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The effects of health status on work productivity loss among the older working population in China

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Abstract

Objectives: We used the first two-wave longitudinal data from the China Health and Retirement Longitudinal Study (CHARLS) to analyze the effects of health status on work productivity loss among the older working population in China.

Methods: We measured work productivity loss in two ways: work exit and the number of absent workdays due to health problems. To investigate the worker heterogeneity in the effects of health status on work productivity loss, we divided the sample into four groups according to gender and work types (farmers who conducted any agricultural work at the first wave versus non-farmers who conducted non-agricultural work only) and analyzed the four groups separately.

Results: Farmers (11.0% for women and 4.9% for men) were less likely to stop working than non-farmers (18.5% and 12.0% respectively) but took more absent workdays (16.6 days for women and 15.0 days for men) than non-farmers (5.6 and 4.9). Health status was not significantly associated with the work exit of female non-farmers. Among the other three groups, female farmers, male farmers and male non-farmers, the concurrent health status rather than the two-year lagged health status was significantly associated with work productivity loss when both concurrent and lagged health status were independently included in our analysis models. Furthermore, the older workers (except female non-farmers) with poor health at either or both waves were significantly more likely to stop working or missed more workdays than those with persistently good health over time. Those with persistently poor health incurred the largest productivity loss.

Conclusions: The effects of health status differ by both gender and work types. Among the older Chinese workers except female non-farmers, poorer concurrent health is more likely to lead to work exit and more absent workdays than poorer two-year lagged health, and persistently poor health over time is most detrimental.

Strengths and limitations of this study

- **We analyzed the effects of the concurrent and lagged health status and the evolution of health status over time on work productivity loss among the older working population in China.**
- **We measured work productivity loss in terms of both work exit and the number of absent workdays due to health problems among those who remained working.**
- **To address the problems of endogeneity and measurement error of self-rated health status (SRH), we used three detailed health measures to instrument the SRH in our analyses.**
- **We only selected working population in 2011 which might underestimate the effect of health status.**

Keywords: Health status; Work productivity loss; Older working population; China

Introduction

China has become one of the fastest ageing countries in the world.[1] The number of people in labour force (aged 18-64 years) is expected to decline by approximately 140 million in 2050 even under the current universal two-child policy.[2] The rapid growth of the older population and shrinking labour force raise many problems in Chinese society. One of the prominent problems is a possible threat to the stability and sustainability of the current social pension system of China. The shrinking labour force will contribute less to the retirement income system and an increasing aged population will be eligible to receive retirement pensions. Therefore the combination of the two trends could significantly impact economic growth adversely and cause the pension fund to become bankrupt.

Currently, China's labour market has shown the following two characteristics. On one hand, the employment rate among older population in the urban area is very low, it only reaches 40% among people between 50 and 59, and this rate decreases further to about 20% for those aged 60-64.[3] This might be due to the official mandatory retirement policies implemented in the urban formal sectors.[4] Specifically, the retirement age for men is 60 years, the retirement age for female workers is 50 years, and for female cadres is 55 years. On the other hand, the employment rate among older population in the rural area is very high, most people still work between 65 and 69, and by the age of 80, the employment rate is still above 20%.[3] This divergence of employment for the urban and rural areas is mainly due to the fact that the retirement policy, the pension program and unemployment insurance program are limited only to the urban formal sectors in China but not to the rural population. Considering that the older population has become or will become the

main component of labour force in China, it is crucial to keep them active and productive in the labour market to maintain sufficient labour supply and contain the increasing national spending on income support.

Labour market activities are affected by many factors, among which the influence of health on labour supply has attracted more and more attention. There is a vast literature that demonstrates poor health has a negative impact on labour force participation in the developed countries especially among older population. In these economic and epidemiological studies, poor health has been measured by self-rated health (SRH),[5-13] chronic diseases such as depression,[14] rheumatoid arthritis,[15] diabetes,[16] cancer,[17] and functional limitations.[18] Many studies have also shown the impact of one specific disease on the number of absent workdays among people with the disease.[19-25] However, worldwide, there are only a few studies from the developed countries that measure the number of absent workdays in the general population due to a lack of data.[26-30] Most studies to date have focused on either comparing the incremental effects of different chronic diseases on absent workdays or estimating the incremental productivity loss due to different chronic diseases. **Overall, there are few studies analyzing the effect of health on labour force participation or absenteeism in the developing countries,[31] especially among older working population.**

In addition, most of the previous studies have examined the static relationship between health and labour force participation. However, the relationship can be a dynamic process. Studies have shown that not only the current health status but also the previous health status affect decisions concerning labour force participation.[9, 10] Therefore, the impact of

persistently poor health might be different from that of recent health deterioration. To fill the literature gap, this present paper was to examine the effects of health status on work productivity loss among the older working population in China, using longitudinal, individual level data from the China Health and Retirement Longitudinal Study (CHARLS). Specifically, we measured the impact of previous health status and concurrent health status as well as the change of health status over time on work exit and the number of absent workdays due to the health problems among the older people who were previously working.

DATA AND METHODS

Data and study population

The data used in the paper were drawn from the first two waves (2011 and 2013) of the CHARLS survey in China. The details of the survey can be found in Zhao *et al*.[32] Generally speaking, CHARLS is designed in the similar way to the US Health and Retirement Study as a broad-purposed social science and health survey of people aged 45 or older and their spouses in China. It is a high-quality survey of nationally representative sample of Chinese residents. The survey contains detailed information on individual and household characteristics, such as individual demographics, work activities, health conditions, health services utilization and insurance, physical measurements, and household income, expenditure, and assets.

Our study population was based on the CHARLS participants who engaged in either agricultural or non-agriculture work or both in 2011 and whose age was between 45 and 55 years for women or between 45 and 60 years for men in 2013 (n = 4,683). The age restriction was chosen

according to the legal retirement age typically for those who are employed in the urban formal sectors in China. Although retirement age policy does not apply to the rural population, for comparison purpose, we chose the same age bands for participants who engaged in the agricultural job. We further restricted our study sample to those without missing data on labour participation status and other explanatory variables. As a result, our final sample used for analyzing the effect of health status on work exit was 4,332. Among them, 3,942 individuals were still working in 2013 and eligible for the questions on number of absent workdays due to health problems. After removing sample with missing value on number of absent workdays, 3,846 individuals were used for analyzing the effect of health status on number of absent workdays. To investigate the potential worker heterogeneity in the effects of health status on work productivity loss, we divided our sample into four separate groups according to gender and working types in 2011: female farmers (i.e., any agricultural work), female non-farmers (non-agricultural work only), male farmers, and male non-farmers.

Measures

Measurement of work productivity loss

In the present paper, we employed two indicators to measure work productivity loss: work exit and the number of absent workdays due to health problems in 2013. Labour force participation status was determined by a series of questions in CHARLS. An individual was considered as "working" if he or she engaged in agricultural work (including farming, forestry, fishing, and husbandry for his or her own family or others) for more than 10 days in the past year, or worked for at least one hour last week (such as earning a wage, running their own business and unpaid family business work), or was on leave but expected to go back or still received salary.

Otherwise, an individual was considered as "not working". Since our study population was the CHARLS participants who were "working" in 2011, "not working" in 2013 referred to work exit.

The number of absent workdays due to health problems was measured based on the question, "How many days of work did you miss last year due to health problems?" for those who were still working in 2013, i.e., those who engaged in household agricultural work, being employed, or in non-farm self-employed and unpaid family business.

Measurement of health and other controls

SRH has been used extensively in epidemiological and economic studies not only as a measure of population health but also as a predictor of mortality, morbidity, health care utilization and labour force participation.[5, 8, 9, 12, 33-36] To be consistent with literature, we used SRH as our main health measure, which was derived from the question, "Would you say your health is very good, good, fair, poor or very poor?" The SRH in 2011 (i.e., two-year lagged health status) and 2013 (i.e., concurrent health status) were categorized into: good (reported very good or good), fair (reported fair), and poor (reported poor or very poor), respectively. The change of health status from 2011 to 2013 was defined by four categories: poor in 2011 to poor 2013, good/fair 2011 to poor 2013, poor 2011 to good/fair 2013, good/fair 2011 to good/fair 2013.

Other detailed health measures were used to instrument the SRH to address the endogeneity and measurement error issues of the SRH, which was described in the Econometric models section. These measures included disability condition, number of chronic diseases, and functional

limitations. Other control variables included age, education (illiterate, lower than elementary school, elementary school graduate, and middle school or higher), marriage status (married vs. not), and monthly household expenditures on food, utilities, household items, clothing, medical care, taxes, *etc*. **The detailed definition of the health-related and control variables are presented in the Appendix.**

Econometric models

There are a number of potential problems with the SRH. First, there might exist reverse causality between health and labour market activities.[37, 38] Second, the SRH may also suffer "justification bias", that is, an individual could justify his or her work exit by reporting worse health status than his or her true health status.[39] Third, due to individual heterogeneity, the SRH measure might not be comparable across respondents, which means there may also be measurement error problem.

To address the potential endogeneity and measurement error of the SRH, we followed Bound *et. al.*(1999)[9] and used the latent variable model , which is analogous to using the three detailed health measures (i.e., disability condition, number of chronic diseases, and functional limitations) to instrument the SRH.[9, 10, 37] Specifically, we used **Probit model for not working** in 2013, and ordered Probit model for the SRH in 2011 ($\boldsymbol{H}_{11}$) and 2013 ($\boldsymbol{H}_{13}$) as well as the change of SRH from 2011 to 2013. We carried out the full information maximum likelihood (FIML) estimation method using SAS QLIM procedure.[40] SAS QLIM procedure reports the simulated maximum likelihood estimates for the models with more than one endogenous variable ($\boldsymbol{H}_{11}$and $\boldsymbol{H}_{13}$). For the simulated maximum likelihood estimation method,

QLIM procedure uses the Geweke-Hajivassiliou-Keane simulator to simulate the joint distribution of the dependent variable and the endogenous variables.[41] The simulation is facilitated by assuming that the error terms in the latent models for the dependent variable and the endogenous explanatory variables are distributed as multivariate normal. A number of goodness-of-fit measures (including different Pseudo R-squared) for the ordered Probit model for the SRH were provided in the Appendix to show how well the three detailed measures predict SRH.

Four different model specifications were used: Model I. to examine the effect of lagged health status by including H_{11} in the model only; Model II. to examine the effect of concurrent health status by including H_{13} in the model only; Model III. to examine the effect of both lagged and concurrent health status by including both H_{11} and H_{13} independently in the model; Model IV. to examine the effect of change in health status by including the change of SRH from 2011 to 2013 in the model. The specific model specifications were presented in the Appendix. All analyses were weighted using the individual longitudinal weights provided by CHARLS.

Similar method was used for absent workdays. We employed the Tobit model for the number of absent workdays and the ordered Probit models for the SRH in 2011 and 2013 and the change of SRH. Tobit regression was used for the number of absent workdays due to health problems, as its value was truncated at zero with a large number of observations at the zero point.

Interpreting estimated health coefficients

It is difficult to interpret the magnitude of the estimated health coefficients in Probit model for not working and Tobit model for the number of absent workdays. To help the interpretation, we presented the expected probability of not working for each of the four categories of the change of health status from 2011 to 2013.[42, 43] To do this, we first assigned all individuals in our datasets to one of the four categories, and then calculated the expected probability of not working for each individual using their own levels for the control variables (i.e., age, education, marriage status, and expenditures in 2011) and the assigned category of the change of health status. Last, we reported the mean value of the expected probability of not working among all individuals. For absent workdays, we calculated the average expected number of absent workday following the same method.

Sensitivity analysis

We conducted all the analyses without using the weights and conducted the analyses by including all older farmers without applying the age restriction.

Results

Table 1 presents our sample characteristics in 2011 by gender and by our four separate working groups: female farmers, female non-farmers, male farmers, and male non-farmers. About 36% of women and 39% of men were non-farmers (weighted proportion), *i.e.*, engaged in non-agricultural work only in 2011. Not surprisingly, non-farmers' education level was much higher than that of farmers and men's education was higher than that of women. In terms of SRH, famers and women had poorer SRH than non-farmers and men, respectively. Consistently,

farmers were more likely to be disabled, and suffered from more chronic diseases and functional limitations than non-farmers, regardless of gender.

Overall, about 90% were still working in 2013. Among both women and men, non-farmers (18.5% for women and 12.0% for men) were more likely to stop working than farmers (11.0% and 4.9%, respectively). **Table 2 describes the relationships between the SRH in 2011 and 2013, the change of SRH and work productivity loss. Consistently among all the four groups, people in poor health status in 2011 or 2013 were more likely to stop working in 2013 except for female non-farmers. The recent health deterioration (good/fair to poor) and persistently poor health (poor to poor) were associated with a higher probability of not working for both females and males but this relationship was not shown among non-farmers after further breaking the population down by farmers and non-farmers. In terms of absent workdays, people in poor health status in 2011 and 2013, respectively, or in persistently poor health status over time had the largest number of absent workdays across all the groups.**

Work exit

Table 3 presents the analysis results of model I for two-year lagged health only, model II for concurrent health only, and model III for both lagged and concurrent health. Model I and model II showed that people with poorer lagged health status except for non-farmers and people with poorer concurrent health status except for female non-farmers were significantly more likely to stop working. Model II has better model fit (i.e., smaller Akaike information criterion) than model I except for female non-farmers (shown in the Appendix).

When including both the lagged and concurrent health status independently into one model, the concurrent health rather than the lagged health was significantly associated with the probability of not working in all the four separate groups except for female non-famers.

Table 4 presents the effect of change of health status over time on work exit. People who changed health status from poor to poor, good/fair to poor, and poor to good/fair were significantly more likely to stop working than people with persistently good status except for female non-farmers. The expected values shown in Table 5 are more helpful in understanding the magnitudes of the effects. Across all groups, people with persistently poor health had the highest probability of not working, e.g., 0.31 for all males with persistently poor health compared with 0.05 for those with persistently good health. There was then a decreasing trend of probability of not working among farmers with health status change from good/fair to poor, poor to good/fair and then good to good. However, this trend did not hold for non-farmers.

Number of absent workdays due to health problems

Among those who were still working in 2013, the overall average number of absent workdays due to health problems was 12 days (SE=0.63). The average number of absent workdays among farmers (16.6 (1.4) for women and 15.0 (1.1) for men), much higher than non-farmers (5.6 (1.3) and 4.9 (0.9), respectively) (Table 2). All older working people with poorer health status had significantly more number of absent workdays due to health problems (Table 3). The concurrent health status was more associated with the number of absent workdays than the two-year lagged health status. The two-year lagged health status did not significantly

affect the number of absent workdays among all the four groups while controlling the concurrent health status.

When analyzing the impact of the change of health status over time, the model parameters (Table 4) and expected values (Table 5) showed a decreasing trend with persistently poor status leading to the largest number of absent workdays, followed by the changes from good/fair to poor, from poor to good/fair, and persistently good/fair. The exception was found in female non-farmers.

Sensitivity analyses

The analysis results without using the weights provided by CHARLS were consistent with the main analysis results considering the weights. In addition, after dropping the age restriction for farmers, we observed similar effects (in terms of magnitude and significance) of the concurrent and lagged health status and the change of health status over time. The detailed results can be found in the Appendix.

Discussion

The effect of health status on work exit and absent workdays among older working people in China has not been extensively studied. This present paper fills the gap by examining the impact of the concurrent health status and two-year lagged health status and the change of health status over time on continuous working status and absent workdays in a representative older working population sample in China. We found that the effects of health status varied by the two work productivity loss outcomes (i.e., work exit and absent workdays) as well as by both gender

and working types (agricultural work vs. non-agricultural work). Health status did not have significant effects on work exit among female non-farmers. Among the other three groups, female farmers, male farmers and male non-farmers, the concurrent health status had more impact on both work exit and absent workdays than the two-year lagged health status. In addition, the older workers (except female non-farmers) with poor health at either or both time points were significantly more likely to stop working or missed more workdays than those with persistently good health over time. Those with persistently poor health incurred the largest work productivity loss (i.e., the highest probability of not working and number of absent workdays).

Also, our study has revealed some interesting findings if we combine the two productivity loss outcomes. Our results indicated that the work exit rate was lower in farmers than non-farmers, which is consistent with previous studies.[3, 4] Specifically, 11.0% female farmers and 4.9% male farmers stopped working in 2013, compared to 18.5% for female non-farmers and 12.0% for male non-farmers in 2013. However, conditional on keeping working in 2013, the number of absent workdays in farmers (16.6 days for women and 15.0 days for men) was found to be higher than that of non-farmers (5.6 days and 4.9 days). These results may suggest that older farmers adapt to poor health so that they are able to continue their labour force participation, and taking more sick leaves is one way of adapting for them to remain in the labour force.

