Age Paradox: Depressive Symptomatology For Older Men and Women in Taiwan

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Abstract

Background: To discern if prevalence of depressive symptoms in adults aged 65 and above in Taiwan changed during the past decade and to identify if protective and risk factors of depressive symptomatology differ by gender.

Method: Data of nationally representative older adults (65+) interviewed from the 2005, 2009 and 2013 National Health Interview Survey (NHIS) in Taiwan was analyzed (n=8,832). The Center for Epidemiologic Studies Depression Scale (CES-D) was used for the measurement of depressive symptomatology.

Results: Age adjusted prevalence rate of depressive symptomatology among older adults in Taiwan reduced from 20.6% to 13.3% ($\chi^2=-7.5$, $p<.05$) in the community. The most significant factors associated with higher depressive symptomatology in both gender was too much carbohydrates intake, which was significantly associated with 8.8 (95%CI=5.1-15.2) and 7.9 (95%CI=5.2-11.8) times depressive symptomatology in men and women respectively. Factors associated with lower depressive symptomatology in both gender include advanced age (over the age of 85), exercise and social participation. The advanced age for men and women reduced about 63% (AOR_{over the age of 85}=0.4, 95%CI=0.2-0.9) and 62% (AOR_{over the age of 85}=0.4, 95%CI=0.2-0.8) of depressive symptomatology for men and women respectively; Exercise reduced about 50% (AOR_{exercise}=0.5, 95%CI=0.3-0.6) and 58% (AOR_{exercise}=0.5, 95%CI=0.3-0.6) of depressive symptomatology for men and women respectively; social participation reduced about 55% (AOR_{social participation}=0.5, 95%CI=0.3-0.7) and 36% (AOR_{social participation}=0.6, 95%CI=0.5-0.9) of depressive symptomatology for men and women respectively.

Conclusions: For adults aged over 65, advanced age, which is 85+ for men and 75+ for women, is a significant protective factor guarding against depressive symptoms. Carbohydrates, cognitive disorder, heart disease and falls were associated with higher depressive symptomatology in both gender. The pulmonary disease, underweight and educational level were risk factors for men; metabolic disease and milk intake were risks for women. Common factors associated with lower depressive symptomatology in both gender includes advanced age, exercise and social participation. Tea and coffee intake and married status were associated with lower depressive symptomatology for women.

Introduction

Taiwan's older adults over the age of 65 in 2018 accounted for 14.1% of the national population, which conformed to the definition of "old age society", and the United Nations estimated that the proportion of Taiwan's older adults will reach 19.9% in 2050 as the third fastest growing country between 2019 and 2050. In the context of an ever-increasing elderly population, we still do not know whether the mental state of the elderly is quiet and comfortable, and we used to blame the disease on the physiological causes due to our habit or lack of understanding of depression and to ignore the effect of the patients' mental health on their condition, which makes the effect of the mental state on health often underestimated or ignored, but the risk of lack of mental health is widespread, for instance, conscious or unconscious fall and language or non-language barrier may be associated with mental disability, and depression is one of the most common symptoms of all patients with mental health imbalance.

With the increasing investment in study, depression has become an important issue in the health of the contemporary elderly [1]. A survey of the Center for Epidemiological Survey Depression (CES-D) scale for the study on 1,487 older adults over the age of 65 in Taiwan with information from the Survey of Health and Living Status of the Elderly found that the incidence rate of depression among the elderly in Taiwan from 1999 to 2003 was 19.7%, among them, depression is most likely to especially occur in women who are facing economic stress, are in poor health or have low life satisfaction [2]. Another study of major and minor depressions in the older adults living in Taiwanese communities in 2017 classified major depression as a group diagnosed as hypochondria; minor depression was classified as a group with depressive symptomatology that did not meet the clinical diagnostic criteria. The study found that the prevalence rates of minor and major depressions were 3.7% and 1.5% respectively, compared with older age groups in other countries, although the elderly in Taiwan showed a lower prevalence of depression as a whole, only 20% of them with major depression indicated that they received antidepressant treatment, indicating a lack of assessment of depressive symptoms in the elderly in the communities.

The senile depression may be regulated by multiple factors, for instance, Martin G. Cole and others suggested that the occurrence of these three situations might be a risk factor for depression in the elderly from bereavement, sleep disturbance and mobility disability, etc. [3] The study of Heng-Chia Chiu in Taiwan also found that the elderly with no offspring, living alone or suffering from angiocardiopathy, fractura, metabolic disease or paralytic stroke are at high risk for depression [4]; J. K. Djernes used databases MEDLINE and Psycinfo to search such keywords as "prevalence rate, old age, predictors, epidemiology, community and institution" between 1993 and 2004 in four different languages in order to identify major international risk factors associated with depression and to discover women, physiological disease, cognitive disorder, physical disability, lack or loss of close interpersonal relationships and the medical history of depression was considered highly correlated with the occurrence of depression [5]. The studies in other countries of the world found that the symptoms and prevalence of depression in both gender varied and that the prevalence rate of depression in women was generally higher than that in men. Angst, Jules and others surveyed six European countries, and the two studies on 38,997 male interviewees and 41,543 female interviewees showed the result that women were more likely to experience major depression than men was common at all ages, and that even classification of major physical defects or employment status did not affect women's performance of more depressive symptoms than men, and the studies also found that what made women feel depressive was the quality of their sleep and their overall health and what made men feel depressive was their working ability. (1) Yuriko Katsumata and others used Geriatric Depression Scale (GDS) to test 731 qualified Japanese older adults and also found that women had a higher depression index than men and further pointed out that the important factors affecting depression in both sexes were respectively pressure for men and health status and disability for women (2).

