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Predicted factors for older Taiwanese to be healthy octogenarians: Results of an 18-year national cohort study

Wei-Chung Hsu,[1] Alan C. Tsai,[2] Yu-Chia Chen[3] and Jiun-Yi Wang[2,4] (ID)

[1]*Department of Radiation Oncology, Chung-Kang Branch, Cheng-Ching General Hospital,* [2]*Department of Healthcare Administration, Asia University, and* [4]*Department of Medical Research, China Medical University Hospital, China Medical University, Taichung,* [3]*Department of Senior Citizen Services, National Tainan Institute of Nursing, Tainan, Taiwan*

Aim: To identify factors that predict the 62–69 years old Taiwanese to be healthy octogenarians.

Methods: We analyzed the 1989 (baseline), and 2003 and 2007 (end-point) datasets of the Taiwan Longitudinal Survey on Aging, a national cohort study. A total of 1977 participants aged 62–69 years at baseline were tracked for 14–18 years. The outcome measure was "being healthy octogenarians", defined as participants who were aged ≥80 years, free from activities of daily living dependency, depressive symptoms or cognitive impairment, and able to provide social support. A logistic regression model was used to identify the predictors.

Results: The results showed that higher educational level, conjugal living, absence of smoking or betel quid chewing, moderate alcohol drinking, routine physical activity, more leisure activities, no hypertension, no diabetes, sleeping well and satisfied with economic condition were the positive predictors for becoming a healthy octogenarian.

Conclusions: Using a multidimensional criterion, the present study identified a list of factors in predicting older Taiwanese becoming healthy octogenarians. The findings highlight the need to identify potential factors for various populations. Many of the predictors are modifiable factors. The present results would be valuable for planning effective health promotion strategies to achieve healthy aging for older adults. **Geriatr Gerontol Int 2017; ••: ••–••.**

Keywords: aging, cohort study, healthy octogenarians, older adults, predictors.

Introduction

Successful aging or health aging is a universal desire. It has been a main subject of investigation in recent decades. Despite the lack of a consistent definition of successful aging, numerous studies have attempted to identify the associated factors in order to design strategies to promote good health and well-being of older adults.[1] Depp *et al.* identified younger age, absence of smoking and free of chronic diseases, such as arthritis and diabetes, as associated factors based on a criterion of being free of physical disability and having good mental health.[2,3] Li *et al.* reported currently married, sleeping well (7–8 h/day), and higher self-rated economic status, leisure activity and life satisfaction as the predictors for older Chinese based on a criterion of no dependency of activities of daily living (ADL), and good cognitive function and mood status.[4] In contrast, Fiori and Jager suggested social functioning, such as social support, was correlated with physical and psychological health.[5] The Macarthur Studies of Successful Aging identified greater baseline emotional support as a significant predictor of better cognitive function at a 7.5-year follow up.[6] Thus, a multidimensional concept that considers physical, mental and social dimensions has increasingly been recognized.[7,8]

This multidimensional concept appears to coincide with that of successful aging proposed by Rowe and Khan, covering three main components: low probability of disease and disability, high cognitive and physical functioning, and active engagement with life.[9] To date, most researchers have adopted this multidimensional operative standard. Ng *et al.* reported that 28.6% of older Chinese in Singapore achieved successful aging and identified age, gender, educational level, housing, religious/spiritual beliefs, physical activity, and nutritional status as the significant predictors.[8] Hamid *et al.* showed that the prevalence of successful aging was 13.8% among older Malaysians, and identified age, educational level, household income and ethnicity as associated factors.[10]

Most of these studies emphasized good health during the aging process rather than longer life. However, most

people desire both longer life and good health. Understanding the predictors of living longer with good health would benefit health promotion programs. Furthermore, many of the identified predictors are lifestyle or socioeconomic variables that can vary greatly among populations. For example, betel quid chewing is a unique lifestyle of people in Southeastern Asia, and alcohol drinking often occurs in social gatherings or for business-related occasions in many Asian cultures. Hence, the specific goal of the present study was to identify the population-specific factors that predict young-old Taiwanese becoming healthy octogenarians based on a multidimensional definition of good health.