In our population selection, we restricted to women between 45 and 55 years and men between 45 and 60 years in 2013 based on the retirement age policy that is applied to the urban formal sectors in China. However, this policy does not apply to the rural population (i.e. those in agricultural work). We therefore conducted sensitivity analyses by including

all older working farmers without the age restriction. It showed that the effects of health status were similar to our main analysis results by applying the age restriction, which might suggest no age-dependent influence of health status on work productivity loss for farmers.

In addition, when analyzing the impact on work exit, we only distinguished "not working" in 2013 vs. "working" but did not further distinguish those who were not working by their work exit routes, e.g., retirement, disability (due to health reasons), or other reasons. We found among those who stopped working in 2013, neither health reasons nor retirement is the major reason for them to stop working. Specifically, about 25% of female farmers and 40% of male farmers were not working due to health reasons and these proportions went up to 33% and 41%, respectively, if we dropped the age restriction. Only 2% of female and male farmers were not working due to retirement and the proportions did not change much if we dropped the age restriction (2% of female farmers and 5% of male farmers). The small proportion of retirement for farmers is partially due to the lack of retirement and pension schemes for rural population in China.[44] On the other hand, about 5% and 27% of female non-farmers and 20% and 8% of male non-farmers stopped working due to health reasons and retirement, respectively. Therefore, the effects of health status on work exit were comparable in the three groups (female farmers, male farmers and male non-farmers) because of their similar work exit routes. Also, the fact that very few female non-farmers stopped working due to health reasons possibly explains why we did not find significant effects of health status on work exit among them.

To account for the endogeneity and measurement error problems associated with the SRH, some researchers have proposed to use objective health measures instead.[45, 46] However, using these objective measures as proxy measures of health status can also lead to the errors-in-variables problem and endogeneity issue.[39] Therefore, such a strategy does not eliminate the problems but is subject to the similar problems of using SRH. To address these issues, a more common empirical strategy, which is followed by our paper, is to use a latent variable model, in which health indicators are used to instrument the error-ridden variables (i.e., SRH). [9, 10, 37]

Our study examines the effect of the health status at two different time points and its change over time on work productivity loss. In this way, we are able to find that, in addition to the current poor health or lagged poor health, whether deterioration in health over time helps explain the current work productivity loss. Therefore, we chose the framework and survey design adopted by Bound *et al*. who tested the same hypotheses.[9] Other panel data approaches, for example, modeling the effect conditional on the initial value of the outcome,[47] are not able to examine the time-related impact of health status.

In the present study, we only selected working population in 2011. People in poor health in 2011 who continued working in 2013 might have unobserved characteristics that encouraged them to work. For example, they might be in better health status than our health measures suggested or had a strong commitment to their work.[9] Therefore, we may have underestimated the effect of health status. However, we were more interested in examining the effect of health on the decision whether to continue working among the older people who had been already in the

labour force. Therefore, our study findings are more relevant to the policies that attempt to retain the existing older working population through improving their health.

The proportion of older workers is expected to increase among the working population in China, which will be further exacerbated by China's recent plan to raise the official retirement age.[48] Our study has important policy implications for China and other developing countries. Since exit from labour force is generally not reversible at an older age particularly for non-farmers, the priority should be given to the policies that better improve the overall workers' health status and improve the work circumstances of workers especially with persistently poor health. In addition, having realized the problem of lacking old-age security for the rural elderly, China government launched a nationwide, experimental rural social pension plan in 2009, which is expected to cover 10 percent of rural regions by the end of 2009, about 50 percent by 2012, and 100 percent by 2020.[49] However, our and previous findings using the same data indicated that the new pension plan did not affect the labor supply of rural elderly, as the majority of the elderly population sampled continued to work into their seventies. Our findings of older farmers taking more sick leaves to remain in the labour force also suggest an unproductive rural labour force. It may indicate that the new pension plan has not provided enough social security for the elderly in rural China or there is a lack of knowledge and awareness of such pension plans. More research is needed in the future to explore the reasons why rural elderly still keep working under the new pension plan and accurately estimate the effect of the new pension plan on welfare of rural elderly.

In conclusion, among three older Chinese working groups, female farmers, male famers and male non-farmers, poor lagged health status or poor concurrent health status is more likely to lead to work exit and more absent workdays. Compared with the lagged health status, the concurrent health status is more associated with work productivity loss. Furthermore, persistently poor health status over time is most detrimental to the work productivity of the older working population except for female non-farmers. These effects of health status differ by both gender and working type (agricultural work vs. non-agricultural work). Any relevant policies therefore need to be tailored to these different working groups.

Contribution Statement

XL and WZ designed the study, developed data analysis plan and equally contributed to this study. HS performed statistical analysis of the data. AHA provided guidance on economic theory and analysis. All authors made significant contributions to the interpretation of results and participated in drafting and revising the manuscript. All authors have approved the final version.

Competing Interests

None.

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Data Sharing Statement

All data collected in CHARLS are maintained at the National School of Development of Peking University, Beijing, China, and are publicly available at: http://charls.pku.edu.cn/en.

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Table 1. Demographic and health characteristics in 2011

Variables	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Sample N	1652	2680	1256	396	1874	806
Age, years	48.06 (0.07)	51.07 (0.09)	48.16 (0.06)	47.89 (0.16)	51.28 (0.1)	50.74 (0.16)
Education						
Illiterate	344 (19.45)	158 (5.45)	319 (26.01)	25 (7.69)	135 (7.46)	23 (2.36)
Lower than elementary school	250 (14.12)	337 (12.17)	218 (17.32)	32 (8.38)	273 (14.93)	64 (7.91)
Elementary school	369 (21.27)	574 (20.59)	308 (24.73)	61 (15.07)	448 (24.31)	126 (14.86)
Middle school or higher	689 (45.15)	1611 (61.78)	411 (31.93)	278 (68.86)	1018 (53.3)	593 (74.87)
Married	1587 (95.15)	2573 (95.68)	1214 (96.3)	373 (93.09)	1788 (94.81)	785 (97.03)
Household expenditures monthly	2744.55 (143.88)	2869.26 (163.99)	2120.78 (80.98)	3862.59 (353.58)	2104.85 (86.05)	4048.25 (393.95)
Self-rated health						
Good	424 (26.38)	884 (36.15)	284 (22.94)	140 (32.54)	544 (30.82)	340 (44.38)
Fair	872 (54.22)	1372 (49.29)	665 (52.12)	207 (57.98)	982 (50.28)	390 (47.76)
Poor	356 (19.41)	424 (14.56)	307 (24.95)	49 (9.48)	348 (18.9)	76 (7.86)
Disable	148 (8.12)	315 (11.07)	124 (10.12)	24 (4.55)	251 (13.29)	64 (7.64)
No. of chronic diseases (range 0-14)	0.99 (0.04)	1 (0.03)	1.1 (0.04)	0.81 (0.07)	1.07 (0.03)	0.89 (0.06)
Functional limitations (range 0-18)	0.48 (0.04)	0.33 (0.02)	0.63 (0.05)	0.19 (0.06)	0.44 (0.03)	0.16 (0.03)

Notes: the proportions in parentheses are weighted proportions; the means are weighted means, and standard errors of the mean are in parentheses.

Table 2. Work exit and number of absent workdays in 2013 by self-rated health

	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Proportion of not working						
Overall	202 (13.65)	188 (7.71)	129 (10.95)	73 (18.50)	85 (4.91)	103 (12.02)
Self-rated health in 2011						
Good	52 (12.49)	50 (5.47)	28 (11.31)	24 (13.98)	18 (3.76)	32 (7.31)
Fair	106 (14.27)	90 (8.48)	67 (10.23)	39 (20.77)	38 (4.30)	52 (15.27)
Poor	44 (13.52)	48 (10.64)	34 (12.11)	10 (20.16)	29 (8.40)	19 (18.93)
Self-rated health in 2013						
Good	46 (13.02)	46 (6.69)	21 (10.10)	25 (16.42)	14 (2.94)	32 (10.96)
Fair	106 (13.47)	85 (6.44)	68 (9.65)	38 (19.95)	33 (3.06)	52 (11.82)
Poor	50 (14.90)	57 (14.11)	40 (14.48)	10 (16.54)	38 (13.21)	19 (16.45)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	130 (13.42)	113 (6.45)	72 (9.46)	58 (18.88)	38 (2.80)	75 (11.10)
Poor – Good/Fair	22 (12.69)	18 (7.29)	17 (11.47)	5 (17.08)	9 (4.42)	9 (19.37)
Good/Fair – Poor	28 (15.49)	27 (13.44)	23 (16.59)	5 (12.54)	18 (12.60)	9 (15.39)
Poor – Poor	22 (14.30)	30 (15.11)	17 (12.66)	5 (24.90)	20 (14.05)	10 (18.46)
Number of absent workdays						
Overall	12.85 (1.07)	11.23 (0.79)	16.61 (1.40)	5.57 (1.30)	15.04 (1.09)	4.89 (0.94)
Self-rated health in 2011						
Good	7.80 (1.59)	5.98 (0.86)	10.96 (2.07)	3.67 (2.39)	9.73 (1.53)	1.85 (0.49)
Fair	10.94 (1.38)	10.49 (0.97)	14.32 (1.85)	4.88 (1.49)	13.14 (1.21)	5.58 (1.53)
Poor	25.48 (3.17)	27.86 (3.59)	27.04 (3.58)	17.30 (5.81)	29.60 (4.00)	20.59 (7.88)
Self-rated health in 2013						
Good	5.80 (1.43)	4.13 (0.76)	6.24 (1.28)	5.24 (2.81)	6.10 (1.23)	1.70 (0.73)
Fair	9.39 (1.04)	9.60 (1.01)	12.04 (1.32)	4.45 (1.38)	12.63 (1.37)	4.22 (1.24)
Poor	31.77 (3.88)	32.91 (3.49)	36.48 (4.57)	12.40 (4.54)	37.99 (3.90)	19.53 (6.17)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	7.58 (0.86)	6.59 (0.61)	9.98 (1.07)	3.94 (1.33)	9.16 (0.87)	2.97 (0.77)
Poor – Good/Fair	13.87 (2.93)	17.24 (4.25)	13.39 (3.29)	15.63 (6.63)	19.09 (4.89)	8.00 (6.54)
Good/Fair – Poor	26.42 (5.48)	25.88 (3.78)	32.98 (7.10)	9.40 (4.61)	31.75 (4.51)	12.29 (4.91)
Poor – Poor	37.47 (5.49)	43.92 (6.49)	39.49 (5.97)	20.69 (11.49)	46.87 (6.87)	34.21 (15.48)
Notes: the proportions in parentheses are weighted proportions; the means are weighted means, and standard errors of the mean are in parentheses.						

Table 3. Model parameters for work exit and absent workdays

Model[a]	Health Status[b]	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Probability of not working							
I	**2011**						
	Poor	0.744 (0.259)***	0.577 (0.253)**	0.655 (0.287)**	0.753 (0.546)	0.810 (0.296)***	0.281 (0.447)
	Fair	0.446 (0.156)***	0.306 (0.151)**	0.298 (0.182)	0.563 (0.305)*	0.300 (0.192)	0.251 (0.250)
II	**2013**						
	Poor	0.856 (0.248)***	1.197 (0.209)***	0.868 (0.257)***	0.201 (0.650)	1.371 (0.273)***	0.941 (0.362)***
	Fair	0.440 (0.153)***	0.405 (0.140)***	0.368 (0.176)**	0.285 (0.344)	0.378 (0.196)*	0.479 (0.227)**
III	**2011**						
	Poor	0.080 (0.399)	-0.754 (0.323)**	-0.275 (0.436)	1.167 (0.714)	-0.314 (0.418)	-0.582 (0.596)
	Fair	0.124 (0.214)	-0.322 (0.175)*	-0.142 (0.237)	0.707 (0.369)*	-0.226 (0.236)	-0.177 (0.315)
	2013						
	Poor	0.892 (0.390)**	1.566 (0.256)***	1.137 (0.366)***	-0.938 (0.929)	1.522 (0.359)***	1.053 (0.518)**
	Fair	0.441 (0.213)**	0.589 (0.163)***	0.502 (0.218)**	-0.327 (0.481)	0.468 (0.237)**	0.480 (0.294)
Number of absent workdays							
I	**2011**						
	Poor	101.39 (17.00)***	135.61 (13.50)***	105.66 (17.72)***	72.05 (40.43)*	131.60 (16.20)***	153.55 (25.85)***
	Fair	46.67 (10.19)***	65.60 (7.99)***	48.16 (10.79)***	24.87 (22.84)	64.12 (9.71)***	69.65 (14.15)***
II	**2013**						
	Poor	177.82 (18.25)***	184.16 (13.12)***	180.16 (17.14)***	153.31 (64.57)**	192.15 (15.60)***	174.71 (24.13)***
	Fair	84.04 (10.92)***	89.67 (7.96)***	90.05 (10.82)***	59.58 (34.34)*	93.38 (9.33)***	83.69 (14.83)***
III	**2011**						
	Poor	-21.25 (21.51)	63.11 (19.86)***	-25.76 (23.65)	-11.97 (40.38)	-30.74 (23.72)	1.32 (42.33)
	Fair	-11.23 (11.82)	25.95 (10.91)**	-14.23 (13.04)	-7.15 (22.66)	-20.81 (13.00)	-5.36 (21.21)
	2013						
	Poor	194.18 (22.24)***	113.03 (18.14)***	197.68 (21.14)***	185.77 (54.55)***	212.13 (20.91)***	179.81 (34.04)***
	Fair	92.12 (12.53)***	50.38 (10.19)***	98.41 (12.34)***	74.76 (29.12)**	103.91 (11.84)***	87.76 (19.02)***

[a]: Model I includes 2011 health status (two-year lagged) only; Model II includes 2013 heath status (concurrent) only; Model III includes both 2011 and 2013 health status.
[b]: In all models, the reference group for health status is Good.
* P≤0.1; ** P≤0.05; ***P≤0.01

Table 4. Model parameters for work exit and absent workdays

Model[a]	Change of Health Status[b]	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Probability of not working							
IV	**Poor–Poor**	0.732 (0.211)***	1.229 (0.209)***	0.779 (0.217)***	0.245 (0.656)	1.283 (0.249)***	1.399 (0.383)***
	Good/Fair–Poor	0.581 (0.173)***	0.906 (0.160)***	0.768 (0.175)***	-0.311 (0.489)	1.090 (0.194)***	0.826 (0.279)***
	Poor–Good/Fair	0.344 (0.159)**	0.541 (0.170)***	0.435 (0.172)**	-0.048 (0.388)	0.443 (0.207)**	1.090 (0.314)***
	Good/Fair–Good/Fair						
Number of absent workdays							
IV	**Poor–Poor**	102.27 (12.36)***	134.48 (11.12)***	113.19 (12.21)***	31.61 (42.13)	138.32 (12.64)***	143.26 (23.00)***
	Good/Fair–Poor	79.05 (9.94)***	94.48 (8.29)***	83.36 (9.87)***	28.37 (28.89)	102.46 (9.67)***	86.61 (15.40)***
	Poor–Good/Fair	45.30 (8.90)***	55.54 (7.75)***	39.42 (9.21)***	52.33 (22.68)**	58.09 (8.37)***	58.33 (19.49)***
	Good/Fair–Good/Fair						

[a]: Model IV includes the changes of health status from 2011 to 2013.
[b]: In all models, the reference group for health status is Good/Fair in 2011 to Good/Fair 2013.
* P≤0.1; ** P≤0.05; ***P≤0.01

Table 5. Expected probability of not working and expected number of absent workdays by the change of health status over time

Health Status (2011)	Health Status (2013)	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Probability of not working							
Poor	Poor	0.282	0.305	0.250	0.256	0.234	0.537
Good/Fair	Poor	0.235	0.207	0.247	0.117	0.180	0.318
Poor	Good/Fair	0.170	0.123	0.155	0.175	0.061	0.415
Good/Fair	Good/Fair	0.099	0.047	0.074	0.187	0.024	0.099
Number of absent workdays							
Poor	Poor	57.33	76.19	69.72	11.41	84.80	71.21
Good/Fair	Poor	41.58	46.70	47.86	10.53	56.78	30.74
Poor	Good/Fair	23.72	25.36	23.70	18.31	30.03	17.42
Good/Fair	Good/Fair	9.10	8.04	10.56	4.89	9.76	3.67

Appendix

1. Variable definition

Variables	Definition
Age	Continuous variable and measured in years
Education	Four categories: illiterate, lower than elementary school, elementary school graduate, and middle school or higher
Married	Married vs. not
Household expenditures monthly	Monthly household expenditures on food, utilities, household items, clothing, medical care, taxes, etc.
Self-rated Health Status	Three categories: good (reported health status equal to or better than good health), fair (reported health status as fair), and poor (reported health status equal to or worse than poor health)
Disable	Yes vs. no; where yes if having any of the five disabilities: physical disabilities, brain damage/mental retardation, vision problems, hearing problems, speech impediment
No. of chronic diseases (range 0-14)	Chronic diseases considered include 1.hypertension; 2.dyslipidemia; 3.diabetes; 4.cancer; 5.chronic lung disease; 6.liver disease; 7.heart problems; 8.stroke; 9.kidney disease; 10.stomach or other digestive disease; 11.emotional, nervous, or psychiatric problems; 12.memory-related disease; 13.arthritis or rheumatism; and 14.asthma.
Functional limitations (range 0-18)[1]	Functional limitations are assessed in three domains: 7 items measuring physical functions (1.running/jogging about 1 km; 2.getting up from a chair; 3.climbing several flights of stairs; 4.stooping, kneeling or crouching; 5.reaching or extending arms; 6.lifting or carrying over 5 kg; and 7.picking up a small coin), 6 items measuring basic activities of daily living (BADLs) (1.dressing; 2.bathing; 3.eating; 4.getting in/out of bed; 5.using the toilet; and 6.controlling urination and defecation), and 5 items measuring instrumental ADL (IADLs) (1.doing household chores; 2.preparing hot meals; 3.shopping for groceries; 4.managing money; and 5.taking medications) (Hu et al., 2015). Each item is measured using a 4-likert scale, "1= No, I don't have any difficulty", "2=I have difficulty but can still do it", "3= Yes, I have difficulty and need help" and "4= I can not do it". The functional limitations are scored as a total number of items with answers at scale 3 or 4 for functional limitations and at scale > 1 for BADL and ADL.