Whether the depression of the elderly and its prevalence rate will also change after Taiwan enters the old age society and the changes in social patterns in recent years and the development of science and technology have led to changes in the way, distance and media of interpersonal interaction among the elderly. In addition, this study is different from the survey sample groups and generations used in the past foreign studies, so the protective factors and risk

factors of depressive symptoms in the elderly may produce different results due to social and cultural factors, and how to cope with depression-derived disability and disease has become a critical barrier. This study focused on the analysis of the effects of daily diet, living habits, educational level, age and other aspects of the elders of different genders in Taiwan on their depression, such as the effects of grain consumption, tea and coffee consumption or milk intake and level of education received on the senile depression, according to the National Health Interview Survey (NHIS) of the National Health Department of the Ministry of Health and Welfare (2005,2009 and 2013).

Method

Data source

The data from the National Health Interview Survey (NHIS) of the National Health Department of the Ministry of Health and Welfare were used for the analysis in this study. Such data were derived from the regular National Health Interview Survey conducted by the National Health Research Institutes and Health Promotion Administration, Ministry of Health and Welfare, the Executive Yuan to understand the health status and medical use of the general public in Taiwan through regular interview surveys. The survey took the household registration data of ordinary households in each area on January 16, 2001 as the sampling base and adopted multistage stratified systematic sampling design. The Probability Proportional to Size (PPS) was used in each stratification to gradually draw out "villages and towns and cities", "neighbors" and "households" as the basic sampling unit, and all members of the selected households were interviewees. The data were collected by structural questionnaire and face-to-face interviews by trained interviewees, and cross-sectional surveys were conducted in 2005, 2009 and 2013. The questionnaire included basic characteristics of individual cases, household structure, living arrangements, health status and medical care utilization, leisure and social participation and mental state of the elderly, which were representative in Taiwan [8]. Because the measure of depressive symptoms was comparable after 2005, this study employed data of the 2005, 2009 and 2013 interviews for analysis, and the numbers of samples were 2727, 2904 and 3203 respectively.

Measures

The measure of depression estimated for older adults living in the community was assessed by using the Center for Epidemiologic Studies Depression Scale (CES-D) (3). This schedule included a total of 10 questions about wanting to eat nothing, being in bad mood, things always go wrong, fitful sleep, feeling happy, feeling lonely, feeling unfriendly, feeling living well, feeling sad, feeling tired and spiritless to do anything, with a total score of 0 to 30. Clinically significant burden of depressive symptoms (CES-D ≥ 10) (4) was determined as having depressive symptomatology for the participants in the current study.

The depression-related factors include social demography, health status and health behaviors. Social demography mainly includes age, gender, living alone or not, marital status and educational level. Among them, marital status is divided into married and others (cohabited, unmarried, divorced, widowed, separated and others); educational level is divided into low educational level (lower than junior high school educational level, ≤ 9 years), secondary educational level (higher and secondary vocational education, 10–12 years) and higher educational level (junior college degree or above, 13 + years).

Health status includes hypertension, hyperglycemia, hyperlipemia, heart disease, pulmonary disease, cataracta, hearing problems and cognitive disorder. Among them, hypertension, diabetes mellitus and hyperlipemia are combined into "metabolic disease" variables, that is, the interviewees will be deemed to have suffered from "metabolic disease" as long as they are diagnosed by a physician to suffer from one of the diseases. Whether the interviewees have suffered from heart disease, pulmonary disease, cataracta and hearing problems will be determined by a physician's definite diagnosis on whether the interviewees have suffered from such diseases in the questionnaire, but hearing problems are judged based on whether to wear a hearing aid due to lack of questions subject to a physician's diagnosis. The definition of cognitive disorder has been introduced in Part I disability.

Health behaviors mainly include body mass index (BMI), exercise or not, falls within a year, social participation, depressive symptoms and five diets. Among them, the body mass index (BMI) refers to the definition of Taiwan National Health Department(5). It is too light if $BMI < 18.5$, it is normal if $18.5 \leq BMI < 24$, it is too heavy if $24 \leq BMI < 27$, and it is obese if $BMI \geq 27$; social participation includes three questions, that is, "Are you currently serving as a voluntary worker or volunteer", "Are you currently participating in a religious activity" and "Are you currently participating in a community neighborhood group or activity", in which the options for the question about whether to serve as a voluntary worker or volunteer include never, rarely, sometimes and often, and the options for the other two questions include never, occasional participation and regular participation, as long as the interviewees do not answer "No or Never" to any of the questions finally, they will be considered to have had social participation; the five diets are tea or coffee, eggs, beans and fish, vegetables, cereal rhizomes and milk. The questions about diets are not exactly the same in each survey. The question "How often do you have coffee or tea a week?" was used in the questionnaire 2005, the question "Did you have a cup (240c.c) of tea or coffee yesterday?" was used in the questionnaire 2009, and the options for the questions used in the questionnaires 2005 include never, less than once a week or seldom, 1–2 times a week, 3–5 times a week, every day or almost every day. The options for the question used in the questionnaire 2009 include yes or no. As long as the interviewees do not answer "never or no" to any of the questions in each survey, they will be considered to have had tea or coffee, otherwise, they will be considered to have never had tea or coffee; the four questions about eggs, beans, fish and meat were used in the questionnaire 2005, that is, "How often do you eat meat or poultry a week?", "How often do you eat fish a week?", "How often do you eat eggs a week?", "How often do you eat soya beans a week?" and "How often do you eat fresh beans a week?", and the question "Did you eat half of eggs, beans, fish and meat yesterday?" was used in the questionnaire 2009. The options for the questions used in the questionnaires 2005 include never, less than once a week or seldom, 1–2 times a week, 3–5 times a week, every day or almost every day. The options for the question used in the questionnaire 2009 include yes or no. As long as the interviewees do not answer "never or no" to any of the questions in each survey, they will be considered to have eaten eggs, beans, fish and meat, otherwise, they will be considered to have never eaten eggs, beans, fish and meat; with regard to vegetables, the question "How often do you eat fresh vegetables a week?" was used in the questionnaires 2005, and the question "Did you eat half of the vegetables yesterday?" was used in the questionnaire 2009. The options for the questions used in the questionnaires 2005 include never, less than once a week or seldom, 1–2 times a week, 3–5 times a week, every day or almost every day. The options for the question used in the questionnaire 2009