Methods

Ethics statement

Our data source, the Taiwan Longitudinal Survey on Aging (TLSA), was carried out according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human participants were reviewed and approved by government-appointed representatives. Written informed consent was obtained from all participants. The institutional review board of the Cheng Ching General Hospital approved the study protocol and ethical aspects of the present study (HP130017).

Source of data

We analyzed the datasets of the TLSA, which is an ongoing longitudinal cohort survey initiated in 1989 by the Health Promotion Administration of Taiwan. The survey used a three-stage equal probability sampling process to draw 4412 aged ≥60 years men and women in 1989 (the baseline). These participants were interviewed at this time and every 3 or 4 years thereafter by trained interviewers. Details of the design and sampling of the TLSA have been described previously.[11]

We tracked the participants from the baseline to an end-point as they reached 80 years-of-age. The number 80 was chosen because most Taiwanese consider it a desired number to reach, and the current life expectancy in Taiwan is approximately 80 years. Considering that the risks of functional decline and death are highly associated with advanced age, and that the interview survey took place every 4 years, we chose to have a narrow age range of 4 years (80–83 years) at the end-point. In addition, in order to increase the number of participants for analysis, we included two cohorts: sample A (885 participants, aged 66–69 years) and sample B (1193 participants, aged 62–65 years) at baseline. We tracked sample A for 14 years (1989–2003) and sample B for 18 years (1989–2007), so that all participants would reach 80–83 years at the end-point (Fig. 1). Among the 2078 participants at the baseline,
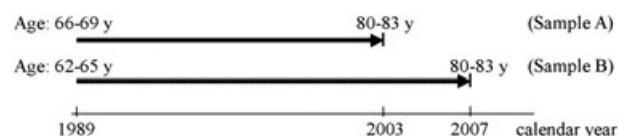

Figure 1 Follow-up period of the study participants.

44 in sample A and 57 in sample B were lost to follow up. The remaining 1977 served as the participants of the present study (Fig. 2).

Outcome measure

Our outcome measure followed the multidimensional concept proposed by Rowe and Khan with modifications.[9] In the present study, participants were determined as healthy octogenarians if they were alive at the end-point (aged 80–83 years) and met all the three conditions: (i) free of any ADL dependency; (ii) without depressive symptoms or cognitive impairment; and (iii) able to provide a certain level of social support to others.

The ADL scale measures self-care abilities in six daily activities, including bathing, dressing/undressing, self-feeding, functional transferring, ambulation and toileting.[12] A person who found it very difficult or were unable to carry out a daily activity at all was considered as ADL-dependent for that activity. Participants who were free of any ADL dependency would meet the above condition (i). Depressive symptoms were measured using the 10-item Center for Epidemiologic Studies Depression scale. The scale has a score range of 0–30, and a score ≥10 is considered as having depressive symptoms. It has been shown to have good sensitivity and specificity, and perform well in older Chinese.[13] Cognitive function was
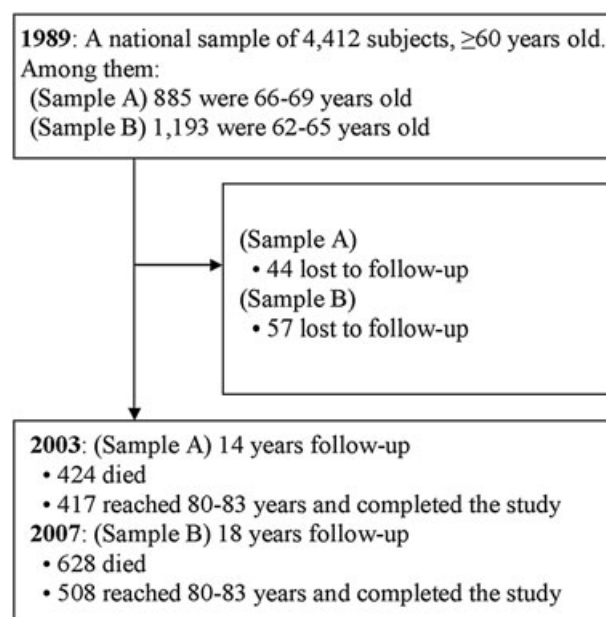