[1] Hu L, Lv X, Zhou S, *et al.* Socio-Demographic Determinants, Physical Health Status, and Depression Associated with Functional Limitations Among Older Chinese Adults. Ageing International 2015; 40: 311–326.

2. Econometric model specifications

We used the Model III, including both lagged and concurrent health status independently he model, as an example to show our model specifications.

Modeling work exit

We used Probit model for not working in 2013, and ordered Probit model for health status in 2011 and 2013. For each individual i, let y_i^w be labour force participation status observed in 2013, $\mathbf{x}_i$ be the vector of exogenous factors (i.e., age, education, marriage status, and log transformed expenditures in 2011), $\mathbf{z}_{11i}$ and $\mathbf{z}_{13i}$ be the vector of detailed health measures (disability condition, number of chronic diseases, the number of total functional limitations) in 2011 and 2013, respectively, and $\boldsymbol{H}_{11i}$ and $\boldsymbol{H}_{13i}$ be the SRH in 2011 and 2013, respectively. Then our models were specified as:

$$y_i^{w*} = \boldsymbol{H}'_{11i}\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{11i}} + \boldsymbol{H}'_{13i}\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{13i}} + \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{x}} + u_i^w \quad (1)$$

$$y_i^w = \begin{cases} Work, & y_i^{w*} < 0 \\ Not\ work, & y_i^{w*} \geq 0 \end{cases} \quad (2)$$

$$h_{11i}^{w*} = \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{x11i}} + \mathbf{z}'_{11i}\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{z11i}} + \varepsilon_{11i}^w \quad (3)$$

$$h_{13i}^{w*} = \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{x13i}} + \mathbf{z}'_{13i}\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{z13i}} + \varepsilon_{13i}^w \quad (4)$$

$$\boldsymbol{H}_{ki} = \begin{cases} Good, & if\ h_{ki}^{w*} \leq 0 \\ Fair, & if\ 0 < h_{ki}^{w*} \leq c_k^w \\ Poor, & if\ h_{ki}^{w*} > c_k^w \end{cases}, (k = 11, 13) \quad (5)$$

where $y_i^{w*}$and h_{ki}^{w*} are the latent variables for y_i^w and $\boldsymbol{H}_{ki}$, respectively, $(u^w, \varepsilon_{11}^w, \varepsilon_{13}^w)$ is independent of $(\mathbf{z}_{11}, \mathbf{z}_{13})$ and distributed as multivariate normal with mean zero and covariance matrix $\begin{pmatrix} 1 & \rho_1 & \rho_2 \\ \rho_1 & 1 & \rho_3 \\ \rho_2 & \rho_3 & 1 \end{pmatrix}$. The full information likelihood based on the joint distribution of $(y^w, \boldsymbol{H}_{11}, \boldsymbol{H}_{13})$ given $\mathbf{x}$ and $\mathbf{z}$ was used for estimating all parameters in structure equations (1) –

(5) simultaneously, which was described as the full information maximum likelihood (FIML) estimation method in Wooldridge (2002). As pointed by Woodridge (2002), with these models, the average probability of not working for given **x**, **z,** $\boldsymbol{H}_{11}$, and $\boldsymbol{H}_{13}$ can be estimated by

$$P(y^w = \text{not work}) = \boldsymbol{\Phi}(\boldsymbol{H}'_{11i}\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{11i}} + \boldsymbol{H}'_{11i}\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{13i}} + \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{w}}_{\boldsymbol{x}}) \qquad (6).$$

where $\boldsymbol{\Phi}$ is the cumulative density function of the standard normal distribution.

Modeling for number of absent workdays due to health problems

Same method was used to address the endogeneity of SRH for absent workdays. While we used the Probit model for not working, we employed the Tobit model for number of absent workdays, and the ordered Probit models for health status in 2011 and 2013. Tobit regression was used for the number of absent workdays due to health problems, as its value was truncated at zero with a large number of observations at the zero point. Similar to the labour force participation model, the number of absent workday models were specified as

$$y_i^{m*} = \boldsymbol{H}'_{11i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{11i}} + \boldsymbol{H}'_{13i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{13i}} + \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{x}} + u_i^m \qquad (7)$$

$$y_i^m = \begin{cases} y_i^{m*}, & y_i^{m*} > 0 \\ 0, & y_i^{m*} \le 0 \end{cases} \qquad (8)$$

$$h_{11i}^{m*} = \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{x11i}} + \mathbf{z}'_{11i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{z11i}} + \varepsilon_{11i}^m \qquad (9)$$

$$h_{13i}^{m*} = \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{x13i}} + \mathbf{z}'_{13i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{z13i}} + \varepsilon_{13i}^m \qquad (10)$$

$$H_{ki} = \begin{cases} Good, & if\ h_{ki}^{m*} \le 0 \\ Fair, & if\ 0 < h_{ki}^{m*} \le c_k^m, \\ Poor, & if\ h_{ki}^{m*} > c_k^m \end{cases} \qquad (k = 11, 13) \qquad (11)$$

where y^m denotes the number of absent workdays, $(u^m, \varepsilon_{11}^m, \varepsilon_{13}^m)$ is independent of $(\mathbf{z}_{11}, \mathbf{z}_{13})$ and distributed as multivariate normal with mean zero and covariance matrix

$$\begin{pmatrix} \sigma^2 & \rho_{1m} & \rho_{2m} \\ \rho_{1m} & 1 & \rho_{3m} \\ \rho_{2m} & \rho_{3m} & 1 \end{pmatrix}.$$

For given $\mathbf{x}$, $\mathbf{z}$, $\boldsymbol{H}_{11}$, and $\boldsymbol{H}_{13}$, the expectation of y^m can be estimated by

$$E(y^m|\mathbf{x}, \boldsymbol{H}_{11}, \boldsymbol{H}_{13}) = P(y^m > 0|\mathbf{x}, \boldsymbol{H}_{11}, \boldsymbol{H}_{13}) \cdot E(y^m|\mathbf{x}, \boldsymbol{H}_{11}, \boldsymbol{H}_{13}, y > 0)$$

$$= \boldsymbol{\Phi}((\boldsymbol{H}'_{11i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\mathbf{11}\boldsymbol{i}} + \boldsymbol{H}'_{13i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\mathbf{13}\boldsymbol{i}} + \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{x}})/\sigma)(\boldsymbol{H}'_{11i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\mathbf{11}\boldsymbol{i}} + \boldsymbol{H}'_{13i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\mathbf{13}\boldsymbol{i}} + \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{x}})$$

$$+ \sigma\boldsymbol{\phi}((\boldsymbol{H}'_{11i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\mathbf{11}\boldsymbol{i}} + \boldsymbol{H}'_{13i}\boldsymbol{\beta}^{\boldsymbol{m}}_{\mathbf{13}\boldsymbol{i}} + \mathbf{x}'_i\boldsymbol{\beta}^{\boldsymbol{m}}_{\boldsymbol{x}})/\sigma) \qquad (12)$$

where $\boldsymbol{\phi}$ and $\boldsymbol{\Phi}$ are the density function and the cumulative density function of the standard normal distribution, respectively.

3. Sensitivity analyses

Analysis results without considering weights

Table 1. Demographic and health characteristics in 2011, mean (Standard Deviation) or N (%) (No weight)

Variables	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Sample N	1652	2680	1256	396	1874	806
Age, years	48.12 (2.06)	51.25 (3.77)	48.21 (2.07)	47.86 (1.99)	51.39 (3.81)	50.93 (3.67)
Education						
Illiterate	344 (20.82)	158 (5.90)	319 (25.40)	25 (6.31)	135 (7.20)	23 (2.85)
Lower than elementary school	250 (15.13)	337 (12.57)	218 (17.36)	32 (8.08)	273 (14.57)	64 (7.94)
Elementary school	369 (22.34)	574 (21.42)	308 (24.52)	61 (15.40)	448 (23.91)	126 (15.63)
Middle school or higher	689 (41.71)	1611 (60.11)	411 (32.72)	278 (70.20)	1018 (54.32)	593 (73.57)
Married	1587 (96.07)	2573 (96.01)	1214 (96.66)	373 (94.19)	1788 (95.41)	785 (97.39)
Household expenditures monthly	2403.42 (3072.13)	2472.03 (3887.91)	2041.30 (2555.22)	3551.97 (4118.78)	2005.07 (2631.23)	3557.75 (5701.61)
Health Status						
Good	424 (25.67)	884 (32.99)	284 (22.61)	140 (35.35)	544 (29.03)	340 (42.18)
Fair	872 (52.78)	1372 (51.19)	665 (52.95)	207 (52.27)	982 (52.40)	390 (48.39)
Poor	356 (21.55)	424 (15.82)	307 (24.44)	49 (12.37)	348 (18.57)	76 (9.43)
Disable	148 (8.96)	315 (11.75)	124 (9.87)	24 (6.06)	251 (13.39)	64 (7.94)
No. of chronic diseases (range 0-14)	1.06 (1.23)	1.03 (1.20)	1.12 (1.27)	0.84 (1.06)	1.07 (1.21)	0.93 (1.16)
Functional limitations (range 0-18)	0.53 (1.42)	0.36 (1.12)	0.63 (1.50)	0.24 (1.09)	0.44 (1.23)	0.19 (0.78)

Table 2. Work exit (N (%) of not working) and number of absent workdays (Mean (SE)) in 2013 by self-rated health (No Weight)

	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Probability of not working						
Overall	202 (12.23)	188 (7.01)	129 (10.27)	73 (18.43)	85 (4.54)	103 (12.78)
Self-rated health in 2011						
Good	52 (12.26)	50 (5.66)	28 (9.86)	24 (17.14)	18 (3.31)	32 (9.41)
Fair	106 (12.16)	90 (6.56)	67 (10.08)	39 (18.84)	38 (3.87)	52 (13.33)
Poor	44 (12.36)	48 (11.32)	34 (11.07)	10 (20.41)	29 (8.33)	19 (25.00)
Self-rated health in 2013						
Good	46 (12.17)	46 (5.87)	21 (8.30)	25 (20.00)	14 (2.81)	32 (11.23)
Fair	106 (11.61)	85 (5.77)	68 (9.76)	38 (17.59)	33 (3.18)	52 (11.93)
Poor	50 (13.85)	57 (13.48)	40 (13.07)	10 (18.18)	38 (11.24)	19 (22.35)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	130 (11.61)	113 (5.61)	72 (8.93)	58 (18.47)	38 (2.85)	75 (11.05)
Poor – Good/Fair	22 (12.87)	18 (7.38)	17 (11.81)	5 (18.52)	9 (4.46)	9 (21.43)
Good/Fair – Poor	28 (15.91)	27 (11.11)	23 (16.08)	5 (15.15)	18 (9.38)	9 (17.65)
Poor – Poor	22 (11.89)	30 (16.67)	17 (10.43)	5 (22.73)	20 (13.70)	10 (29.41)
Number of absent workdays						
Overall	14.18 (1.02)	12.02 (0.75)	16.19 (1.24)	7.21 (1.46)	14.68 (0.98)	5.26 (0.90)
Self-rated health in 2011						
Good	8.05 (1.47)	6.94 (1.01)	10.00 (1.96)	3.75 (1.82)	10.04 (1.57)	1.68 (0.38)
Fair	12.18 (1.23)	10.66 (0.85)	13.82 (1.48)	6.40 (1.86)	12.53 (1.08)	5.44 (1.13)
Poor	26.76 (3.18)	28.08 (3.25)	27.52 (3.49)	21.41 (7.09)	28.83 (3.54)	23.85 (8.32)
Self-rated health in 2013						
Good	6.63 (1.35)	4.74 (0.95)	7.31 (1.69)	5.03 (2.15)	6.39 (1.39)	1.62 (0.68)
Fair	10.64 (1.07)	9.51 (0.73)	11.77 (1.26)	6.70 (1.91)	11.54 (0.94)	4.18 (0.89)
Poor	32.14 (3.50)	36.69 (3.63)	35.11 (3.95)	14.38 (5.60)	39.10 (4.12)	25.84 (7.21)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	8.63 (0.85)	7.00 (0.56)	9.93 (1.05)	4.93 (1.37)	8.90 (0.77)	2.92 (0.56)
Poor – Good/Fair	14.90 (3.16)	14.97 (2.73)	14.08 (3.43)	19.50 (8.33)	16.27 (3.04)	7.28 (5.66)
Good/Fair – Poor	25.67 (4.48)	28.71 (3.87)	29.57 (5.35)	8.93 (4.91)	32.27 (4.62)	14.02 (4.99)
Poor – Poor	38.30 (5.31)	48.42 (6.82)	39.87 (5.72)	24.20 (12.87)	48.71 (7.44)	46.91 (17.37)

Table 3. Model parameters for labor force participation status and absent workdays (No weight)

Model[a]	Health Status[b]	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Probability of not working							
I	**2011**						
	Poor	0.817 (0.249)***	0.834 (0.252)***	0.817 (0.290)***	0.734 (0.470)	0.835 (0.318)***	0.837 (0.395)**
	Fair	0.439 (0.154)***	0.310 (0.157)**	0.430 (0.183)**	0.411 (0.283)	0.294 (0.206)	0.297 (0.233)
II	**2013**						
	Poor	0.826 (0.234)***	1.388 (0.196)***	1.060 (0.248)***	-0.256 (0.595)	1.397 (0.257)***	1.415 (0.311)***
	Fair	0.387 (0.150)***	0.508 (0.135)***	0.533 (0.169)***	-0.200 (0.330)	0.476 (0.188)**	0.632 (0.200)***
III	**2011**						
	Poor	0.207 (0.383)	-0.508 (0.343)	-0.238 (0.439)	1.536 (0.529)***	-0.448 (0.452)	-0.277 (0.500)
	Fair	0.143 (0.209)	-0.311 (0.186)*	-0.088 (0.241)	0.789 (0.288)***	-0.316 (0.253)	-0.199 (0.261)
	2013						
	Poor	0.779 (0.361)**	1.622 (0.257)***	1.283 (0.348)***	-1.797 (0.838)**	1.586 (0.339)***	1.488 (0.437)***
	Fair	0.356 (0.202)*	0.642 (0.164)***	0.637 (0.208)***	-0.948 (0.417)**	0.591 (0.227)***	0.671 (0.254)***
Number of absent workdays							
I	**2011**						
	Poor	114.94 (16.76)***	149.06 (14.45)***	119.03 (18.66)***	77.31 (35.92)**	148.62 (17.19)***	158.01 (27.55)***
	Fair	52.73 (10.17)***	70.31 (8.49)***	54.58 (11.34)***	29.71 (21.53)	69.92 (10.14)***	70.00 (15.36)***
II	**2013**						
	Poor	170.10 (16.48)***	194.22 (13.41)***	175.28 (17.40)***	135.55 (54.26)**	196.80 (15.43)***	191.01 (27.43)***
	Fair	82.64 (10.14)***	91.81 (8.10)***	86.22 (10.95)***	59.99 (29.46)**	94.44 (9.35)***	83.69 (16.09)***
III	**2011**						
	Poor	4.98 (21.73)	68.85 (20.60)***	-4.79 (24.41)	58.74 (74.65)	-24.95 (25.26)	47.74 (35.46)
	Fair	0.02 (12.12)	28.09 (11.23)**	-4.93 (13.64)	22.52 (37.08)	-19.70 (13.76)	19.61 (18.73)
	2013						
	Poor	168.47 (21.08)***	129.32 (18.34)***	179.58 (21.62)***	37.49 (126.79)	214.96 (20.61)***	166.43 (35.55)***
	Fair	82.11 (12.02)***	56.00 (10.33)***	88.46 (12.57)***	10.58 (64.63)	104.29 (11.71)***	72.10 (19.78)***