include yes or no. As long as the interviewees do not answer “never or no” to any of the questions in each survey, they will be considered to have eaten vegetables, otherwise, they will be considered to have never eaten vegetables; with regard to cereal rhizomes, the question “How often do you have rice or pasta a week?” was used in the questionnaire 2005, and the question “Did you eat more than half of the whole grain cereals yesterday?” was used in the questionnaire 2009. The options for the question used in the questionnaire 2005 include never, less than once a week or seldom, 1–2 times a week, 3–5 times a week, every day or almost every day. The options for the question used in the questionnaire 2009 include yes or no. As long as the interviewees do not answer “never or no” to any of the questions in each survey, they will be considered to have eaten cereal rhizomes, otherwise, they will be considered to have never eaten cereal rhizomes; with regard to milk, the question “How often do you have milk or ewe's milk a week?” was used in the questionnaires 2005, and the question “Did you eat half of the milchigs yesterday?” was used in the questionnaires 2009. The options for the questions used in the questionnaires 2005 include never, less than once a week or seldom, 1–2 times a week, 3–5 times a week, every day or almost every day, and the options for the question used in the questionnaire 2009 include yes or no. As long as the interviewees do not answer “never or no” to any of the questions in each survey, they will be considered to have had milk, otherwise, they will be considered to have never had milk.

Statistical analysis

Using the SAS 9.4 statistical software package not only presents the social demography distribution of the older adults over the age of 65 from 2005 to 2013 in the descriptive analysis but also makes stratified analysis and description of age and gender for the factors related to disability, and the category variables use Chi-square test. Then, the change trend of disability in the elderly is determined using trend analysis, and the gender difference of disability in each year is analyzed by Chi-square Test; the two way-ANOVA is used to determine whether the gender difference of disability is consistent over the years. Finally, the logistic regression is used to determine the trend of disability under a specific age and gender and to further analyze the factors associated with disability of men and women, and the website <https://wordart.com/> is used to generate text cloud graphics. The text size is defined as follows: the numerical value will be directly entered if $AOR > 1$; the numerical value will be derived by substituting protection multiples generated by $1/AOR$ if $AOR < 1$.

Results

I. Sample description

Table 1 describes the social demography, health status and behavioral characteristics of the samples in each survey. There were 2725, 2904 and 3203 older adults over the age of 65 as samples respectively in 2005, 2009 and 2013. The average age of these older adults in each survey was about 73.4–75.3 without significant trend changes; the women in each survey accounted for about 48.8–56.9%, and most of the older adults were female ones in other years (2005: 50.6%; 2009: 56.9%; 2013: 52.4%). The proportions of male and female interviewees were statistically different in trend significantly in each survey; nearly 60% of the interviewees were married in each survey without significant trend change; the educational level is mainly low educational level (lower than junior high school educational level), approximately accounting for 83.8–87.4%, which had statistically significant trend change. In addition, there were only statistically significant differences in marital status and educational level between male and female interviewees in each survey, and male interviewees tended to be married and highly educated, while female interviewees were the exact opposite. In terms of health status, it was significantly higher for female interviewees than male interviewees in metabolic disease (2005: 62.1% vs 54.9%, 2009: 67.1% vs 57.2%, 2013: 69.4% vs 61.5%), heart disease (2009: 17.7% vs 14.8%, 2013: 21.1% vs 18.3%), cataracta (2005: 29.9% vs 22.8%, 2009: 45.9% vs 36.4%, 2013: 40.1% vs 28.2%) and cognitive disorder (2005: 27.0% vs 14.2%, 2009: 24.8% vs 16.3%, 2013: 22.7% vs 15.9%) in each survey, while it was significantly higher for male interviewees than female interviewees in pulmonary disease (2005: 13.2% vs 7.8%, 2009: 9.0% vs 6.5%, 2013: 10.9% vs 6.9%) and hearing problems (2005: 2.8% vs 1.6%, 2009: 2.5% vs 1.4%, 2013: 3.3% vs 1.5%) in each survey. In terms of health behaviors, except that there was no significant difference in the social participation and the habit of drinking cereal drinks between female and male interviewees in each survey, there was statistically significant difference in most of the rest between female and male interviewees in each survey. Among them, the BMI of male interviewees tended to be normal in each survey (2005: 48.6%, 2009: 52.0%), while the BMI of female interviewees tended to be too heavy and obese (2005: 47.6%, 2009: 50.1%); the proportion of male interviewees exercising was more than half and significantly higher than that of female interviewees in each survey (2005: 57.8% vs 50.6%, 2009: 53.8% vs 47.2%, 2013: 53.7% vs 46.4%); the proportion of female interviewees falling (2005: 26.0% vs 16.4%, 2009: 22.3% vs 15.8%, 2013: 18.0% vs 14.9%) and suffering from depression (2005: 24.5% vs 16.8%, 2009: 18.2% vs 13.0%, 2013: 17.8% vs 9.1%) was significantly higher than that of male interviewees in each survey; in terms of diets, male and female interviewees mainly eat cereals, vegetables and eggs, beans, fish and meat, but the proportion of male interviewees having tea or coffee was significantly higher than that of female interviewees in each survey (2005: 74.2% vs 52.3%, 2009: 50.1% vs 30.6%), while the proportion of female interviewees having milk was significantly higher than that of male interviewees in each survey (2005: 74.0% vs 68.0%, 2009: 50.6% vs 41.5%).