Figure 2 Flowchart of the study participants.

evaluated using the education-adjusted Short Portable Mental Status Questionnaire (SPMSQ) scale. The Short Portable Mental Status Questionnaire consists of 10 items covering short-term and long-term memory, orientation, knowledge of current events, and mathematical tasks, with the maximum score of 10.[14] By applying an education-adjusted score, participants who scored <6, <7, and <8 for 0, 1–6 and >6 years of formal education, respectively, were considered as cognitively impaired in the present study. Participants who had no depressive symptoms or cognitive impairment would meet the above condition (ii). Social support was assessed according to involvement in emotional and instrumental support by providing emotional care, childcare or ADL/instrumental ADL support to family members or friends. Participants who could provide at least one social support were considered to have met the above condition (iii).

Other measures

Lifestyle variables

Smoking status and betel quid chewing were each classified as current users, past users, and never-users. Alcohol drinking was classified by the frequency of consumption. Physical activity was classified as routine, sometimes and inactive according to the frequency of carrying out any types of physical activities including yard work, gardening, farming or indoor/outdoor physical exercise. Leisure activity was classified into three levels: none, 1–2 and ≥3 activities, according to involvement in social, recreational or group activities, such as socializing, sightseeing and participating in social groups. Sleeping status was classified as sleeping well or not.

Socioeconomic variables

Educational level was classified into three levels: ≤6, 7–12 and >12 years of formal education. Marital status was classified into: married, separated, divorced/widowed and never married. Self-perceived economic status was classified into three levels: satisfied, somewhat satisfied and unsatisfied.

Health-related variables

Hypertension and diabetes are common chronic diseases in older Taiwanese. These diseases were considered as independent variables rather than as a part of the outcome variable, because these diseases can contribute to ADL disability and impact psychological health. The disease status was rated based on self-reported answers to whether a physician had ever told the participant that he/she had such diseases. The specific questions in the questionnaire were "Do you have this disease?" and "Were you told by a physician?". Those who answered "yes" to both questions were considered as having the disease.

Statistical analysis

Statistical analysis was carried out with SPSS software (version 17.0; SPSS, Chicago, IL, USA). Descriptive data were presented with simple statistics. The numbers of participants who met all combinations of the three dimensional conditions were listed. Logistic regression was carried out to determine the abilities of demographic, lifestyle, socioeconomic and health-related variables in predicting 62–69-year-old participants to be healthy octogenarians, according to odds ratios with 95% confidence intervals. Significance level for all analyses was set at α = 0.05.

Results

Table 1 shows the characteristics of participants at baseline. One-quarter (24.2%) of participants drank alcohol at least once per week; 6.4% were current betel quid chewers; 38.0% were current smokers; 37.5% had routine physical activity; 27.4% had ≥3 leisure activities per week; 73.7% slept well; 27.3% had hypertension; 9.2% had diabetes; and 41.8% were satisfied with their economic conditions.

Figure 3 shows the survival status of all participants and the health distribution of participants who were alive at age 80–83 years. Over half of participants (53.2%) died before the age of 80 years. Among the 925 surviving participants, 477 (51.6%) were healthy in all three dimensions, 201 (21.7%) in two dimensions, 125 (13.5%) in one dimension and 122 (13.2%) in 0 dimension.