[a]: Model I includes 2011 health status (two-year lagged) only; Model II includes 2013 heath status (concurrent) only; Model III includes both 2011 and 2013 health status.
[b]: In all models, the reference group for health status is Good.
* P≤0.1; ** P≤0.05; ***P≤0.01

Table 4. Model parameters for work exit and absent workdays (No weight)

Model[a]	Change of Health Status[b]	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Probability of not working							
IV	**Poor–Poor**	0.749 (0.210)***	1.393 (0.193)***	0.830 (0.225)***	0.034 (0.545)	1.323 (0.238)***	1.624 (0.315)***
	Good/Fair–Poor	0.697 (0.167)***	0.964 (0.164)***	0.838 (0.177)***	-0.235 (0.432)	0.968 (0.197)***	1.074 (0.279)***
	Poor–Good/Fair	0.454 (0.156)***	0.647 (0.164)***	0.541 (0.172)***	-0.076 (0.348)	0.471 (0.205)**	1.190 (0.279)***
	Good/Fair–Good/Fair						
Number of absent workdays							
IV	**Poor–Poor**	109.00 (12.16)***	142.22 (11.03)***	113.77 (12.92)***	46.85 (38.53)	142.74 (12.57)***	156.61 (23.29)***
	Good/Fair–Poor	75.06 (9.88)***	101.54 (8.50)***	77.80 (10.43)***	27.70 (30.08)	104.03 (9.62)***	98.77 (18.18)***
	Poor–Good/Fair	48.85 (8.95)***	57.28 (7.78)***	41.97 (9.73)***	60.95 (22.37)***	58.95 (8.56)***	59.80 (19.95)***
	Good/Fair–Good/Fair						

[a]: Model IV includes the changes of health status from 2011 to 2013.
[b]: In all models, the reference group for health status is Good/Fair in 2011 to Good/Fair 2013.
* P≤0.1; ** P≤0.05; ***P≤0.01

Table 5. Expected probability of not working and expected number of absent workdays by the change of health status over time (No weight)

Health Status (2011)	Health Status (2013)	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Probability of not working							
Poor	Poor	0.275	0.349	0.254	0.200	0.248	0.616
Good/Fair	Poor	0.258	0.215	0.256	0.134	0.152	0.402
Poor	Good/Fair	0.188	0.139	0.171	0.171	0.064	0.447
Good/Fair	Good/Fair	0.092	0.046	0.068	0.190	0.024	0.097
Number of absent workdays							
Poor	Poor	61.51	80.43	68.98	18.25	87.14	78.82
Good/Fair	Poor	38.87	50.01	43.60	11.86	56.91	36.01
Poor	Good/Fair	25.37	25.58	24.65	24.29	29.98	17.26
Good/Fair	Good/Fair	9.42	8.04	10.66	5.77	9.70	3.71

Analysis results without age restriction for farmers

Table 1. Demographic and health characteristics in 2011 (No restriction)

Variables	Female farmers (3)	Female farmers without restriction (3)	Male Farmers (5)	Male farmers without restriction (5)
Sample N	1256	3625	1874	3839
Age, years	48.16 (0.06)	56.35 (0.16)	51.28 (0.1)	58.09 (0.17)
Education				
Illiterate	319 (26.01)	1640 (45.93)	135 (7.46)	520 (13.21)
Lower than elementary school	218 (17.32)	719 (19.36)	273 (14.93)	784 (21.00)
Elementary school	308 (24.73)	666 (18.45)	448 (24.31)	1148 (30.31)
Middle school or higher	411 (31.93)	600 (16.26)	1018 (53.3)	1387 (35.48)
Married	1214 (96.3)	3309 (90.58)	1788 (94.81)	3555 (92.10)
Household expenditures monthly	2120.78 (80.98)	1805.23 (43.29)	2104.85 (86.05)	1850.99 (51.04)
Self-rated health				
Good	284 (22.94)	727 (20.46)	544 (30.82)	977 (26.97)
Fair	665 (52.12)	1833 (50.54)	982 (50.28)	1991 (50.76)
Poor	307 (24.95)	1065 (29.01)	348 (18.9)	871 (22.26)
Disable	124 (10.12)	532 (14.20)	251 (13.29)	700 (17.51)
No. of chronic diseases (range 0-14)	1.1 (0.04)	1.30 (0.02)	1.07 (0.03)	1.22 (0.02)
Functional limitations (range 0-18)	0.63 (0.05)	1.00 (0.04)	0.44 (0.03)	0.65 (0.03)
Notes: the proportions in parentheses are weighted proportions; the means are weighted means, and standard errors of the mean are in parentheses.				

Table 2. Model parameters for work exit and absent workdays (No restriction)

Model[a]	Health Status[b]	Female farmers (3)	Female farmers without restriction (3)	Male Farmers (5)	Male farmers without restriction (5)
Probability of not working					
I	**2011**				
	Poor	0.655 (0.287)**	0.597 (0.159)***	0.810 (0.296)***	0.898 (0.159)***
	Fair	0.298 (0.182)	0.274 (0.102)***	0.300 (0.192)	0.526 (0.102)***
II	**2013**				
	Poor	0.868 (0.257)***	1.084 (0.140)***	1.371 (0.273)***	1.473 (0.146)***
	Fair	0.368 (0.176)**	0.429 (0.097)***	0.378 (0.196)*	0.619 (0.101)***
III	**2011**				
	Poor	-0.275 (0.436)	-0.476 (0.210)**	-0.314 (0.418)	-0.237 (0.220)
	Fair	-0.142 (0.237)	-0.230 (0.118)*	-0.226 (0.236)	-0.000 (0.126)
	2013				
	Poor	1.137 (0.366)***	1.430 (0.175)***	1.522 (0.359)***	1.694 (0.190)***
	Fair	0.502 (0.218)**	0.604 (0.111)***	0.468 (0.237)**	0.713 (0.121)***
Number of absent workdays					
I	**2011**				
	Poor	105.66 (17.72)***	135.72 (11.81)***	131.60 (16.20)***	118.97 (10.91)***
	Fair	48.16 (10.79)***	64.21 (7.38)***	64.12 (9.71)***	52.93 (6.68)***
II	**2013**				
	Poor	180.16 (17.14)***	198.82 (11.95)***	192.15 (15.60)***	190.71 (11.23)***
	Fair	90.05 (10.82)***	97.39 (7.53)***	93.38 (9.33)***	91.45 (6.78)***
III	**2011**				
	Poor	-25.76 (23.65)	63.67 (14.84)***	-30.74 (23.72)	-15.89 (14.35)
	Fair	-14.23 (13.04)	30.38 (8.51)***	-20.81 (13.00)	-14.75 (8.04)*
	2013				
	Poor	197.68 (21.14)***	152.64 (14.69)***	212.13 (20.91)***	206.01 (14.33)***
	Fair	98.41 (12.34)***	72.38 (8.61)***	103.91 (11.84)***	100.17 (8.20)***

[a]: Model I includes 2011 health status (two-year lagged) only; Model II includes 2013 heath status (concurrent) only; Model III includes both 2011 and 2013 health status.
[b]: In all models, the reference group for health status is Good.
* P≤0.1; ** P≤0.05; ***P≤0.01

Table 3. Model parameters for work exit and absent workdays (No restriction)

Model[a]	Change of Health Status[b]	Female farmers (3)	Female farmers without restriction (3)	Male Farmers (5)	Male farmers without restriction (5)
Probability of not working					
IV	**Poor–Poor**	0.779 (0.217)***	1.059 (0.115)***	1.283 (0.249)***	1.103 (0.130)***
	Good/Fair–Poor	0.768 (0.175)***	0.815 (0.096)***	1.090 (0.194)***	1.076 (0.104)***
	Poor–Good/Fair	0.435 (0.172)**	0.399 (0.093)***	0.443 (0.207)**	0.372 (0.105)***
	Good/Fair–Good/Fair				
Number of absent workdays					
IV	**Poor–Poor**	113.19 (12.21)***	139.23 (8.68)***	138.32 (12.64)***	138.04 (9.10)***
	Good/Fair–Poor	83.36 (9.87)***	96.37 (7.16)***	102.46 (9.67)***	107.34 (7.34)***
	Poor–Good/Fair	39.42 (9.21)***	57.35 (6.23)***	58.09 (8.37)***	64.14 (6.19)***
	Good/Fair–Good/Fair				

[a]: Model IV includes the changes of health status from 2011 to 2013.
[b]: In all models, the reference group for health status is Good/Fair in 2011 to Good/Fair 2013.
* P≤0.1; ** P≤0.05; ***P≤0.01

4. Goodness-of-fit measures

From the ordered Probit model for 2011 self-rated health status

Measures	Formula	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Likelihood Ratio (R)	2 * (LogL - LogL0)	305.94	424.91	250.77	40.31	268.59	131.75
Upper Bound of R (U)	- 2 * LogL0	3,082.98	4,333.81	2,654.50	508.99	3,482.89	937.43
Aldrich-Nelson	R / (R+N)	0.16	0.14	0.17	0.09	0.13	0.14
Cragg-Uhler 1	1 - exp(-R/N)	0.17	0.15	0.18	0.10	0.13	0.15
Cragg-Uhler 2	(1-exp(-R/N)) / (1-exp(-U/N))	0.20	0.18	0.21	0.13	0.16	0.22
Estrella	1 - (1-R/U)^(U/N)	0.18	0.15	0.19	0.10	0.14	0.16
Adjusted Estrella	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)	0.17	0.15	0.18	0.07	0.13	0.15
McFadden's LRI	R / U	0.10	0.10	0.09	0.08	0.08	0.14
Veall-Zimmermann	(R * (U+N)) / (U * (R+N))	0.24	0.22	0.25	0.16	0.19	0.26
McKelvey-Zavoina		0.23	0.20	0.24	0.14	0.17	0.23

From the ordered Probit model for 2013 self-rated health status

Measures	Formula	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Likelihood Ratio (R)	2 * (LogL - LogL0)	413.76	601.28	352.19	56.32	425.28	162.02
Upper Bound of R (U)	- 2 * LogL0	3,082.98	4,333.81	2,654.50	508.99	3,482.89	937.43
Aldrich-Nelson	R / (R+N)	0.20	0.18	0.22	0.12	0.18	0.17
Cragg-Uhler 1	1 - exp(-R/N)	0.22	0.20	0.24	0.13	0.20	0.18
Cragg-Uhler 2	(1-exp(-R/N)) / (1-exp(-U/N))	0.26	0.25	0.28	0.18	0.24	0.26
Estrella	1 - (1-R/U)^(U/N)	0.24	0.21	0.26	0.14	0.21	0.20
Adjusted Estrella	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)	0.23	0.21	0.25	0.11	0.21	0.18
McFadden's LRI	R / U	0.13	0.14	0.13	0.11	0.12	0.17
Veall-Zimmermann	(R * (U+N)) / (U * (R+N))	0.31	0.30	0.32	0.22	0.28	0.31
McKelvey-Zavoina		0.29	0.28	0.32	0.18	0.26	0.29

5. Akaike information criterion

Outcome	Model[a]	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Not working	I	4233	6158	3201	1025	4198	1935
Not working	II	4159	5965	3054	1060	3967	1921
Not working	III	6951	10532	5277	1673	7296	3214
Absent workdays	I	8792	14094	7877	1375	11848	2856
Absent workdays	II	8681	13769	7665	1414	11504	2813
Absent workdays	III	11045	17956	9587	1891	14593	3922

[a]: Model I includes 2011 health status (two-year lagged) only; Model II includes 2013 heath status (concurrent) only; Model III includes both 2011 and 2013 health status.

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The effects of health status on work exit and absenteeism among the older working population in China

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Abstract

Objectives: We used the first two-wave data from the China Health and Retirement Longitudinal Study (CHARLS) to analyze the effects of health status on work exit and absenteeism among the older working population in China.

Design: Secondary analysis of a cohort sample.

Setting and participants: Community samples who engaged in either agricultural or non-agriculture work or both in the 2011 wave of CHARLS and whose age was 45-55 years for women or 45-60 years for men in the 2013 wave.

Outcome measures: We measured two outcomes: work exit and number of absent workdays due to health problems in 2013. To address the problems of measurement error of self-rated health status, we used disability condition, number of chronic diseases and functional limitation to construct an index of health. We divided the sample into four groups according to gender and work types (farmers who conducted any agricultural work in 2011 versus non-farmers who conducted non-agricultural work only) and conducted analyses separately.

Results: Farmers (11.0% for women and 4.9% for men) were less likely to exit from work than non-farmers (18.5% and 12.0%, respectively) but took more absent workdays (16.6 days for women and 15.0 days for men) than non-farmers (5.6 and 4.9). Poor health status in 2011 was significantly associated with the work exit in 2013 of female and male farmers but not non-farmers. Older workers (except female non-farmers) with persistently poor health or recent health deterioration over time were significantly more likely to stop working or missed more workdays than those with persistently good health.

Conclusions: The effects of health status differ by both gender and work types. Poor two-year lagged health leads to work exit of female and male farmers. Persistently poor health or recent

health deterioration over time is most detrimental among all older Chinese workers except female non-farmers.

Strengths and limitations of this study

- We analyzed the effects of the lagged health status and the evolution of health status over time on work exit and absenteeism among the older working population in China.
- We measured two outcomes: work exit and the number of absent workdays due to health problems among those who remained working.
- To address the problems of measurement error of self-rated health status, we used three detailed health measures to construct an index of health in our analyses.
- We only selected working population in 2011 which might underestimate the effect of health status.

Keywords: Health status; Work exit and absenteeism; Older working population; China

Introduction

China has become one of the fastest ageing countries in the world.[1] The number of people in labour force (aged 18-64 years) is expected to decline by approximately 140 million in 2050 even under the current universal two-child policy.[2] The rapid growth of the older population and shrinking labour force raise many problems in Chinese society. One of the prominent problems is a possible threat to the stability and sustainability of the current social pension system of China. The shrinking labour force will contribute less to the retirement income system and an increasing aged population will be eligible to receive retirement pensions. Therefore the combination of the two trends could significantly impact economic growth adversely and cause the pension fund to become bankrupt.

Currently, China's labour market has shown the following two characteristics. On one hand, the employment rate among older population in the urban area (mainly conducting non-agricultural work) is very low, it only reaches 40% among people between 50 and 59, and this rate decreases further to about 20% for those aged 60-64.[3] This might be due to the official mandatory retirement policies implemented in the urban formal sectors.[4] Specifically, the retirement age for men is 60 years and for women, it is 55 for civil servants and employees for state enterprises, and 50 for others. On the other hand, the employment rate among older population in the rural area (mainly conducting agricultural work) is very high, most people still work between 65 and 69, and by the age of 80, the employment rate is still above 20%.[3] This divergence of employment for the urban and rural areas is mainly due to the fact that the retirement policy, the pension program and unemployment insurance program are limited only to the urban formal sectors in China but not to the rural population. Considering that the older population has become or will become the main component of labour force in China, it is crucial to keep them active and productive in the labour

market to maintain sufficient labour supply and contain the increasing national spending on income support.

Labour market status are affected by many factors, among which the influence of health on labour supply has attracted more and more attention. Specifically, people would have to stop working due to their poor health status or frequently take sick leaves while remaining working. It is important and necessary to study the effect of health status on work exit and absenteeism among the older working people for the following two reasons. First, it helps policy makers better understand the impact of health on labor market activities and therefore they will be able to develop appropriate policies to encourage older working people to not only remain active in the labour market but also remain productive. Second, it helps policy makers better understand the consequence of poor health, which includes not only the higher healthcare expenditures but also the productivity losses attributable to work exit and absenteeism.

There is a vast literature that demonstrates poor health has a significant impact on work exit in the developed countries especially among older population. In these economic and epidemiological studies, poor health has been measured by self-rated health (SRH),[5-13] chronic diseases such as depression,[14] rheumatoid arthritis,[15] diabetes,[16] cancer,[17] and functional limitations.[18] Many studies have also shown the impact of one specific disease on the number of absent workdays among people with the disease.[19-25] However, worldwide, there are only a few studies from the developed countries that measure the number of absent workdays in the general population due to a lack of data.[26-30] Most studies to date have focused on either comparing the incremental effects of different chronic diseases on absent workdays or estimating the incremental productivity loss

due to different chronic diseases.[26-31] Overall, there are few studies analyzing the effect of health on work exit or absenteeism in the developing countries,[32] especially among older working population.