Table 1
Differences of participants in each interview in the entire sample and by gender (%,2005–2013)

	Total ^a			Men ^b			Women ^b		
	2005	2009	2013	2005	2009	2013	2005	2009	2013
Sample size	2725	2904	3203	1347	1253	1525	1378	1651	1678
Sociodemographic									
Age									
mean	74.03	74.75	75.27	73.98	75.03	75.34	74.07	74.54	75.22
(min-max)	(65-102.6)	(65–99)	(65-100.16)	(65-102.6)	(65-99.5)	(65-96.8)	(65-95.4)	(65-98.4)	(65-100.2)
Age group (years)									
65–74	59.1	55.3	48.4	58.2	52.5	53.6	60.0	57.4	53.8
75–84	34.9	35.9	41.4	37.1	38.4	35.7	32.7	34.0	36.6
85+	6.0	8.8	10.2	4.8	9.1	10.7	7.3	8.6	9.7
Gender									
Men	49.4	43.2	47.6	-	-	-	-	-	-
Women	50.6	56.9	52.4	-	-	-	-	-	-
Marital status									
married/partnered	58.6	59.0	58.6	71.6	73.5	73.6	45.9	48.0	45.0
others	41.4	41.0	41.4	28.4	26.5	26.4	54.1	52.0	55.0
Living alone									
Yes	10.1	12.8	11.1	10.5	11.9	10.5	9.8	13.5	11.6
No	89.9	87.2	89.0	89.5	88.1	89.5	90.2	86.5	88.4
Level of education									
Low	87.4	85.8	83.8	79.8	76.4	74.6	94.8	93.0	92.1
Medium	6.2	7.7	8.6	9.2	12.0	12.9	3.3	4.4	4.6
High	6.4	6.5	7.6	11.1	11.6	12.5	1.9	2.6	3.3
Health condition									
Metabolic disease	58.5	62.8	65.6	54.9	57.2	61.5	62.1	67.1	69.4
Heart disease	18.0	16.4	19.1	17.0	14.8	18.3	19.1	17.7	21.1
Lung disease	10.5	7.6	8.8	13.2	9.0	10.9	7.8	6.5	6.9
Cataract	26.4	41.8	34.5	22.8	36.4	28.2	29.9	45.9	40.1
Hearing problem	2.2	1.9	2.5	2.8	2.5	3.3	1.6	1.4	1.5
Cognitive impairment	20.5	21.1	19.5	14.2	16.3	15.9	27.0	24.8	22.7
Behavior factors									
BMI									
Underweight	6.9	4.7	-	6.1	4.7	-	7.8	4.7	-
Normal	46.6	48.3	-	48.6	52.0	-	44.6	45.3	-
Overweight	27.4	28.2	-	28.5	28.0	-	26.3	28.3	-
Obesity	19.1	18.9	-	16.8	15.3	-	21.3	21.8	-
Exercise	54.1	50.1	49.9	57.8	53.8	53.7	50.6	47.2	46.4
Fall	21.3	19.5	16.5	16.4	15.8	14.9	26.0	22.3	18.0
Social engagement	42.9	39.9	41.6	42.9	39.4	42.6	42.9	40.4	40.7
Depressive symptomatology	20.6	15.9	13.7	16.8	13.0	9.1	24.5	18.2	17.8

	Total ^a			Men ^b			Women ^b		
	2005	2009	2013	2005	2009	2013	2005	2009	2013
Diet									
Tea or coffee	63.1	39.0	-	74.2	50.1	-	52.3	30.6	-
Protein	99.1	87.8	-	99.5	92.2	-	98.8	84.4	-
Veggies	99.1	88.7	-	99.2	86.2	-	99.0	90.4	-
Carbs	99.2	24.3	-	99.3	26.3	-	99.1	23.5	-
Dairy	71.0	46.7	-	68.0	41.5	-	74.0	50.6	-

II. Prevailing trends of disability

Table 2 presents the prevalence and trend analysis and gender differences of senile depression over the years after age standardization. The study found that the prevalence rate of depressive symptomatology ranged from 13.3 to 20.6%, all of which showed a decreasing trend ($\chi^2_{\text{depressive symptomatology}}=-7.5$) and was statistically significant; in addition, the prevalence rate of disability in women was significantly higher than that of men over the years (17.3–24.2% vs 9.0–16.9%). From the trend, it can be found that the depressive symptomatology of men and women ($\chi^2_{\text{men}}=-6.3$, $\chi^2_{\text{women}}=-4.7$) have tended to decrease significantly over the years. The adjusted odds ratio after adjustment of the effects of age structure over the years by logistic regression analysis was 0.59 for men (95%CI = 0.51–0.68) and 0.76 for women (95%CI = 0.68–0.84), which showed a significant decrease in the prevalence rate of depression in men and women in Taiwan.