Table 2 shows the variables identified for predicting healthy octogenarians by the logistic regression analysis. Results showed that higher educational level, conjugal living, absence of smoking and betel quid chewing, moderate alcohol drinking, routine physical activity, without hypertension or diabetes, sleeping well, and satisfied with economic status were the positive predictors for being healthy octogenarians (all $P < 0.05$).

Discussion

In the present study, we analyzed a national representative longitudinal dataset and identified a broad list of factors that predict 62–69-year-old Taiwanese becoming healthy octogenarians. The positive predictors include absence of cigarette smoking or betel quid chewing, moderate alcohol drinking, routine physical activity, high leisure activities, no hypertension, no diabetes, sleeping well and satisfied with economic condition. Some of these factors have been repeatedly identified by others, but several are infrequently identified.

The present results suggest that lifestyle factors, including absence of smoking, moderate alcohol drinking and routine physical activities, are significant predictors of becoming healthy octogenarians for older Taiwanese. These results reconfirm the findings of many previous studies focusing on the non-oldest old elderly. Smoking has been

Table 1 Characteristics of participants at baseline

Variables	n (%)
Sex	
Male	1196 (60.5)
Female	781 (39.5)
Age (years)	
62–65	1136 (57.5)
66–69	841 (42.5)
Formal education (years)	
≤6	1549 (78.4)
7–12	322 (16.3)
>12	106 (5.4)
Marital status	
Married	1336 (67.6)
Separated	104 (5.3)
Divorced/widowed	452 (22.9)
Never married	85 (4.3)
Alcohol drinking	
Non-drinker	1499 (75.8)
1 time/month to 3 times/week	305 (15.4)
>3 times/week	173 (8.8)
Betel quid chewing	
Never	1778 (89.9)
Past	73 (3.7)
Current	126 (6.4)
Cigarette smoking	
Never	942 (47.6)
Past	283 (14.3)
Current	752 (38.0)
Physical activities[†]	
Inactive	800 (40.5)
Sometimes	436 (22.1)
Routine	741 (37.5)
Leisure activities[‡] (per week)	
None	140 (7.1)
1–2	1295 (65.5)
≥3	542 (27.4)
Sleeping well	
Yes	1457 (73.7)
No	520 (26.3)
Hypertension	
No	1437 (72.7)
Yes	540 (27.3)
Diabetes	
No	1795 (90.8)
Yes	182 (9.2)
Self-perceived economic status	
Satisfied	827 (41.8)
Somewhat satisfied	795 (40.2)
Unsatisfied	355 (18.0)

Total n = 1977. [†]Including all types of physical activities, such as carrying out yard work, gardening, farming and outdoor sports. [‡]Including all types of leisure activities, such as socializing, sightseeing and participating in social groups.
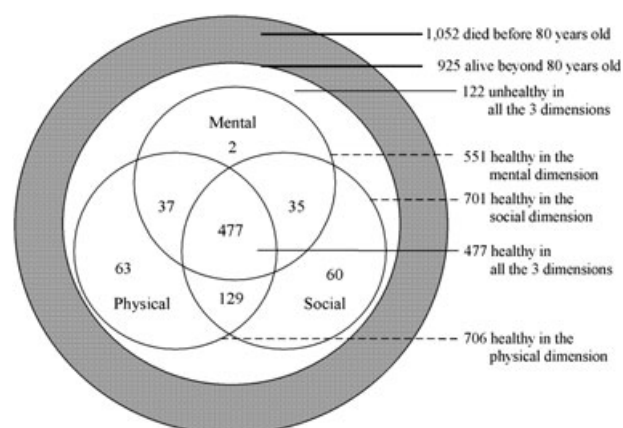
Figure 3 Distribution of survival and healthy status for the study participants at end-point.

widely reported to be harmful and responsible for several chronic diseases.[15] People who had smoked >20 packs/year were observed to be more likely to be frail than those who had never smoked.[16] Whether drinking contributes to good health is somewhat controversial. We identified moderate drinking as a positive predictor of becoming healthy octogenarians. However, Green and Polen pointed out that alcohol drinking behavior itself might be an indicator of healthy status.[17] People who think their health status can sustain alcohol would drink, whereas those who have poor health would not. Moderate alcohol drinking might only be beneficial to older adults who have rather poor health.[18]