In addition, most of the previous studies have examined the static relationship between health and work exit. However, the relationship can be a dynamic process. Studies have shown that not only the current health status but also the previous health status affect decisions concerning work exit.[9,10] Therefore, the impact of persistently poor health might be different from that of recent health deterioration. To fill the literature gap, this present paper was to examine the effects of health status on work exit and absenteeism among the older working population in China. Specifically, we measured the impact of previous health status and the change of health status over time on work exit and the number of absent workdays due to the health problems among the older people who were previously working. Our hypotheses were: 1) those with poorer previous health status were expected to be more likely to exit from work or missed more workdays; 2) those with persistently poor health were expected to be most likely to exit from work and had the highest number of absent workdays.

METHODS

Data and study population

The data used in the paper were drawn from the first two waves (2011 and 2013) of the China Health and Retirement Longitudinal Study (CHARLS) survey in China. The details of the survey can be found in Zhao *et al*.[33] Generally speaking, CHARLS is designed in the similar way to the US Health and Retirement Study as a broad-purposed social science and health survey of people

aged 45 or older and their spouses in China. It is a high-quality survey of nationally representative sample of Chinese residents. The national baseline survey for CHARLS was conducted between June 2011 and March 2012 and the respondents are followed every 2 years, using a face-to-face computer-assisted personal interview (CAPI). Samples were chosen through multistage probability sampling. In the first stage, 150 county-level units were randomly chosen with a probability proportional-to-size sampling technique from a sampling frame containing all county-level units with the exception of Tibet. The sample was stratified by region and within region by urban districts or rural counties and per capita statistics on gross domestic product. The final sample of 150 counties fell within 28 provinces. After excluding empty or non-resident dwellings, 12,740 households were age-eligible for CHARLS. Final CAPI interviews were conducted on 10,257 households, which included 17,708 individual participants. The response rate of the survey was 80.5%. Of the 19.5% rate of nonresponse, 8.8% was due to refusal to respond, 8.2% to unable to contact sample residents, and 2.0% to other reasons. The survey contains detailed information on individual and household characteristics, such as individual demographics, work activities, health conditions, health services utilization and insurance, physical measurements, and household income, expenditure, and assets.

Our study population was based on the CHARLS participants who engaged in either agricultural or non-agriculture work or both in 2011 and whose age was between 45 and 55 years for women or between 45 and 60 years for men in 2013 (n = 4,683). The age restriction was chosen according to the legal retirement age typically for those who are employed in the urban formal sectors in China. Although retirement age policy does not apply to the rural population, for comparison purpose, we chose the same age bands for participants who engaged in the agricultural job. We

further restricted our study sample to those without missing data on labour participation status and other explanatory variables. As a result, our final sample used for analyzing the effect of health status on work exit was 4,332. Among them, 3,942 individuals were still working in 2013 and eligible for the questions on number of absent workdays due to health problems. After removing sample with missing value on number of absent workdays, 3,846 individuals were used for analyzing the effect of health status on number of absent workdays.

Ethics approval for this study was not required because it was based exclusively on the publicly available data, CHARLS, and the study subjects were not directly approached.

Measures

Measurement of work exit and absenteeism

In the present paper, we measured two outcomes: work exit and the number of absent workdays due to health problems in 2013. Work exit status was determined by a series of questions in CHARLS (see the Appendix). An individual was considered as "working" if he or she engaged in agricultural work (including farming, forestry, fishing, and husbandry for his or her own family or others) for more than 10 days in the past year, or worked for at least one hour last week (such as earning a wage, running their own business and unpaid family business work), or was on leave but expected to go back or still received salary. Otherwise, an individual was considered as "not working". Since our study population was the CHARLS participants who were "working" in 2011, "not working" in 2013 was referred to as work exit.

The number of absent workdays due to health problems was measured based on the question, "How many days of work did you miss last year due to health problems?" for those who were still working in 2013, i.e., those who engaged in household agricultural work, being employed, or in non-farm self-employed and unpaid family business.

Measurement of health and other controls

SRH has been used extensively in epidemiological and economic studies not only as a measure of population health but also as a predictor of mortality, morbidity, health care utilization and work exit.[5, 8, 9, 12, 34-37] To be consistent with literature, we used SRH as our main health measure. The SRH (5-point Likert scale) in 2011 and 2013 were categorized into: good (reported good health or better than good health), fair (reported fair health), and poor (reported poor health or worth than poor health), respectively. The change of health status from 2011 to 2013 was defined by four categories: poor in 2011 to poor 2013, good/fair 2011 to poor 2013, poor 2011 to good/fair 2013, good/fair 2011 to good/fair 2013.

Other detailed health measures were used to construct an index of health to address the endogeneity and measurement error issues of the SRH, which was described in the Econometric models section. These measures included disability condition, number of chronic diseases, and functional limitations. Other control variables included age, education (illiterate, lower than elementary school, elementary school graduate, and middle school or higher), marriage status (married vs. not), and monthly household expenditures on food, utilities, household items, clothing, medical care, taxes, *etc*. The detailed definition of the health-related and control variables are presented in the Appendix.

Patient and public involvement

No patients were involved in the development of research question, the outcome measures, the design or implementation of the study. There are no plans about dissemination of the results.

Econometric models

There are a number of potential problems with the SRH. First, there might exist reverse causality between health and labour market status.[38, 39] To address this, we measured the impact of health status before work exit on work exit (i.e., the impact of health status in 2011 on work exit in 2013) to avoid the reverse causality. Second, the SRH may also suffer "justification bias", that is, an individual could justify his or her work exit by reporting worse health status than his or her true health status.[40] Third, due to individual heterogeneity, the SRH measure might not be comparable across respondents, which means there may also be measurement error problem.

To address the potential endogeneity and measurement error of the SRH, we followed Bound *et. al.*(1999)[9] and used the latent variable model , which is analogous to using the three detailed health measures (i.e., disability condition, number of chronic diseases, and functional limitations) to construct an index of health.[9, 10, 38] Specifically, we used ordered Probit model for the SRH in 2011 (H_{11}) and the change of SRH from 2011 to 2013. We carried out the full information maximum likelihood estimation method using SAS QLIM procedure.[41] A number of goodness-of-fit measures (including different Pseudo R-squared) for the ordered Probit model for the SRH were provided in the Appendix to show how well the three detailed measures predict SRH.

Two different model specifications were used: Model I. to examine the effect of lagged health status by including H_{11} in the model; Model II. to examine the effect of change in health status by including the change of SRH from 2011 to 2013 in the model. The specific model specifications were presented in the Appendix. All analyses were weighted using the individual longitudinal weights provided by CHARLS.

Similar method was used for absent workdays. We employed the Tobit model for the number of absent workdays and the ordered Probit models for the SRH in 2011 and the change of SRH. Tobit regression was used for the number of absent workdays due to health problems, as its value was truncated at zero with a large number of observations at the zero point.

Considering the gender difference in health and labour force participation,[5, 9, 12] the recommendation of gender-disaggregated analysis,[42-44] and the difference in population and polices between rural and urban areas mentioned above, we divided our sample into four separate groups according to gender and working types in 2011: female farmers (i.e., any agricultural work), female non-farmers (non-agricultural work only), male farmers, and male non-farmers.

Interpreting estimated health coefficients

It is difficult to interpret the magnitude of the estimated health coefficients in Probit model for work exit and Tobit model for the number of absent workdays. To help the interpretation, we presented the expected probability of work exit for each of the four categories of the change of health status from 2011 to 2013.[45, 46] To do this, we first assigned all individuals in our datasets to one of the four categories, and then calculated the expected probability of work exit for each

individual using their own levels for the control variables (i.e., age, education, marriage status, and expenditures in 2011) and the assigned category of the change of health status. Last, we reported the mean value of the expected probability of work exit among all individuals. For absent workdays, we calculated the average expected number of absent workday following the same method.

Sensitivity analysis

We conducted all the analyses without using the weights and conducted the analyses by including all older farmers without applying the age restriction.

Results

Table 1 presents our sample characteristics in 2011 by gender and by our four separate working groups: female farmers, female non-farmers, male farmers, and male non-farmers. About 36% of women and 39% of men were non-farmers (weighted proportion), *i.e.*, engaged in non-agricultural work only in 2011. Not surprisingly, non-farmers' education level was much higher than that of farmers and men's education was higher than that of women. In terms of SRH, farmers and women had poorer SRH than non-farmers and men, respectively. Consistently, farmers were more likely to be disabled, and suffered from more chronic diseases and functional limitations than non-farmers, regardless of gender.

Overall, about 90% were still working in 2013. Among both women and men, non-farmers (18.5% for women and 12.0% for men) were more likely to stop working than farmers (11.0% and 4.9%, respectively). Table 2 describes the relationships between the SRH in 2011 and 2013, the change of SRH and work exit and absenteeism. Consistently among all the four groups, people in poor

health status in 2011 or 2013 were more likely to stop working in 2013 except for female non-farmers. The recent health deterioration (good/fair to poor) and persistently poor health (poor to poor) were associated with a higher probability of work exit for both females and males but this relationship was not shown among non-farmers after further breaking the population down by farmers and non-farmers. In terms of absent workdays, people in poor health status in 2011 and 2013, respectively, or in persistently poor health status over time had the largest number of absent workdays across all the groups.

Work exit

Table 3 presents the analysis results of model I for the impact of two-year lagged health only and model II for the impact of the change of health status over time. Model I showed that people with poorer lagged health status except for non-farmers were significantly more likely to exit from work. People who changed health status from poor to poor, good/fair to poor, and poor to good/fair were significantly more likely to exit from work than people with persistently good status except for female non-farmers. The expected values shown in Tables 4 and 5 are more helpful in understanding the magnitudes of the effects. Across all groups except for female farmers and female non-farmers, people with persistently poor health had the highest probability of work exit, e.g., 0.28 for all males with persistently poor health compared with 0.05 for those with persistently good health. There was then a decreasing trend of probability of work exit among farmers with health status change from good/fair to poor, poor to good/fair and then good to good. However, this trend did not hold for non-farmers.

Number of absent workdays due to health problems

Among those who were still working in 2013, the overall average number of absent workdays due to health problems was 12 days (SE=0.63). The average number of absent workdays among farmers (16.6 (1.4) for women and 15.0 (1.1) for men), much higher than non-farmers (5.6 (1.3) and 4.9 (0.9), respectively) (Table 2). All older working people with poorer health status had significantly more number of absent workdays due to health problems (Table 3 and Table 4). When analyzing the impact of the change of health status over time, the model parameters (Table 3) and expected values (Table 5) showed a decreasing trend with persistently poor status leading to the largest number of absent workdays, followed by the changes from good/fair to poor, from poor to good/fair, and persistently good/fair. The exception was found in female non-farmers.

Sensitivity analyses

The analysis results without using the weights provided by CHARLS were consistent with the main analysis results considering the weights. In addition, after dropping the age restriction for farmers, we observed similar effects (in terms of magnitude and significance) of the lagged health status and the change of health status over time. The detailed results can be found in the Appendix.

Discussion

The effect of health status on work exit and absent workdays among older working people in China has not been extensively studied. This present paper fills the gap by examining the impact of the two-year lagged health status and the change of health status over time on work exit and absent workdays in a representative older working population sample in China. We found that the effects of health status varied by the two outcomes (i.e., work exit and absent workdays) as well as by both gender and working types (agricultural work vs. non-agricultural work). Two-year lagged

health status had significant effects on work exit among female and male farmers but not among non-farmers. In addition, the older workers (except female non-farmers) with poor health in either 2011or both 2011 and 2013 were significantly more likely to exit from work or missed more workdays than those with persistently good health over time. Those with persistently poor health or recent health deterioration incurred the highest probability of work exit and number of absent workdays except for female non-farmers.

Many studies have investigated the relationship between health and labor force participation or work exit among older workers in the developed countries.[5-13] For example, Bound et al. (1999) investigated the dynamic effects of health on labor force behaviour of older workers using US data and found that poor health led many older workers to withdraw from the labor force.[9] In addition, respondents whose health declined relatively recently were more likely to exit from the labour force than those whose health declined earlier.[9] Disney et al. (2006) demonstrated that ill health predicted individual retirement behaviour among workers aged from 50 until state pension age in Britain.[10] van den Berg et al. (2010) showed that poor SRH was strongly associated with exit from paid employment due to retirement, unemployment or disability among older workers in 11 European countries.[7] However, there are very few such studies in the developing countries. Consistent with findings in literature, our study showed that female or male older workers with poor health (without further distinguishing farmers and non-farmers) were significantly more likely to exit from work. In contrast to Bound et al.,[9] we found that female or male older workers with persistently poor health incurred the highest probability of work exit. The discrepancy might be due to different populations, labour force markets and social security systems.

Our study revealed the important differences between farmers and non-farmers as well as between males and females in Table 1 and Table 2. Farmers generally had worse health status than non-farmers. However, the work exit rate was lower in farmers than in non-farmers, which is consistent with previous studies.[3, 4, 47] Specifically, 11.0% female farmers and 4.9% male farmers stopped working in 2013, compared to 18.5% for female non-farmers and 12.0% for male non-farmers in 2013. Conditional on keeping working in 2013, the number of absent workdays for farmers (16.6 days for women and 15.0 days for men) was found to be higher than that of non-farmers (5.6 days and 4.9 days). One possible explanation is that since social security schemes have not been fully implemented in rural areas and agricultural income is the main source of income for older farmers, they have to continue their work to late life. The other possible explanation is that poorer health status of farmers compared to non-farmers causes them to take more sick leaves while remaining working. In addition, we found that health status was not a significant factor leading to work exit for female non-farmers, which suggests that work exit of female non-farmers is attributable to factors other than health. The improvement in health status only might not keep female non-farmers at work.

In our population selection, we restricted to women between 45 and 55 years and men between 45 and 60 years in 2013 based on the retirement age policy that is applied to the urban formal sectors in China. However, this policy does not apply to the rural population (i.e. those in agricultural work). We therefore conducted sensitivity analyses by including all older working farmers without the age restriction. It showed that the effects of health status were similar to our main analysis results by applying the age restriction and relaxing the age restriction did not affect our conclusion on the influence of health status on work exit and the number of absent workdays for farmers.

One of our limitations is that when analyzing the impact on work exit, we did not further distinguish those who were not working in 2013 by their work exit routes, e.g., retirement, disability (due to health reasons), or other reasons due to the small sample size for the subgroups. We found neither health reasons nor retirement was the major reason for the work exit in 2013. Specifically, about 25% of female farmers and 40% of male farmers were not working due to health reasons and these proportions went up to 33% and 41%, respectively, if we dropped the age restriction. Only 2% of female and male farmers were not working due to retirement and the proportions did not change much if we dropped the age restriction (2% of female farmers and 5% of male farmers). The small proportion of retirement for farmers was partially due to the lack of retirement and pension schemes for rural population in China.[47] On the other hand, about 5% and 27% of female non-farmers and 20% and 8% of male non-farmers stopped working due to health reasons and retirement, respectively. Therefore, the effects of health status on work exit were comparable in the three groups (female farmers, male farmers and male non-farmers) because of their similar work exit routes. Also, the facts that very few female non-farmers stopped working due to health reasons and relatively high proportion of female non-farmers stopped working due to retirement partially confirm our explanation that work exit of female non-farmers is attributable to factors other than health.

To account for the endogeneity and measurement error problems associated with the SRH, some researchers have proposed to use objective health measures instead.[48, 49] However, using these objective measures as proxy measures of health status can also lead to the errors-in-variables problem and endogeneity issue.[40] Therefore, such a strategy does not eliminate the problems but

is subject to the similar problems of using SRH. To address these issues, a more common empirical strategy, which is followed by our paper, is to use a latent variable model, in which detailed health measures are used to construct an index of health.[9, 10, 38] Different Pseudo R^2s were used to indicate how well these health measures explain SRH. According to Louviere et al. [50] (page 54), one should not expect to obtain pseudo R^2 values as high as the R^2 commonly obtained in ordinary least squared (OLS) regression applications. For instance, values of McFadden's LRI between 0.2-0.4 indicate extremely good model fits, which is approximately equivalence to 0.7-0.9 for R^2 from OLS based on simulations. Therefore, our pseudo R^2 values (McFadden's LRI ranged from 0.09 to 0.18 shown in the Appendix) suggested that the detailed health measures moderately to strongly explained SRHs.

In the present study, we only selected working population in 2011. People in poor health in 2011 who continued working in 2013 might have unobserved characteristics that encouraged them to work. For example, they might be in better health status than our health measures suggested or had a strong commitment to their work.[9] Therefore, we may have underestimated the effect of health status. However, we were more interested in examining the effect of health on the decision whether to continue working among the older people who had been already in the labour force. Therefore, our study findings are more relevant to the policies that attempt to retain the existing older working population through improving their health.