Table 2
Age adjusted trend analysis of prevalence of depressive symptomatology across interviews (%;2005–2013)

Disability	Total			Men ^a			Women ^a			χ^2 for trend			Trend difference
	2005	2009	2013	2005	2009	2013	2005	2009	2013	Total	Men	Women	
Depressive symptomatology	20.6	16.1	13.3	16.9	12.9	9.0	24.2	18.6	17.3	-7.51	-6.33	-4.67	0.96

Note: 1) The sign, “-”, means there have different question in this wave compared with other wave so that we did not analysis. 2) ^a Bold numbers mean there have significant gender difference in disability factors within each wave. ($p < 0.05$). 3) **Depressive symptomatology** mean participants have 10 points or over in the CES-D scale (range 0–30). 3) The longitudinal waves were not the same for each disability because the data limitation. Depressive symptomatology used the wave from 2005 to 2013.

III. Disability-related factors

Table 3 is a regression analysis of depression-related independent factors for different gender. The independent predictor most associated with depressive symptomatology in men and women is cereal rhizome uptake that is significantly associated with 8.8 (95%CI = 5.1–15.2) and 7.9 (95%CI = 5.2–11.8) times depressive symptomatology in men and women respectively. Among the risk factors associated with health behaviors, fall (men: $\text{AOR}_{\text{fall}}=2.1$, women: $\text{AOR}_{\text{fall}}=1.5$) is a common factor for men and women, while underweight ($\text{BMI} \leq 18.5$) is a factor associated with depressive symptomatology specific to older men. The factors significantly correlated with depressive symptomatology specific to underweight older men include: heart disease (men: $\text{AOR}_{\text{heart disease}}=2.0$, women: $\text{AOR}_{\text{heart disease}}=1.5$) and cognitive disorder (men: $\text{AOR}_{\text{cognitive disorder}}=2.5$, women: $\text{AOR}_{\text{cognitive disorder}}=1.8$), while the pulmonary disease ($\text{AOR}_{\text{pulmonary disease}}=2.4$, 95%CI = 1.5–3.6) and secondary educational level ($\text{AOR}_{\text{higher and secondary vocational education}}=2.3$, 95%CI = 1.1–4.9) of men and metabolic disease of women ($\text{AOR}_{\text{metabolic disease}}=1.4$, 95%CI = 1.0–1.8) are also associated with depressive symptomatology. Finally, the co-protection factors that reduce the depressive symptomatology in men and women are advanced age (over the age of 85), exercise and social participation: the significant protection of advanced age for men and women reduced about 63% ($\text{AOR}_{\text{over the age of 85}}=0.4$, 95%CI = 0.2–0.9) and 62% ($\text{AOR}_{\text{over the age of 85}}=0.4$, 95%CI = 0.2–0.8) of depressive symptomatology respectively; the significant protection of exercise for men and women reduced about 50% ($\text{AOR}_{\text{exercise}}=0.5$, 95%CI = 0.4–0.7) and 58% ($\text{AOR}_{\text{exercise}}=0.5$, 95%CI = 0.3–0.6) of depressive symptomatology respectively; the significant protection of social participation for men and women reduced about 55% ($\text{AOR}_{\text{social participation}}=0.5$, 95%CI = 0.3–0.7) and 36% ($\text{AOR}_{\text{social participation}}=0.6$, 95%CI = 0.5–0.9) of depressive symptomatology respectively. In addition, the protective factors for depressive symptomatology in women include the age groups 75–79 and 80–84 ($\text{AOR}_{75-79 \text{ years old}}=0.6$, 95%CI = 0.4–0.8, $\text{AOR}_{80-84 \text{ years old}}=0.4$, 95%CI = 0.2–0.7), married status ($\text{AOR}_{\text{married}}=0.7$, 95%CI = 0.5–0.9) and tea or coffee intake ($\text{AOR}_{\text{tea or coffee}}=0.7$, 95%CI = 0.5–0.9).