The present results also showed that engaging in routine physical activity could increase the likelihood of becoming healthy octogenarians. Physical activity has been suggested to have a long-term effect on people's perception of health and be an essential element of successful aging. The level of physical activity at age 65 years was reported to predict successful aging 7 years later in the PROOF (PROgnostic indicator OF cardiovascular and cerebrovascular events) study[19] and the Cardiovascular Health Study.[20] Physically active people are more likely to have a healthier lifestyle, avoiding smoking or excessive drinking. Furthermore, sedentary behavior and physical activity have both been identified as independent predictors of healthy aging.[21]

We have also observed that the absence of hypertension and diabetes were strong predictors. This finding is consistent with many previous studies.[2,8,20,22] Willcox *et al.* reported that the absence of hypertension and diabetes was associated with higher exceptional and overall survival.[22] Burke *et al.* reported that the absence of diabetes and hypertension, along with high high-density lipoprotein cholesterol, high physical activity, and free of smoking and obesity were associated with maintenance of good health in older adults.[20] Ng *et al.* also showed that the prevalence of hypertension and diabetes was lower in healthy aging Chinese in Singapore.[8] Taken together, the

Table 2 Logistic regression analysis of baseline sociodemographic, lifestyle and health-related factors in predicting 62–69-year-old Taiwanese becoming healthy octogenarians

Variables	OR (95% CI)	p
Sex		
Male	1	
Female	1.15 (0.82–1.61)	0.423
Formal years of education (y)		
≤6	1	
7–12	1.67 (1.24–2.24)	0.001
>12	1.82 (1.16–2.86)	0.009
Marital status		
Married	1	
Separated	0.41 (0.22–0.77)	0.006
Divorced/widowed	0.80 (0.61–1.06)	0.124
Never married	0.15 (0.05–0.43)	<0.001
Alcohol drinking		
Non-drinker	1	
1 time/month to 3 times/week	1.50 (1.10–2.05)	0.010
>3 times/week	1.19 (0.78–1.81)	0.410
Betel quid chewing		
Never	1	
Past	0.83 (0.45–1.55)	0.567
Current	0.45 (0.25–0.81)	0.007
Cigarette Smoking		
Never	1	
Past	0.81 (0.55–1.19)	0.281
Current	0.59 (0.42–0.82)	0.002
Physical activities[†]		
Inactive	1	
Sometimes	1.31 (0.97–1.76)	0.075
Routine	1.55 (1.19–2.01)	0.001
Leisure activities[‡] per week		
None	1	
1–2	1.84 (1.04–3.28)	0.038
≥3	2.10 (1.15–3.83)	0.015
Sleeping well		
Yes	1	
No	0.63 (0.48–0.84)	0.001
Hypertension		
No	1	
Yes	0.62 (0.48–0.81)	0.001
Diabetes		
No	1	
Yes	0.28 (0.16–0.49)	<0.001
Self-perceived economic status		
Satisfied	1	
Somewhat satisfied	0.89 (0.70–1.13)	0.338
Unsatisfied	0.54 (0.38–0.77)	0.001

Total n = 1977. [†]Including all types of physical activities, such as carrying out yard work, gardening, farming and outdoor sports. [‡]Including all types of leisure activities, such as socializing, sightseeing and participating in social groups. 95% CI, 95% confidence interval; OR, odds ratio.

results of these studies suggest that lifestyle improvement should be an important health promotion strategy to help older adults to become healthy octogenarians.