The proportion of older workers is expected to increase among the working population in China, which will be further exacerbated by China's recent plan to raise the official retirement age.[51] Our study has important policy implications for China and other developing countries. Female non-

farmers currently have earlier legal retirement age than male non-farmers and our findings indicate that female non-farmers might have to stop working due to the legal retirement age requirement instead of health. Therefore, more research is needed to investigate whether the legal retirement age should be extended for female non-farmers. Since exit from labour force is generally not reversible at an older age particularly for non-farmers, the priority should be given to the policies that better improve the overall workers' health status and improve the work circumstances of workers especially with persistently poor health. In addition, having realized the problem of lacking old-age security for the rural elderly, China government launched a nationwide, experimental rural social pension plan in 2009, which is expected to cover 10 percent of rural regions by the end of 2009, about 50 percent by 2012, and 100 percent by 2020.[52] However, our and previous findings using the same data indicated that the new pension plan did not affect the labor supply of rural elderly, as the majority of the elderly population sampled continued to work into their seventies. Our findings of older farmers taking more sick leaves while remaining in the labour force also suggest an unproductive rural labour force. It may indicate that the new pension plan has not provided enough social security for the elderly in rural China or there is a lack of knowledge and awareness of such pension plan. More research is needed in the future to explore the reasons why rural elderly still keep working under the new pension plan and accurately estimate the effect of the new pension plan on welfare of rural elderly.

In conclusion, the effects of health status on work exit and absenteeism differ by both gender and work types among older Chinese workers. Poor two-year lagged health leads to work exit of female and male farmers. Persistently poor health or recent health deterioration over time is most detrimental among all older Chinese workers except female non-farmers.

Contribution Statement

XL and WZ designed the study, developed data analysis plan and equally contributed to this study. HS performed statistical analysis of the data. AHA provided guidance on economic theory and analysis. All authors made significant contributions to the interpretation of results and participated in drafting and revising the manuscript. All authors have approved the final version.

Competing Interests

None.

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Data Sharing Statement

All data collected in CHARLS are maintained at the National School of Development of Peking University, Beijing, China, and are publicly available at: http://charls.pku.edu.cn/en.

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Table 1. Demographic and health characteristics in 2011

Variables	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Sample N	1652	2680	1256	396	1874	806
Age, years	48.06 (0.07)	51.07 (0.09)	48.16 (0.06)	47.89 (0.16)	51.28 (0.1)	50.74 (0.16)
Education						
Illiterate	344 (19.45)	158 (5.45)	319 (26.01)	25 (7.69)	135 (7.46)	23 (2.36)
Lower than elementary school	250 (14.12)	337 (12.17)	218 (17.32)	32 (8.38)	273 (14.93)	64 (7.91)
Elementary school	369 (21.27)	574 (20.59)	308 (24.73)	61 (15.07)	448 (24.31)	126 (14.86)
Middle school or higher	689 (45.15)	1611 (61.78)	411 (31.93)	278 (68.86)	1018 (53.3)	593 (74.87)
Married	1587 (95.15)	2573 (95.68)	1214 (96.3)	373 (93.09)	1788 (94.81)	785 (97.03)
Household expenditures monthly	2744.55 (143.88)	2869.26 (163.99)	2120.78 (80.98)	3862.59 (353.58)	2104.85 (86.05)	4048.25 (393.95)
Self-rated health						
Good	424 (26.38)	884 (36.15)	284 (22.94)	140 (32.54)	544 (30.82)	340 (44.38)
Fair	872 (54.22)	1372 (49.29)	665 (52.12)	207 (57.98)	982 (50.28)	390 (47.76)
Poor	356 (19.41)	424 (14.56)	307 (24.95)	49 (9.48)	348 (18.9)	76 (7.86)
Disable	148 (8.12)	315 (11.07)	124 (10.12)	24 (4.55)	251 (13.29)	64 (7.64)
No. of chronic diseases (range 0-14)	0.99 (0.04)	1 (0.03)	1.1 (0.04)	0.81 (0.07)	1.07 (0.03)	0.89 (0.06)
Functional limitations (range 0-18)	0.48 (0.04)	0.33 (0.02)	0.63 (0.05)	0.19 (0.06)	0.44 (0.03)	0.16 (0.03)
Notes: the proportions in parentheses are weighted proportions; the means are weighted means, and standard errors of the mean are in parentheses.						

Table 2. Work exit and number of absent workdays in 2013 by self-rated health

	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Proportion of work exit						
Overall	202 (13.65)	188 (7.71)	129 (10.95)	73 (18.50)	85 (4.98)	103 (12.02)
Self-rated health in 2011						
Good	52 (12.49)	50 (5.47)	28 (11.31)	24 (13.98)	18 (3.76)	32 (7.31)
Fair	106 (14.27)	90 (8.48)	67 (10.23)	39 (20.77)	38 (4.36)	52 (15.27)
Poor	44 (13.52)	48 (10.64)	34 (12.11)	10 (20.16)	29 (8.45)	19 (18.93)
Self-rated health in 2013						
Good	46 (13.02)	46 (6.69)	21 (10.10)	25 (16.42)	14 (2.98)	32 (10.96)
Fair	106 (13.47)	85 (6.44)	68 (9.65)	38 (19.95)	33 (3.06)	52 (11.82)
Poor	50 (14.90)	57 (14.11)	40 (14.48)	10 (16.54)	38 (13.71)	19 (16.45)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	130 (13.42)	113 (6.45)	72 (9.46)	58 (18.88)	38 (2.88)	75 (11.10)
Poor – Good/Fair	22 (12.69)	18 (7.29)	17 (11.47)	5 (17.08)	9 (4.42)	9 (19.37)
Good/Fair – Poor	28 (15.49)	27 (13.44)	23 (16.59)	5 (12.54)	18 (12.80)	9 (15.39)
Poor – Poor	22 (14.30)	30 (15.11)	17 (12.66)	5 (24.90)	20 (14.05)	10 (18.46)
Number of absent workdays						
Overall	12.85 (1.07)	11.23 (0.79)	16.61 (1.40)	5.57 (1.30)	15.04 (1.09)	4.89 (0.94)
Self-rated health in 2011						
Good	7.80 (1.59)	5.98 (0.86)	10.96 (2.07)	3.67 (2.39)	9.73 (1.73)	1.85 (0.49)
Fair	10.94 (1.38)	10.49 (0.97)	14.32 (1.85)	4.88 (1.49)	13.14 (1.21)	5.58 (1.53)
Poor	25.48 (3.17)	27.86 (3.59)	27.04 (3.58)	17.30 (5.81)	29.60 (4.00)	20.59 (7.88)
Self-rated health in 2013						
Good	5.80 (1.43)	4.13 (0.76)	6.24 (1.28)	5.24 (2.81)	6.10 (1.23)	1.70 (0.73)
Fair	9.39 (1.04)	9.60 (1.01)	12.04 (1.32)	4.45 (1.38)	12.63 (2.37)	4.22 (1.24)
Poor	31.77 (3.88)	32.91 (3.49)	36.48 (4.57)	12.40 (4.54)	37.99 (6.90)	19.53 (6.17)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	7.58 (0.86)	6.59 (0.61)	9.98 (1.07)	3.94 (1.33)	9.16 (0.87)	2.97 (0.77)
Poor – Good/Fair	13.87 (2.93)	17.24 (4.25)	13.39 (3.29)	15.63 (6.63)	19.09 (5.89)	8.00 (6.54)
Good/Fair – Poor	26.42 (5.48)	25.88 (3.78)	32.98 (7.10)	9.40 (4.61)	31.75 (4.51)	12.29 (4.91)
Poor – Poor	37.47 (5.49)	43.92 (6.49)	39.49 (5.97)	20.69 (11.49)	46.87 (6.87)	34.21 (15.48)

Notes: the proportions in parentheses are weighted proportions; the means are weighted means, and standard errors of the mean are in parentheses.

Table 3. Model parameters for work exit and absent workdays

Model [a]	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
I - 2011 Health status [b]						
Poor	0.744 (0.259)***	0.577 (0.253)**	0.655 (0.287)**	0.753 (0.546)	0.810 (0.296)***	0.281 (0.447)
Fair	0.446 (0.156)***	0.306 (0.151)**	0.298 (0.182)	0.563 (0.305)*	0.300 (0.192)	0.251 (0.250)
II – Health status change [c]						
Poor-Poor	0.753 (0.202)***	1.142 (0.204)***	0.752 (0.209)***	0.472 (0.633)	1.265 (0.239)***	1.163 (0.411)***
Good/Fair-Poor	0.621 (0.171)***	0.865 (0.161)***	0.763 (0.173)***	-0.135 (0.507)	1.097 (0.194)***	0.681 (0.300)**
Poor-Good/Fair	0.358 (0.156)**	0.471 (0.165)***	0.415 (0.168)**	0.043 (0.386)	0.419 (0.199)**	0.895 (0.331)***
Number of absent workdays						
I - 2011 Health status [b]						
Poor	101.39 (17.00)***	135.61 (13.50)***	105.66 (17.72)***	72.05 (40.43)*	131.60 (16.20)***	153.55 (25.85)***
Fair	46.67 (10.19)***	65.60 (7.99)***	48.16 (10.79)***	24.87 (22.84)	64.12 (9.71)***	69.65 (14.15)***
II – Health status change [c]						
Poor-Poor	99.55 (12.27)***	130.13 (10.91)***	109.38 (12.00)***	33.51 (42.47)	132.86 (12.40)***	142.50 (22.46)***
Good/Fair-Poor	78.13 (10.02)***	93.61 (8.35)***	82.18 (9.87)***	29.85 (29.01)	100.77 (9.71)***	87.96 (15.53)***
Poor-Good/Fair	43.48 (8.82)***	52.31 (7.59)***	36.60 (9.08)***	53.28 (22.65)**	54.17 (8.18)***	59.26 (19.42)***

[a]: Model I includes 2011 health status (two-year lagged); Model II includes the changes of health status from 2011 to 2013.
[b]: The reference group for health status is Good.
[c]: The reference group for the change of health status is Good/Fair in 2011 to Good/Fair in 2013.
* P≤0.1; ** P≤0.05; ***P≤0.01

Table 4. Expected probability of work exit and expected number of absent workdays by 2011 health status

2011 Health status	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
Poor	0.218	0.122	0.192	0.288	0.123	0.145
Fair	0.143	0.077	0.110	0.229	0.048	0.139
Good	0.067	0.043	0.064	0.100	0.025	0.091
Number of absent workdays						
Poor	42.25	54.90	48.34	20.48	57.66	56.51
Fair	16.50	18.72	19.25	6.61	21.42	13.04
Good	5.68	4.42	6.82	3.12	5.67	1.94

Table 5. Expected probability of work exit and expected number of absent workdays by the change of health status over time

Health status change	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
Poor-Poor	0.288	0.279	0.243	0.322	0.229	0.448
Good/Fair-Poor	0.245	0.199	0.246	0.148	0.182	0.273
Poor-Good/Fair	0.173	0.111	0.151	0.191	0.058	0.347
Good/Fair-Good/Fair	0.098	0.048	0.074	0.180	0.024	0.101
Number of absent workdays						
Poor-Poor	55.79	73.22	67.42	11.86	81.04	70.67
Good/Fair-Poor	41.33	46.53	47.61	10.94	56.21	31.56
Poor-Good/Fair	23.13	24.16	22.77	18.57	28.48	17.81
Good/Fair-Good/Fair	9.19	8.10	10.68	4.83	9.86	3.66

Appendix

1. Variable definition

Variables	Definition
Age	Continuous variable and measured in years
Education	Four categories: illiterate, lower than elementary school, elementary school graduate, and middle school or higher
Married	Married vs. not
Household expenditures monthly	Monthly household expenditures on food, utilities, household items, clothing, medical care, taxes, etc.
Self-rated Health Status	Three categories: good (reported health status equal to or better than good health), fair (reported health status as fair), and poor (reported health status equal to or worse than poor health)
Disable	Yes vs. no; where yes if having any of the five disabilities: physical disabilities, brain damage/mental retardation, vision problems, hearing problems, speech impediment
No. of chronic diseases (range 0-14)	Chronic diseases considered include 1.hypertension; 2.dyslipidemia; 3.diabetes; 4.cancer; 5.chronic lung disease; 6.liver disease; 7.heart problems; 8.stroke; 9.kidney disease; 10.stomach or other digestive disease; 11.emotional, nervous, or psychiatric problems; 12.memory-related disease; 13.arthritis or rheumatism; and 14.asthma.
Functional limitations (range 0-18)	Functional limitations are assessed in three domains: 7 items measuring physical functions (1.running/jogging about 1 km; 2.getting up from a chair; 3.climbing several flights of stairs; 4.stooping, kneeling or crouching; 5.reaching or extending arms; 6.lifting or carrying over 5 kg; and 7.picking up a small coin), 6 items measuring basic activities of daily living (BADLs) (1.dressing; 2.bathing; 3.eating; 4.getting in/out of bed; 5.using the toilet; and 6.controlling urination and defecation), and 5 items measuring instrumental ADL (IADLs) (1.doing household chores; 2.preparing hot meals; 3.shopping for groceries; 4.managing money; and 5.taking medications) (Hu et al., 2015)[1]. Each item is measured using a 4-likert scale, "1= No, I don't have any difficulty", "2=I have difficulty but can still do it", "3= Yes, I have difficulty and need help" and "4= I can not do it". The functional limitations are scored as a total number of items with answers at scale 3 or 4 for functional limitations and at scale > 1 for BADL and ADL.

[1] Hu L, Lv X, Zhou S, *et al.* Socio-Demographic Determinants, Physical Health Status, and Depression Associated with Functional Limitations Among Older Chinese Adults. Ageing International 2015; 40: 311–326.

2. The questions in CHARLS and the criteria used to determine work status:

FA001: Did you engage in agricultural work (including farming, forestry, fishing, and husbandry for your own family or others) for more than 10 days in the past year?

FA002: Did you work for at least one hour last week? We consider any of the following activities to be work: earn a wage, run your own business and unpaid family business work, et al. Work does not include doing your own housework or doing activities without pay, such as voluntary work.

If respondent said 'yes' on either question FA001 or FA002, then she or he was considered as 'working'. If the answers on both questions were 'no', then the respondent needed to answer the following two questions:

FA005: Do you expect to go back to this job at a definite time in the future or within 6 months?

FA006: Do you still receive any salary from this job?

If respondent said 'yes' on either question FA005 or FA006, then she or he was considered as 'working'.

If respondent said 'no' on all four questions, she or he was considered as 'not working'.

3. Econometric model specifications

We used Model I, including 2011 health status in the model, as an example to show our model specifications.

Modeling work exit

We used Probit model for work exit in 2013, and ordered Probit model for health status in 2011. For each individual i, let y_i^w be labour force participation observed in 2013, $\mathbf{x}_i$ be the vector of exogenous factors (i.e., age, education, marriage status, and log transformed expenditures in 2011), $\mathbf{z}_i$ be the vector of detailed health measures (disability condition, number of chronic diseases, the number of total functional limitations) in 2011 and $\boldsymbol{H}_i$ be the SRH in 2011. Then our models were specified as:

$$y_i^{w*} = \boldsymbol{H}_i'\boldsymbol{\beta}_{\boldsymbol{h}}^{\boldsymbol{w}} + \mathbf{x}_i'\boldsymbol{\beta}_{\boldsymbol{x}}^{\boldsymbol{w}} + u_i^w \quad (1)$$

$$y_i^w = \begin{cases} Work, & y_i^{w*} < 0 \\ Not\ work, & y_i^{w*} \geq 0 \end{cases} \quad (2)$$

$$h_i^{w*} = \mathbf{x}_i'\boldsymbol{\beta}_{\boldsymbol{hx}}^{\boldsymbol{w}} + \mathbf{z}_i'\boldsymbol{\beta}_{\boldsymbol{hz}}^{\boldsymbol{w}} + \varepsilon_i^w \quad (3)$$

$$\boldsymbol{H}_i = \begin{cases} Poor, & if\ h_i^{w*} \leq 0 \\ Fair, & if\ 0 < h_i^{w*} \leq c^w \\ Good, & if\ h_i^{w*} > c^w \end{cases} \quad (4)$$

where $y_i^{w*}$and h_i^{w*} are the latent variables for y_i^w and H_i, respectively; (u^w, ε^w) is independent of $\boldsymbol{z}$ and distributed as multivariate normal with mean zero and covariance matrix $\begin{pmatrix} 1 & \rho_w \\ \rho_w & 1 \end{pmatrix}$.

The full information likelihood based on the joint distribution of $(\boldsymbol{y^w}, \boldsymbol{H})$ given $\mathbf{x}$ and $\mathbf{z}$ was used for estimating all parameters in structure equations (1) – (4) simultaneously, which was described as the full information maximum likelihood (FIML) estimation method in Wooldridge

(2002). As pointed by Woodridge (2002), with these models, the average probability of work exit for given **x**, **z,** and ***H*** can be estimated by

$$P(y^w = \text{not work}) = \boldsymbol{\Phi}(\boldsymbol{H}'\boldsymbol{\beta}_{\boldsymbol{h}}^{\boldsymbol{w}} + x'\boldsymbol{\beta}_{\boldsymbol{x}}^{\boldsymbol{w}}) \quad (5),$$

where $\boldsymbol{\Phi}$ is the cumulative density function of the standard normal distribution.