Table 3
Associations of depressive symptomatology with sociodemographic, health condition, and behavioral factors among men and women: Adjusted Odds Ratios (AOR) and 95% Confidence Intervals(CI) from Binary Logistic Regression Analyses

Characteristic	Men (N = 2,038) Women (N = 2,235)			
	AOR	95%CI	AOR	95%CI
Sociodemographic				
Age group (years, ref = 65–69)				
70–74	1.02	0.67–1.56	0.84	0.60–1.16
75–79	0.86	0.55–1.35	0.57	0.39–0.83
80–84	0.92	0.54–1.57	0.39	0.23–0.66
85+	0.37	0.15–0.92	0.38	0.19–0.78
Living alone	1.59	0.94–2.70	1.12	0.73–1.72
Married/Partnered	0.73	0.48–1.10	0.68	0.50–0.91
Level of education(ref = High)				
Low	1.70	0.92–3.15	2.86	0.86–9.48
Medium	2.34	1.12–4.89	0.98	0.22–4.43
Health condition				
Metabolic disease	0.92	0.65–1.29	1.35	1.00–1.82
Heart disease	1.99	1.34–2.96	1.45	1.05–2.02
Lung disease	2.36	1.54–3.59	1.37	0.84–2.24
Cataract	0.89	0.61–1.28	1.16	0.88–1.53
Hearing problem	1.65	0.67–4.07	1.94	0.69–5.47
Cognitive impairment	2.46	1.64–3.69	1.77	1.32–2.39
Behavior factors				
BMI (ref = Normal)				
Underweight	2.03	1.13–3.63	1.13	0.64–2.01
Overweight	0.69	0.46–1.02	1.02	0.73–1.42
Obesity	0.71	0.44–1.14	0.99	0.70–1.41
Exercise	0.50	0.36–0.69	0.42	0.32–0.56
Fall	2.08	1.41–3.06	1.45	1.08–1.95
Social engagement	0.45	0.32–0.65	0.64	0.48–0.85
Depressive symptomatology	-	-		
Diet				
Tea or coffee	0.85	0.60–1.20	0.67	0.50–0.88
Protein	1.90	0.43–8.46	1.19	0.60–2.38
Veggies	1.10	0.46–2.60	1.47	0.54–3.97
Carbs	8.77	5.07–15.17	7.85	5.22–11.8
Dairy	1.20	0.86–1.68	1.48	1.10–1.99
Note: Bold number means there have significant difference (p < 0.05).				

Discussion

This study found that the common risk factors of depression in men and women were carbohydrates, cognitive disorder, heart disease and falls, and the pulmonary disease, underweight and educational level (higher and secondary vocational education) were also risk factors for men, including the additional metabolic disease and milk intake for women (6); in terms of protective factors for depression in the older adults, advanced age (men over the age of 85, and

women over the age of 75), exercise and social participation were co-protection factors (7), including the additional tea and coffee intake and married status for women. The reasons for the gradual decline in the prevalence rate of depression among the elderly in Taiwan may be related to the social atmosphere that focuses on the health of the elderly in Taiwan in recent years. Under the advocacy of "living happily" and "living happily in old age", more and more older adults accept the ideas of going on a hike and taking part in more community activities and having exercise to live, for example, singing karaoke at the sodality for the elderly, learning how to make hand-made soaps at community college and climbing mountains, which helps to increase the social participation and exercise of the older adults, especially for the elderly groups, the importance of maintaining good social participation habits for health is comparable to regular exercise and non-smoking. (8) The most common explanation is that social connections provide a cushion against pressure on the elderly and reduce the incidence of pressure-related diseases (9). On the other hand, the parity of high-tech products such as tablets and mobile phones and the popularity of mobile networks have made it easier for the elderly to access information online, have social media accounts such as line and Facebook, maintain ties between the elderly and their relatives and friends through private messages and outgoing messages and other functions and have timely platforms to express their feelings when they feel depressed.

This study found that the prevalence rate of senile depression in women was higher than that in men, which was the same as that in previous studies of each country. In 2002, Kockler, M et al. used Composite International Diagnostic Interview (CIDI) to survey the differences in depression between men and women and also found that women showed more depressive symptomatology than men, in which female elders were prone to taste disturbance or loss of happiness, and male elders are more likely to be accompanied by agitation. (10) Another study of Nolen-Hoeksema et al. explained the differences in the prevalence rate of depression between men and women, first of all, the social status of women is generally inferior to that of men in all cultures of the world due to women's small strength, so the proportion of women who have experienced trauma and especially sexual abuse in their childhood or prime is higher than that of men, moreover, women continue to experience various forms and objects of harassment, disrespect and disparagement or face economic difficulties while they grow up, so the prevalence rate of depression in women is higher than that in men, regardless of age levels. The study also suggests another more biological reason that the previous studies focused on the direct effects of hormones such as estrogen or progesterone on women's mood, but in fact the mechanisms of association of hormones with depression are not clear, and most of the studies in recent years have turned to the discussions about non-direct effects of female hormone on mood, for example, the regulatory mechanism by which individuals are subjected to pressure. The hypothalamic-pituitary-adrenal (HPA) axis influences mood by regulating various hormones such as cortisol in the body. Dysregulation of HPA response can be found in the groups experiencing major depression, and one of the study's assumptions about differences in depression in men and women is that women are more likely to experience traumatic events and therefore more likely to experience regulatory disability in HPA response, and it is considered that the causal relationship between the regulatory function of HPA axis and the differences in depression in men and women has not been established, which is one of the feasible directions for future studies. (11) In addition, the causes of higher prevalence rate of depression in women than that in men may also be related to the men's tendency to be married and have higher proportion of exercise. In the growing environment of the elderly, Taiwan's marriage roles are influenced by the traditional views of valuing the male child only and requiring the woman to stay at home and the man to earn the money in Taiwan, and men are mostly a pillar of the economy and put themselves into the career development in their prime, and their sense of achievement comes from career success; women are often responsible for the internal affairs of the family, including cooking three meals, washing clothes, cleaning and other daily chores, even if they work as a career woman (who also has a job outside), they are mostly the main executor of their household duties after they return home from work. The same results were found in the study of H. C. Hsu, that is, men are generally given a job, and the accumulated connections and social resources at work enable men to have more social participation than women after retirement, which was one of the major causes for helping them maintain their mental health. (12) On the other hand, due to the influence of the concept of "helping the husband and teaching the children", most of the burdens of educating and bringing up children fall on women. As a result of caring for children from childhood to adulthood and building a deeper connection with children, women are used to worrying about their children's careers, marriage, interpersonal relations and other matters even when they get older. Therefore, women are more likely to worry about whether their children are living well compared with men, which is also a potential factor for the depression in women. In addition to the traditional gender division of labor in society, in terms of daily living habits, men have more exercise than women, and the formation of regular exercise habits help release endorphins and reduce the incidence of depression in men so that women show a higher incidence of depression than men. (13, 14)

