age groups in American society and the rise of the young-old. *Ann Am Acad Polit Soc Sci* 1974; 415:187-198
25. Cohen-Mansfield J, Shmotkin D, Blumstein Z: The old, old-old, and the oldest old: continuation or distinct categories? An examination of the relationship between age and changes in health, function, and wellbeing. *Int J Aging Hum Dev* 2013; 77:37-57
26. Scheetz LT, Martin P, Poon LW: Do centenarians have higher levels of depression? Findings from the Georgia Centenarian Study. *J Am Geriatr Soc* 2012; 60:238-242
27. Yi Z, Vaupel JW: Functional capacity and self-evaluation of health and life of oldest old in China. *J Soc Issues* 2002; 58:733-748
28. Schnittker J: When mental health becomes health: age and the shifting meaning of self-evaluations of general health. *Milbank Q* 2005; 83:397-423
29. Clegg A, Young J, Illiffe S: Frailty in elderly people. *Lancet* 2013; 381:752-762
30. Morley JE, Vellas B, van Kan GA, et al: Frailty consensus: a call to action. *J Am Med Dir Assoc* 2013; 14:392-397
31. Duarte N, Teixeira L, Ribeiro O, et al: Frailty phenotype criteria in centenarians: findings from the Oporto Centenarian Study. *Eur Geriatr Med* 2014; 5:371-376
32. Taylor SE, Brown JD: Illusion and well-being: a social psychological perspective on mental health. *Psychol Bull* 1988; 103:193-210
33. Kempen GI, Sullivan M, van Sonderen E, et al: Performance-based and self-reported physical functioning in low-functioning older persons: congruence of change and the impact of depressive symptoms. *J Gerontol B Psychol* 1999; 54:380-386
34. Adams KB: Depressive symptoms, depletion, or developmental change? Withdrawal, apathy, and lack of vigor in the Geriatric Depression Scale. *Gerontologist* 2001; 41:768-777
35. Gallo JJ, Anthony JC, Muthen BO, et al: Age differences in the symptoms of depression: a latent trait analyses. *J Gerontol B Psychol* 1994; 49:251-264
36. Cumming E, Henry W: *Growing Old: the Process of Disengagement*. New York, NY: Basic Books, 1961
37. Tornstam L: *Transcendence in later life*. *Generations* 2000; 33:10-14
38. Carstensen LL: Social and emotional patterns in adulthood. *Psychol Aging* 1992; 7:331-338
39. Adams KB, Matto HC, Sanders S: Confirmatory factor analysis of the Geriatric Depression Scale. *Gerontologist* 2004; 44:818-826
40. Van Kan GA, Rolland Y, Bergman H, et al: The IANA task force on frailty assessment of older people in clinical practice. *J Nutr Health Aging* 2008; 12:29-37
41. Lee HB, Chiu HFK, Kwok WY, et al: Chinese elderly and the GDS short form: a preliminary study. *Clin Gerontol* 1993; 14:37-42
42. Morichi V, Dell'Aguila G, Trotta F, et al: Diagnosing and treating depression in older and oldest old. *Curr Pharm Des* 2015; 21:1690-1698
43. Martin P, Rott C, Poon LW, et al: A molecular view of coping behavior in older adults. *J Aging Health* 2001; 13:72-91
44. Jopp D, Smith J: Resources and life-management strategies as determinants of successful aging: on the protective effect of selection, optimization, and compensation. *Psychol Aging* 2006; 21:253-265
45. Wong W, Lau H, Kwok C, et al: The well-being of community-dwelling near-centenarians and centenarians in Hong Kong: a qualitative study. *BMC Geriatr* 2014; 14:63
46. Chi I, Chou KL: Social support and depression among elderly Chinese people in Hong Kong. *Int J Aging Hum Dev* 2001; 52:231-252
47. Cameron ID, Fairhall N, Langron C, et al: A multifactorial interdisciplinary intervention reduces frailty in older people: a randomized trial. *BMC Med* 2013; 11:65
48. McNamara B, Rosenwax L, Lee E, et al: Evaluation of a healthy ageing intervention for frail older people living in the community. *Australas J Ageing* 2016; 35:30-35
49. Poon LW, Jazwinski M, Green RC, et al: Methodological considerations in studying centenarians: lessons learned from the Georgia Centenarian Studies. *Annu Rev Gerontol Geriatr* 2007; 27:231-264