Modeling for number of absent workdays due to health problems

Same method was used to address the endogeneity of SRH for absent workdays. While we used the Probit model for work exit, we employed the Tobit model for number of absent workdays, and the ordered Probit models for health status in 2011 and 2013. Tobit regression was used for the number of absent workdays due to health problems, as its value was truncated at zero with a large number of observations at the zero point. Similar to the work exit model, the number of absent workday models were specified as

$$y_i^{m*} = \boldsymbol{H}_i'\boldsymbol{\beta}_{\boldsymbol{h}}^{\boldsymbol{m}} + \mathbf{x}_i'\boldsymbol{\beta}_{\boldsymbol{x}}^{\boldsymbol{m}} + u_i^m \quad (6)$$

$$y_i^m = \begin{cases} y_i^{m*}, & y_i^{m*} > 0 \\ 0, & y_i^{m*} \le 0 \end{cases} \quad (7)$$

$$h_i^{m*} = \mathbf{x}_i'\boldsymbol{\beta}_{\boldsymbol{hx}}^{\boldsymbol{m}} + \mathbf{z}_i'\boldsymbol{\beta}_{\boldsymbol{hz}}^{\boldsymbol{m}} + \varepsilon_i^m \quad (8)$$

$$H_i = \begin{cases} Poor, & if\ h_i^{m*} \le 0 \\ Fair, & if\ 0 < h_i^{m*} \le c^m \\ Good, & if\ h_i^{m*} > c^m \end{cases}, \quad (9)$$

where y^m denotes the number of absent workdays, (u^m, ε^m) is independent of $\boldsymbol{z}$ and distributed as multivariate normal with mean zero and covariance matrix $\begin{pmatrix} \sigma^2 & \rho_m \\ \rho_m & 1 \end{pmatrix}$.

For given **x**, **z,** and ***H***, the expectation of y^m can be estimated by

$$E(y^m|\mathbf{x}, H) = P(y^m > 0|\mathbf{x}, \boldsymbol{H}) \cdot E(y^m|\mathbf{x}, H, y > 0)$$

$$= \boldsymbol{\Phi}((\boldsymbol{H'\beta_h^m} + \mathbf{x'\beta_x^m})/\sigma)(\boldsymbol{H'\beta_h^m} + \mathbf{x'\beta_x^m}) + \sigma\boldsymbol{\phi}((\boldsymbol{H'\beta_h^m} + \mathbf{x'\beta_x^m})/\sigma) \quad (10)$$

where $\boldsymbol{\phi}$ and $\boldsymbol{\Phi}$ are the density function and the cumulative density function of the standard normal distribution, respectively.

4. Sensitivity analyses

Analysis results without considering weights

Table 1. Demographic and health characteristics in 2011, mean (Standard Deviation) or N (%) (No weight)

Variables	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Sample N	1652	2680	1256	396	1874	806
Age, years	48.12 (2.06)	51.25 (3.77)	48.21 (2.07)	47.86 (1.99)	51.39 (3.81)	50.93 (3.67)
Education						
Illiterate	344 (20.82)	158 (5.90)	319 (25.40)	25 (6.31)	135 (7.20)	23 (2.85)
Lower than elementary school	250 (15.13)	337 (12.57)	218 (17.36)	32 (8.08)	273 (14.57)	64 (7.94)
Elementary school	369 (22.34)	574 (21.42)	308 (24.52)	61 (15.40)	448 (23.91)	126 (15.63)
Middle school or higher	689 (41.71)	1611 (60.11)	411 (32.72)	278 (70.20)	1018 (54.32)	593 (73.57)
Married	1587 (96.07)	2573 (96.01)	1214 (96.66)	373 (94.19)	1788 (95.41)	785 (97.39)
Household expenditures monthly	2403.42 (3072.13)	2472.03 (3887.91)	2041.30 (2555.22)	3551.97 (4118.78)	2005.07 (2631.23)	3557.75 (5701.61)
Health Status						
Good	424 (25.67)	884 (32.99)	284 (22.61)	140 (35.35)	544 (29.03)	340 (42.18)
Fair	872 (52.78)	1372 (51.19)	665 (52.95)	207 (52.27)	982 (52.40)	390 (48.39)
Poor	356 (21.55)	424 (15.82)	307 (24.44)	49 (12.37)	348 (18.57)	76 (9.43)
Disable	148 (8.96)	315 (11.75)	124 (9.87)	24 (6.06)	251 (13.39)	64 (7.94)
No. of chronic diseases (range 0-14)	1.06 (1.23)	1.03 (1.20)	1.12 (1.27)	0.84 (1.06)	1.07 (1.21)	0.93 (1.16)
Functional limitations (range 0-18)	0.53 (1.42)	0.36 (1.12)	0.63 (1.50)	0.24 (1.09)	0.44 (1.23)	0.19 (0.78)

Table 2. Work exit (N (%) of not working) and number of absent workdays (Mean (SE)) in 2013 by self-rated health (No weight)

	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Probability of work exit						
Overall	202 (12.23)	188 (7.01)	129 (10.27)	73 (18.43)	85 (4.54)	103 (12.78)
Self-rated health in 2011						
Good	52 (12.26)	50 (5.66)	28 (9.86)	24 (17.14)	18 (3.31)	32 (9.41)
Fair	106 (12.16)	90 (6.56)	67 (10.08)	39 (18.84)	38 (3.87)	52 (13.33)
Poor	44 (12.36)	48 (11.32)	34 (11.07)	10 (20.41)	29 (8.33)	19 (25.00)
Self-rated health in 2013						
Good	46 (12.17)	46 (5.87)	21 (8.30)	25 (20.00)	14 (2.81)	32 (11.23)
Fair	106 (11.61)	85 (5.77)	68 (9.76)	38 (17.59)	33 (3.18)	52 (11.93)
Poor	50 (13.85)	57 (13.48)	40 (13.07)	10 (18.18)	38 (11.24)	19 (22.35)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	130 (11.61)	113 (5.61)	72 (8.93)	58 (18.47)	38 (2.85)	75 (11.05)
Poor – Good/Fair	22 (12.87)	18 (7.38)	17 (11.81)	5 (18.52)	9 (4.46)	9 (21.43)
Good/Fair – Poor	28 (15.91)	27 (11.11)	23 (16.08)	5 (15.15)	18 (9.38)	9 (17.65)
Poor – Poor	22 (11.89)	30 (16.67)	17 (10.43)	5 (22.73)	20 (13.70)	10 (29.41)
Number of absent workdays						
Overall	14.18 (1.02)	12.02 (0.75)	16.19 (1.24)	7.21 (1.46)	14.68 (0.98)	5.26 (0.90)
Self-rated health in 2011						
Good	8.05 (1.47)	6.94 (1.01)	10.00 (1.96)	3.75 (1.82)	10.04 (1.57)	1.68 (0.38)
Fair	12.18 (1.23)	10.66 (0.85)	13.82 (1.48)	6.40 (1.86)	12.53 (1.08)	5.44 (1.13)
Poor	26.76 (3.18)	28.08 (3.25)	27.52 (3.49)	21.41 (7.09)	28.83 (3.54)	23.85 (8.32)
Self-rated health in 2013						
Good	6.63 (1.35)	4.74 (0.95)	7.31 (1.69)	5.03 (2.15)	6.39 (1.39)	1.62 (0.68)
Fair	10.64 (1.07)	9.51 (0.73)	11.77 (1.26)	6.70 (1.91)	11.54 (0.94)	4.18 (0.89)
Poor	32.14 (3.50)	36.69 (3.63)	35.11 (3.95)	14.38 (5.60)	39.10 (4.12)	25.84 (7.21)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	8.63 (0.85)	7.00 (0.56)	9.93 (1.05)	4.93 (1.37)	8.90 (0.77)	2.92 (0.56)
Poor – Good/Fair	14.90 (3.16)	14.97 (2.73)	14.08 (3.43)	19.50 (8.33)	16.27 (3.04)	7.28 (5.66)
Good/Fair – Poor	25.67 (4.48)	28.71 (3.87)	29.57 (5.35)	8.93 (4.91)	32.27 (4.62)	14.02 (4.99)
Poor – Poor	38.30 (5.31)	48.42 (6.82)	39.87 (5.72)	24.20 (12.87)	48.71 (7.44)	46.91 (17.37)

Table 3. Model parameters for work exit and absent workdays (No weight)

Model [a]	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
I - 2011 Health status [b]						
Poor	0.817 (0.249)***	0.834 (0.252)***	0.817 (0.290)***	0.734 (0.470)	0.835 (0.318)***	0.837 (0.395)**
Fair	0.439 (0.154)***	0.310 (0.157)**	0.430 (0.183)**	0.411 (0.283)	0.294 (0.206)	0.297 (0.233)
II – Health status change [c]						
Poor-Poor	0.765 (0.199)***	1.338 (0.188)***	0.806 (0.215)***	0.290 (0.549)	1.285 (0.229)***	1.564 (0.320)***
Good/Fair-Poor	0.732 (0.164)***	0.951 (0.166)***	0.840 (0.174)***	-0.034 (0.465)	0.967 (0.197)***	1.052 (0.289)***
Poor-Good/Fair	0.462 (0.151)***	0.595 (0.160)***	0.523 (0.168)***	0.033 (0.353)	0.433 (0.199)**	1.130 (0.285)***
Number of absent workdays						
I - 2011 Health status [b]						
Poor	114.76 (16.75)***	149.06 (14.45)***	119.13 (18.66)***	77.31 (35.92)**	148.62 (17.19)***	158.01 (27.55)***
Fair	52.62 (10.17)***	70.31 (8.49)***	54.63 (11.34)***	29.71 (21.53)	69.92 (10.14)***	70.00 (15.36)***
II – Health status change [c]						
Poor-Poor	106.13 (11.96)***	138.59 (10.80)***	110.14 (12.61)***	49.85 (38.52)	138.18 (12.27)***	156.50 (23.29)***
Good/Fair-Poor	74.42 (9.92)***	100.98 (8.51)***	76.97 (10.42)***	30.00 (30.18)	102.99 (9.61)***	100.02 (18.55)***
Poor-Good/Fair	46.76 (8.82)***	54.55 (7.63)***	39.32 (9.56)***	62.34 (22.23)***	55.55 (8.85)***	60.16 (20.07)***

[a]: Model I includes 2011 health status (two-year lagged); Model II includes the changes of health status from 2011 to 2013.
[b]: The reference group for health status is Good.
[c]: The reference group for the change of health status is Good/Fair in 2011 to Good/Fair in 2013.
* P≤0.1; ** P≤0.05; ***P≤0.01

Table 4. Expected probability of work exit and expected number of absent workdays by 2011 health status (No weight)

2011 Health Status	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
Poor	0.235	0.168	0.202	0.324	0.119	0.291
Fair	0.138	0.073	0.111	0.218	0.043	0.140
Good	0.065	0.041	0.050	0.118	0.022	0.085
Number of absent workdays						
Poor	47.02	59.78	52.04	24.18	64.75	54.58
Fair	17.01	18.95	19.13	8.22	21.64	12.04
Good	5.26	4.26	5.98	3.49	5.26	1.90

Table 5. Expected probability of work exit and expected number of absent workdays by the change of health status over time (No weight)

HS Change	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
Poor-Poor	0.279	0.332	0.247	0.265	0.238	0.594
Good/Fair-Poor	0.268	0.213	0.257	0.171	0.153	0.395
Poor-Good/Fair	0.189	0.130	0.167	0.189	0.080	0.425
Good/Fair-Good/Fair	0.091	0.046	0.068	0.180	0.024	0.097
Number of absent workdays						
Poor-Poor	59.84	77.93	66.80	19.26	83.21	78.65
Good/Fair-Poor	38.79	49.97	43.52	12.43	56.63	36.74
Poor-Good/Fair	24.65	24.57	23.76	24.73	28.63	17.39
Good/Fair-Good/Fair	9.49	8.08	10.77	5.67	9.78	3.71

Analysis results without age restriction for farmers

Table 1. Demographic and health characteristics in 2011 (No age restriction)

Variables	Female farmers (3)	Female farmers without restriction (3)	Male Farmers (5)	Male farmers without restriction (5)
Sample N	1256	3625	1874	3839
Age, years	48.16 (0.06)	56.35 (0.16)	51.28 (0.1)	58.09 (0.17)
Education				
Illiterate	319 (26.01)	1640 (45.93)	135 (7.46)	520 (13.21)
Lower than elementary school	218 (17.32)	719 (19.36)	273 (14.93)	784 (21.00)
Elementary school	308 (24.73)	666 (18.45)	448 (24.31)	1148 (30.31)
Middle school or higher	411 (31.93)	600 (16.26)	1018 (53.3)	1387 (35.48)
Married	1214 (96.3)	3309 (90.58)	1788 (94.81)	3555 (92.10)
Household expenditures monthly	2120.78 (80.98)	1805.23 (43.29)	2104.85 (86.05)	1850.99 (51.04)
Self-rated health				
Good	284 (22.94)	727 (20.46)	544 (30.82)	977 (26.97)
Fair	665 (52.12)	1833 (50.54)	982 (50.28)	1991 (50.76)
Poor	307 (24.95)	1065 (29.01)	348 (18.9)	871 (22.26)
Disable	124 (10.12)	532 (14.20)	251 (13.29)	700 (17.51)
No. of chronic diseases (range 0-14)	1.1 (0.04)	1.30 (0.02)	1.07 (0.03)	1.22 (0.02)
Functional limitations (range 0-18)	0.63 (0.05)	1.00 (0.04)	0.44 (0.03)	0.65 (0.03)
Notes: the proportions in parentheses are weighted proportions; the means are weighted means, and standard errors of the mean are in parentheses.				

Table 2. Model parameters for work exit and absent workdays (No age restriction)

Model [a]	Female farmers (3)	Female farmers without restriction (3)	Male farmers (5)	Male farmers without restriction (5)
Probability of work exit				
I - 2011 Health status [b]				
Poor	0.655 (0.287)**	0.597 (0.159)***	0.810 (0.296)***	0.898 (0.159)***
Fair	0.298 (0.182)	0.274 (0.102)***	0.300 (0.192)	0.526 (0.102)***
II – Health status change [c]				
Poor-Poor	0.752 (0.209)***	0.954 (0.113)***	1.265 (0.239)***	1.087 (0.125)***
Good/Fair-Poor	0.763 (0.173)***	0.760 (0.096)***	1.097 (0.194)***	1.088 (0.104)***
Poor-Good/Fair	0.415 (0.168)**	0.321 (0.091)***	0.419 (0.199)**	0.341 (0.102)***
Number of absent workdays				
I - 2011 Health status [b]				
Poor	105.52 (17.71)***	135.72 (11.81)***	131.60 (16.20)***	118.97 (11.91)***
Fair	48.21 (10.79)***	64.21 (7.38)***	64.12 (9.71)***	52.93 (6.68)***
II – Health status change [c]				
Poor-Poor	109.38 (12.00)***	137.15 (8.45)***	132.86 (12.40)***	130.68 (8.86)***
Good/Fair-Poor	82.18 (9.87)***	96.67 (7.11)***	100.77 (9.71)***	104.75 (6.38)***
Poor-Good/Fair	36.60 (9.08)***	53.80 (6.05)***	54.17 (8.18)***	58.72 (6.01)***

[a]: Model I includes 2011 health status (two-year lagged); Model II includes the changes of health status from 2011 to 2013.
[b]: The reference group for health status is Good.
[c]: The reference group for the change of health status is Good/Fair in 2011 to Good/Fair in 2013.
* P≤0.1; ** P≤0.05; ***P≤0.01

5. Goodness-of-fit measures

From the ordered Probit model for 2011 self-rated health status

Measures	Formula	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Likelihood Ratio (R)	2 * (LogL - LogL0)	338.75	534.86	248.99	69.06	366.72	138.99
Upper Bound of R (U)	- 2 * LogL0	3309.35	5344.34	2571.62	716.53	3835.49	1472.42
Aldrich-Nelson	R / (R+N)	0.17	0.17	0.17	0.15	0.16	0.15
Cragg-Uhler 1	1 - exp(-R/N)	0.19	0.18	0.18	0.16	0.18	0.16
Cragg-Uhler 2	(1-exp(-R/N)) / (1-exp(-U/N))	0.21	0.21	0.21	0.19	0.20	0.19
Estrella	1 - (1-R/U)^(U/N)	0.19	0.19	0.19	0.17	0.19	0.17
Adjusted Estrella	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)	0.19	0.19	0.18	0.14	0.18	0.15
McFadden's LRI	R / U	0.10	0.10	0.10	0.10	0.10	0.09
Veall-Zimmermann	(R * (U+N)) / (U * (R+N))	0.26	0.25	0.25	0.23	0.24	0.23
McKelvey-Zavoina		0.25	0.24	0.25	0.21	0.24	0.20