This study found that the elders with higher educational level tended to be more likely to show depression than those with lower educational level, which was consistent with the conclusion arrived at by Noori Akhtar-Danesh using Canadian Community Health Survey, Cycle 1.2 (CCHS-1.2) dataset in Ontario, Canada that the degree of depression in the groups with the high school educational level or below was lowest in all categories of educational levels and those with higher educational level had the highest degree of depression. (15) This may be related to the different areas experienced by groups with different educational levels. The elders with higher educational level generally have more to look after and face more complex difficult problems to be addressed than those with lower educational level. The elders with higher educational level may show more consciousness of intellectuals in society, politics, morality and law in addition to their basic living needs, and they are concerned not only with themselves and their families but also with the issues to be considered in more values and ideas. Therefore, the elders with higher educational level consider and worry about a wider range of areas than those with lower educational level. In addition, the occupations and positions of the elders with higher educational level generally tend to labor with minds rather than with body compared with those with lower educational level. Past career failures and crises, if accumulated into old age, may also contribute to the higher prevalence rate of depression among the elders with higher educational level. In addition, the elders who have experienced higher education often have higher self-requirements and higher thresholds for meeting their self-fulfillment needs than those who have not received higher education. If they fail to fulfill their self-expectations or dreams in their prime and perceive their increasingly degraded abilities through everyday chores in their old age, a contrast of having their wish frustrated may upset them and feel dissatisfied with the quality of life for the remainder of their life.

This study found that advanced age is a protective factor for depression, which was different from the previous studies that found that the older adults over the age of 80 suffered from more severe depression than those aged 70–79, indicating that the groups with higher age had higher risk of depression [21]. Demura, Shinichi and others surveyed 657 male elders and 654 female elders living in the community, by using geriatric depression scale (GDS) as the main research method, they found that the old-old elderly showed higher depressive symptoms than the young-old elderly and were more vulnerable to differences

in different living habits, while the function of social participation that reduces depression was more effective for the old-old elderly than the young-old elderly [22]. However, in the study of Dan Blazer and others, the duke EPESE (Establishment Of A Population For Epidemiologic Studies Of The Elderly) used the revised version of ces-d to check 3,998 older adults over the age of 65 living in the community, finding that although depressive symptoms were associated with advanced age, women, low income, physical disability and cognitive disorder under bivariate analysis, but under multiple regression analysis, when the above-mentioned risk factors other than age are excluded, the relationship between age and depressive symptoms turns upside down, and the elderly with higher age will have less depressive symptoms. (16) The results show that the elderly with higher age are generally accompanied by the increased risk of physical illness and cognitive disorder. Without excluding other factors, the study found that the groups with higher age had a higher risk of depression. However, if the relationship between advanced age and depression is taken into account in the context of controlling health factors and cognitive disorder, it can be found that advanced age is the most natural protective factor for depression as found in this study. Advanced age has significant protective effect for men over 85 years old and women over 75 years old.

In terms of disease, heart disease is the common risk factor for depression in men and women, metabolic disease is a risk factor for depression in women, and pulmonary disease is a risk factor for depression in men. The findings of heart disease are consistent with other foreign literature. Reiner Rugulies reviewed the literature from 1966 to 2000 on the association of coronary heart disease (CHD) with depression, and analyzed that depression was associated with the development of coronary heart disease in originally healthy individuals [24]. compared with patients without depression, the patients with depression had poor prognosis. The study of Skilton, Michael R and others showed that metabolic disease were associated with the rise in the prevalence rate of depression for men and women, and the higher the values of an individual's metabolic disease, the more severe the degree of depression. (17) With regard to the association between pulmonary disease and depression, a study conducted by Yon Ju Ryu et al in Korea also found the same result. The study took 84 outpatients with chronic obstructive pulmonary disease (COPD), 37 outpatients with asthma, 33 outpatients with bronchitis and 73 healthy persons as the control group, finding that chronic pulmonary disease was associated with depression or anxiety, and depression was particularly evident in the patients with a higher airflow limitation or groups with a history of smoking. (18)