In the present study, we identified betel quid chewing as a unique predictor that can reduce the probability of older Taiwanese becoming a healthy octogenarian. Betel quid is a major psychoactive substance (in addition to caffeine, tobacco and alcohol) in Taiwan and Southeastern Asian countries. Betel quid chewing is usually synergistic with cigarette smoking.[23] It was reported to be associated with a variety of health harms including neoplasm, hypertension, diabetes mellitus, cerebrovascular problems and the increased risk of all-cause mortality.[24]

The present study also identified conjugal living, more leisure activities, sleeping well and good satisfaction with one's economic condition as predictors of becoming healthy octogenarians. These factors have not been frequently observed or widely discussed in previous studies. Living without a cohabitant, usually as a result of the loss of a spouse, might have a severe psychological impact on the surviving spouse, and could impact the financial condition or even daily life, such as shopping for food or meal preparation.[25] In addition, a higher level of leisure activity could be important for social well-being and increase the likelihood of healthy aging. It has been reported that a higher level of leisure activity was associated with a lower risk of cognitive decline,[26] whereas cognitive decline was associated with inactive leisure activity, but not with physical activity or social activity.[24] The present results also support the findings of Li *et al.* who reported that sleeping 7–8 h daily was a predictor of good health in older Chinese.[4] Because poor sleep quality can cause psychological stress, illness or neuropsychological problems, difficulty in initiating or maintaining sleep could be associated with depression.[27]

Economic satisfaction was identified as a predictor of depressive symptoms and life satisfaction in previous studies using the TLSA data.[28,29] In addition, economic well-being showed significant gross effects on mortality in Chinese older adults.[30]

A feature of the present study is that we used a multidimensional criterion to identify the baseline factors for predicting Taiwanese aged 62–69 years old becoming healthy octogenarians. Another feature is that the outcome measure combined two conditions: achieving the age of 80 years and maintaining good health at 80–83 years. Both are conditions that most older Taiwanese wish to strive for.

The present study could have benefited from multiple time-point measurements and the use of more elaborate analyses. However, because the outcome variable in our study involved the condition of reaching the age of 80–83 years, it involved only one time-point. For independent variables, additional analyses on the other three waves of interviews (1989, 1993 and 1996) showed (data not shown) that the predictors identified in each wave were generally similar to those reported in the present

study, except the effects of physical and leisure activities, and sleeping well were stronger.

Overall survival, healthy survival and healthy aging are distinct concepts. Our outcome measure emphasized a combination of achieving the age of 80–83 years and maintaining good health. Thus, our objective is conceptually different from that for survival beyond the age of 80 years (regardless of health conditions), and the predictors would not be entirely the same for the two models. When we analyzed the dataset for surviving beyond the age of 80 years regardless of health conditions, we found that years of formal educational (>12 years) and sleeping well became not significant, and sex (female) became positively significant, although other predictors remained the same as for living to 80–83 years-of-age with good health (data not shown).

The study had several limitations. Most data in TLSA are interview data. Inaccurate recalls could have occurred, especially in persons who had memory loss, and some might have been unwilling to disclose personal financial or health conditions. Although the impacts of some common chronic diseases, such as hypertension or diabetes, were evaluated, the severity of these diseases was not available in the dataset. The effect of disease severity cannot be assessed. In order to increase the sample size, but maintain a reasonable age range at end-point, we tracked sample A for 14 years and sample B for 18 years. By narrowing the end-point age from 8 to 4 years, it could minimize the aging-associated changes in functional decline, but it could introduce some time-related differences in the end-point conditions, especially in socio environmental aspects. The results of the present study are age- and population-specific, because lifestyle and socioeconomic factors change with age and population. Thus, the application of the present results to other age or other population groups should be done with caution.

We identified the factors that predict 62–69-year-old Taiwanese becoming healthy octogenarians based on a multidimensional definition. The present findings have added evidence to the associations of those frequently identified factors and some specific factors with the probability of becoming healthy octogenarians. These findings should be useful for designing health promotion strategies to increase the likelihood of achieving aging with good health for older adults.

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Disclosure statement

The authors declare no conflict of interest.

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