In terms of diet, eating cereals is a common risk factor for depression in men and women, and milk is a risk factor for depression in women, which are important findings of this study. The study of Dragos Inta et al found that the habit of eating low-carbohydrate help improve major depressive disorders (MDD)(19); although no studies have confirmed the exact mechanisms of association of carbohydrate with depression, many studies suspect that it is associated with intestinal symbiotic microbes. Andrew M. Taylor and Hannah D. Holscher reviewed the studies related to key words such as microbes, depression, diet, eating habits, dietary quality, fiber, probiotics... and found that people's mood or depression could be improved by improving dietary quality, for instance, fructooligosaccharide and galactooligosaccharide with the weight of more than 5 grams a day can improve depression, and the amount of bifidobacteria in the body will also become more abundant, and the habit of eating dietary fibers and omega-3-polyunsaturated fatty acids is also considered to be associated with reducing the incidence of depression (20). However, the specific mechanism on how the diet and intestinal symbiotic bacteria affect the degree of depression remains to be further found. Most of the cereals eaten in Asia are rice and millet which are different from barley and wheat varieties used in western countries, whether it has different effects on the degree of depression in the elderly needs to be clarified in more studies in the future. The dietary protection factor is tea and coffee intake, and the study of Xuguang Guo and others found that the group that was accustomed to drinking tea or coffee without sweeteners had a lower prevalence rate of depression than those who did not drink it (21). The same results can be seen in other past studies, for instance, Giuseppe Grosso and others used Embase and PubMed databases to find that groups with higher caffeine intake had only relative risks of 0.76 depression compared with those with lower caffeine intake, with the best protective effect at 400mL per day, and that coffee had a significant effect but tea not. (22) The study of Anu Ruusunen et al also found that coffee helped protect against the occurrence of depression, but tea was irrelevant thereto. (23)

In addition, there are also studies showing that obesity is especially a protective factor for depression in the elderly in Taiwan. For example, the study of Chang, Hung-Hao and others surveyed 1,351 men and 1,165 women and found that about 10.4% of the older men were overweight and 13.4% of them were obese, and that 19.3% of older women were overweight and 26.4% of them were obese, and both the men and women in overweight and obese groups showed a lower depression rate than moderate and underweight groups, which was contrary to western countries. The study found that this situation was related to cultural differences, and overweight and obesity are considered as diseases in the western world, but obesity is regarded as a symbol of wealth and good fortune rather than as a health crisis in Asian countries such as Taiwan (24). The same results were found in the study of Kuo, S-Y et al, and the study used 10-year trajectory patterns of depressive symptoms to survey 445 older adults over the age of 60 between 1989 and 1999, recorded their (CES-D) scale scores and BMI changes over the past ten years and classified the degree of depression in samples into persistent lowness, persistent mildness, recent increase and chronicness, and the groups with persistent depressive symptoms were found to be mainly associated with low BMI.(25)

The limitation of this study is that the sample source is lack of groups living in institutions such as old age care centers, and the physical function and cognitive function of groups usually living in the relevant institutions are worse than those of the elderly living alone and living with relatives, and the proportion of bed rest is higher. Therefore, in this study, the proportion of disability may be underestimated in the absence of samples living in an institution; the questionnaire is the main method of survey, and there may be some differences in the description of questions in the cross-survey data analysis. The answerers may answer different results under different methods of questioning, or there are too many missing values and data registration errors during the interview. The standard for judgement of hearing impairment in the variables is "whether to wear a hearing aid". Because of economic problems, lack of access channels or maladaptation to aids, many older adults may suffer from hearing impairment but can not use hearing aids in real life so that their number is underestimated.

Conclusions

With the aforementioned limitations, this study focused on the analysis of the older adults over the age of 65 in Taiwan and the analysis of areas including residence, education, eating habits, social participation and health status using the epidemiology research center depression scale as an assessment tool and

discussed both gender separately to clarify the protective factors and risk factors of depression in Taiwanese older adults of different genders, provided empirical evidence to the government units and public health advocacy that highlights the common risk factors of depression in men and women were carbohydrates, cognitive disorder, heart disease and falls. In addition, gender differences on the risk and protective factors were found: the pulmonary disease, underweight and educational level (higher and secondary vocational education) were risk factors for men; metabolic disease and milk intake were risks for women. In terms of protective factors for depression in the older adults, advanced age (men over the age of 85, and women over the age of 75), exercise and social participation were common protective factors for both gender, and that tea and coffee intake and married status were protective for women.

Abbreviations

NHIS

National Health Interview Survey; CES-D:The Center for Epidemiologic Studies Depression Scale; GDS:Geriatric Depression Scale; PPS:Probability Proportional to Size; BMI:body mass index; CID:Composite International Diagnostic Interview; HPA:The hypothalamic-pituitary-adrenal; CCHS-1.2:Canadian Community Health Survey, Cycle 1.2; EPESE:Establishment Of A Population For Epidemiologic Studies Of The Elderly; CHD:coronary heart disease; COPD:chronic obstructive pulmonary disease; MDD:major depressive disorders;

Declarations

Ethics approval and consent to participate:

This study was approved by the Institution Review Board (IRB) of National Cheng Kung University Hospital in Taiwan (No. A-ER-106-499) and waiver of informed consent.

Consent for publication:

Not applicable.

Competing interests:

The authors declare that they have no competing interests.

Availability of data and materials

The data that support the findings of this study are available from Health Data Science Center but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Health Data Science Center.

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Authors' contributions:

Study concept and design: CJC Acquisition of data: CJC. Analysis and interpretation of data: CJC, CYT. Drafting of the manuscript: CJC, CYT. Critical revision of the manuscript for important intellectual content: CCH, CYT. All authors have read and approved the manuscript.

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Figures

Figure 1

The adjusted odds ratio of risk and protective factors for depressive symptomatology among men and women

Figure 2

Risk & protective factors for depressive symptomatology for men and women