From the ordered Probit model for the change of self-rated health status from 2011 to 2013

Measures	Formula	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Likelihood Ratio (R)	2 * (LogL - LogL0)	449.84	645.69	383.94	60.14	455.83	173.20
Upper Bound of R (U)	- 2 * LogL0	3082.98	4333.81	2654.50	508.99	3482.89	937.43
Aldrich-Nelson	R / (R+N)	0.21	0.19	0.23	0.13	0.20	0.18
Cragg-Uhler 1	1 - exp(-R/N)	0.24	0.21	0.26	0.14	0.22	0.19
Cragg-Uhler 2	(1-exp(-R/N)) / (1-exp(-U/N))	0.28	0.27	0.30	0.19	0.26	0.28
Estrella	1 - (1-R/U)^(U/N)	0.25	0.23	0.28	0.15	0.23	0.21
Adjusted Estrella	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)	0.25	0.22	0.27	0.11	0.22	0.19
McFadden's LRI	R / U	0.15	0.15	0.14	0.12	0.13	0.18
Veall-Zimmermann	(R * (U+N)) / (U * (R+N))	0.33	0.31	0.34	0.23	0.30	0.33
McKelvey-Zavoina		0.32	0.29	0.35	0.20	0.28	0.30

6. Model parameters

Parameters (standard error) for work exit, Model I

Parameters	Level	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
notwork.Intercept		-3.953 (1.046)***	-3.552 (0.664)***	-2.724 (1.228)**	-5.527 (2.132)***	-3.802 (0.882)***	-2.583 (1.073)**
notwork.hstatus11	Poor	0.744 (0.259)***	0.577 (0.253)**	0.655 (0.287)**	0.753 (0.546)	0.810 (0.296)***	0.281 (0.447)
notwork.hstatus11	Fair	0.446 (0.156)***	0.306 (0.151)**	0.298 (0.182)	0.563 (0.305)*	0.300 (0.192)	0.251 (0.250)
notwork.hstatus11	Good						
notwork.age10		0.272 (0.195)	0.238 (0.102)**	0.136 (0.226)	0.521 (0.400)	0.129 (0.135)	0.348 (0.166)**
notwork.education	Illiterate	-0.107 (0.115)	-0.054 (0.180)	0.041 (0.126)	-0.400 (0.323)	-0.122 (0.221)	0.243 (0.340)
notwork.education	Lower than elementary school	-0.189 (0.129)	0.178 (0.114)	0.047 (0.143)	-0.708 (0.345)**	0.256 (0.135)*	0.049 (0.213)
notwork.education	Elementary school	-0.128 (0.107)	-0.023 (0.099)	0.031 (0.128)	-0.294 (0.222)	-0.020 (0.126)	-0.077 (0.171)
notwork.education	Middle school/ higher						
notwork.married	Yes	-0.180 (0.172)	-0.312 (0.168)*	-0.342 (0.221)	-0.067 (0.316)	-0.075 (0.221)	-0.604 (0.289)**
notwork.married	No						
notwork.lexpense11		0.173 (0.049)***	0.089 (0.043)**	0.115 (0.061)*	0.240 (0.096)**	0.166 (0.058)***	0.006 (0.071)
notwork.farm	Nor-farmer	0.275 (0.092)***	0.543 (0.084)***				
notwork.farm	Farmer						
hstatus11.Intercept		1.883 (0.767)**	0.419 (0.397)	1.593 (0.864)*	2.850 (1.691)*	0.369 (0.468)	0.848 (0.770)
hstatus11.age10		-0.249 (0.143)*	0.065 (0.062)	-0.095 (0.160)	-0.572 (0.316)*	0.044 (0.072)	0.106 (0.119)
hstatus11.education	Illiterate	-0.265 (0.083)***	-0.089 (0.103)	-0.220 (0.087)**	-0.507 (0.241)**	-0.038 (0.107)	-0.337 (0.276)
hstatus11.education	Lower than elementary school	-0.298 (0.091)***	-0.047 (0.073)	-0.286 (0.099)***	-0.247 (0.233)	-0.118 (0.079)	0.202 (0.168)
hstatus11.education	Elementary school	-0.025 (0.077)	-0.124 (0.058)**	-0.047 (0.087)	0.063 (0.173)	-0.161 (0.065)**	-0.062 (0.119)
hstatus11.education	Middle school/higher						
hstatus11.married	Yes	0.200 (0.134)	0.098 (0.114)	0.164 (0.173)	0.321 (0.248)	0.177 (0.125)	-0.115 (0.248)
hstatus11.married	No						
hstatus11.lexpense11		0.080 (0.036)**	0.099 (0.027)***	0.006 (0.042)	0.209 (0.078)***	0.105 (0.032)***	0.092 (0.050)*
hstatus11.farm	Nor-farmer	0.179 (0.067)***	0.255 (0.050)***				
hstatus11.farm	Farmer						
hstatus11.disabled11	Yes	-0.179 (0.110)	-0.278 (0.075)***	-0.130 (0.114)	-0.512 (0.298)*	-0.243 (0.082)***	-0.412 (0.169)**
hstatus11.disabled11	No						
hstatus11.chronic11		-0.364 (0.028)***	-0.335 (0.020)***	-0.316 (0.031)***	-0.509 (0.066)***	-0.319 (0.024)***	-0.369 (0.039)***
hstatus11.adl11		-0.165 (0.025)***	-0.238 (0.026)***	-0.175 (0.027)***	-0.161 (0.059)***	-0.234 (0.027)***	-0.230 (0.065)***
_Limit2.hstatus11		1.742 (0.049)***	1.642 (0.039)***	1.611 (0.052)***	2.085 (0.120)***	1.577 (0.043)***	1.785 (0.081)***
_Rho		0.254 (0.098)***	0.022 (0.099)	0.287 (0.110)***	0.176 (0.194)	0.182 (0.120)	-0.129 (0.164)

*** P≤0.1; ** P≤0.05; ***P≤0.01**

Parameters (standard error) for work exit, Model II

Parameters	Level	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
notwork.Intercept		-3.450 (1.045)***	-3.675 (0.648)***	-2.261 (1.231)*	-5.014 (2.135)**	-4.073 (0.896)***	-2.727 (1.028)***
notwork.chstatus	Poor-Poor	0.753 (0.202)***	1.142 (0.204)***	0.752 (0.209)***	0.472 (0.633)	1.265 (0.239)***	1.163 (0.411)***
notwork.chstatus	Good/Fair-Poor	0.621 (0.171)***	0.865 (0.161)***	0.763 (0.173)***	-0.135 (0.507)	1.097 (0.194)***	0.681 (0.300)**
notwork.chstatus	Poor-Good/Fair	0.358 (0.156)**	0.471 (0.165)***	0.415 (0.168)**	0.043 (0.386)	0.419 (0.199)**	0.895 (0.331)***
notwork.chstatus	Good/Fair-Good/Fair						
notwork.age10		0.239 (0.194)	0.251 (0.102)**	0.075 (0.227)	0.582 (0.398)	0.180 (0.139)	0.353 (0.163)**
notwork.education	Illiterate	-0.103 (0.115)	-0.063 (0.178)	0.025 (0.126)	-0.376 (0.325)	-0.157 (0.225)	0.219 (0.328)
notwork.education	Lower than elementary school	-0.149 (0.127)	0.120 (0.114)	0.049 (0.140)	-0.633 (0.347)*	0.275 (0.138)**	-0.034 (0.215)
notwork.education	Elementary school	-0.126 (0.108)	-0.060 (0.099)	0.024 (0.128)	-0.354 (0.225)	-0.079 (0.130)	-0.063 (0.168)
notwork.education	Middle school/ higher						
notwork.married	Yes	-0.166 (0.171)	-0.280 (0.167)*	-0.328 (0.220)	-0.158 (0.322)	-0.073 (0.225)	-0.542 (0.285)*
notwork.married	No						
notwork.lexpense11		0.152 (0.049)***	0.098 (0.043)**	0.102 (0.060)*	0.198 (0.094)**	0.164 (0.060)***	0.022 (0.068)
notwork.farm	Non-farmer	0.317 (0.092)***	0.589 (0.082)***				
notwork.farm	Farmer						
chstatus.Intercept		3.749 (0.894)***	0.439 (0.484)	4.128 (0.964)***	3.957 (2.197)*	0.459 (0.537)	0.416 (1.064)
chstatus.age10		-0.417 (0.166)**	0.219 (0.076)***	-0.398 (0.177)**	-0.597 (0.408)	0.240 (0.083)***	0.151 (0.164)
chstatus.education	Illiterate	-0.141 (0.095)	-0.091 (0.122)	-0.150 (0.097)	-0.086 (0.315)	-0.088 (0.124)	-0.247 (0.353)
chstatus.education	Lower than elementary school	-0.073 (0.104)	-0.160 (0.085)*	-0.104 (0.109)	0.195 (0.305)	-0.140 (0.092)	-0.193 (0.206)
chstatus.education	Elementary school	0.017 (0.091)	-0.243 (0.068)***	-0.013 (0.099)	0.063 (0.230)	-0.286 (0.073)***	-0.146 (0.164)
chstatus.education	Middle school/ higher						
chstatus.married	Yes	0.282 (0.148)*	0.109 (0.130)	0.153 (0.181)	0.483 (0.289)*	0.102 (0.137)	0.244 (0.316)
chstatus.married	No						
chstatus.lexpense11		0.009 (0.043)	0.110 (0.034)***	-0.035 (0.046)	0.123 (0.103)	0.088 (0.038)**	0.189 (0.076)**
chstatus.farm	Non-farmer	0.383 (0.082)***	0.288 (0.064)***				
chstatus.farm	Farmer						
chstatus.disabled11	Yes	0.003 (0.185)	-0.163 (0.119)	-0.062 (0.188)	0.311 (0.537)	-0.167 (0.126)	-0.009 (0.288)
chstatus.disabled11	No						
chstatus.chronic11		-0.028 (0.037)	-0.054 (0.030)*	-0.004 (0.039)	-0.111 (0.095)	-0.015 (0.033)	-0.135 (0.065)**
chstatus.adl11		-0.131 (0.025)***	-0.119 (0.024)***	-0.141 (0.027)***	-0.109 (0.064)*	-0.124 (0.025)***	-0.121 (0.078)
chstatus.disabled13	Yes	-0.276 (0.158)*	-0.198 (0.099)**	-0.117 (0.160)	-1.079 (0.460)**	-0.167 (0.106)	-0.307 (0.231)
chstatus.disabled13	No						
chstatus.chronic13		-0.302 (0.032)***	-0.332 (0.029)***	-0.330 (0.036)***	-0.240 (0.074)***	-0.326 (0.032)***	-0.338 (0.061)***
chstatus.adl13		-0.146 (0.024)***	-0.142 (0.019)***	-0.154 (0.025)***	-0.130 (0.070)*	-0.144 (0.020)***	-0.166 (0.063)***
_Limit2.chstatus		0.578 (0.041)***	0.668 (0.039)***	0.549 (0.042)***	0.686 (0.117)***	0.648 (0.042)***	0.736 (0.090)***
_Limit3.chstatus		0.967 (0.048)***	1.063 (0.044)***	0.974 (0.050)***	0.998 (0.127)***	1.097 (0.049)***	1.004 (0.097)***
_Rho		0.351 (0.082)***	0.256 (0.084)***	0.377 (0.087)***	0.104 (0.245)	0.226 (0.101)**	0.443 (0.160)***

*** P≤0.1; ** P≤0.05; ***P≤0.01**

Parameters (standard error) for absent workdays, Model I

Parameters	Level	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
missdays_total.Intercept		72.93 (66.39)	-108.78 (36.03)***	19.19 (74.27)	55.22 (144.86)	-102.70 (41.58)**	-133.37 (69.78)*
missdays_total.hstatus11	Poor	101.39 (17.00)***	135.61 (13.50)***	105.52 (17.71)***	72.05 (40.43)*	131.60 (16.20)***	153.55 (25.85)***
missdays_total.hstatus11	Fair	46.67 (10.19)***	65.59 (7.99)***	48.21 (10.79)***	24.87 (22.84)	64.12 (9.71)***	69.65 (14.16)***
missdays_total.hstatus11	Good						
missdays_total.age10		-25.53 (12.50)**	-1.34 (5.46)	-20.21 (13.60)	-5.83 (28.81)	-3.45 (6.24)	2.09 (10.44)
missdays_total.education	Illiterate	6.25 (7.05)	18.76 (8.41)**	7.52 (7.36)	-27.34 (23.51)	20.06 (8.78)**	6.92 (22.91)
missdays_total.education	Lower than elementary school	5.45 (7.66)	1.94 (6.37)	-0.02 (8.39)	21.95 (17.48)	4.63 (6.90)	-12.93 (15.28)
missdays_total.education	Elementary school	10.14 (6.50)	11.03 (5.04)**	5.05 (7.27)	28.17 (13.67)**	5.87 (5.71)	26.08 (9.85)***
missdays_total.education	Middle school/ higher						
missdays_total.married	Yes	-25.46 (11.03)**	-12.88 (9.60)	-3.12 (15.00)	-42.20 (18.43)**	-13.81 (10.22)	-5.99 (25.41)
missdays_total.married	No						
missdays_total.lexpense11		-0.44 (3.20)	4.68 (2.43)*	0.37 (3.56)	-9.77 (7.62)	5.55 (2.90)*	2.19 (4.22)
missdays_total.farm	Nor-farmer	-30.57 (6.28)***	-26.56 (4.92)***				
missdays_total.farm	Farmer						
_Sigma.missdays_total		74.26 (2.94)***	79.21 (2.72)***	77.39 (3.34)***	62.89 (6.29)***	81.72 (3.06)***	69.81 (5.87)***
hstatus11.Intercept		2.06 (0.84)**	0.28 (0.42)	2.00 (0.94)**	2.40 (1.89)	0.18 (0.49)	0.77 (0.85)
hstatus11.age10		-0.27 (0.16)*	0.08 (0.06)	-0.11 (0.17)	-0.64 (0.35)*	0.04 (0.07)	0.16 (0.13)
hstatus11.education	Illiterate	-0.32 (0.09)***	-0.11 (0.11)	-0.26 (0.09)***	-0.45 (0.28)	-0.04 (0.11)	-0.47 (0.31)
hstatus11.education	Lower than elementary school	-0.33 (0.10)***	-0.05 (0.08)	-0.29 (0.11)***	-0.32 (0.26)	-0.08 (0.08)	0.08 (0.18)
hstatus11.education	Elementary school	-0.08 (0.08)	-0.13 (0.06)**	-0.03 (0.09)	-0.19 (0.19)	-0.17 (0.07)**	-0.06 (0.13)
hstatus11.education	Middle school/higher						
hstatus11.married	Yes	0.19 (0.15)	0.09 (0.12)	0.05 (0.19)	0.50 (0.28)*	0.18 (0.13)	-0.23 (0.30)
hstatus11.married	No						
hstatus11.lexpense11		0.08 (0.04)**	0.11 (0.03)***	-0.02 (0.05)	0.30 (0.09)***	0.13 (0.03)***	0.09 (0.05)*
hstatus11.farm	Nor-farmer	0.20 (0.07)***	0.29 (0.05)***				
hstatus11.farm	Farmer						
hstatus11.disabled11	Yes	-0.13 (0.12)	-0.21 (0.08)***	-0.04 (0.12)	-0.52 (0.33)	-0.23 (0.08)***	-0.15 (0.18)
hstatus11.disabled11	No						
hstatus11.chronic11		-0.40 (0.03)***	-0.35 (0.02)***	-0.36 (0.03)***	-0.55 (0.08)***	-0.33 (0.02)***	-0.40 (0.04)***
hstatus11.adl11		-0.16 (0.03)***	-0.22 (0.03)***	-0.18 (0.03)***	-0.11 (0.08)	-0.22 (0.03)***	-0.21 (0.07)***
_Limit2.hstatus11		1.75 (0.05)***	1.64 (0.04)***	1.63 (0.06)***	2.09 (0.14)***	1.59 (0.05)***	1.75 (0.09)***
_Rho		0.31 (0.08)***	0.44 (0.05)***	0.38 (0.08)***	0.02 (0.22)	0.43 (0.07)***	0.52 (0.09)***

*** P≤0.1; ** P≤0.05; ***P≤0.01**

Parameters (standard error) for absent workdays, Model II

Parameters	Level	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
missdays_total.Intercept		130.62 (64.54)**	-96.15 (33.94)***	112.25 (71.52)	62.70 (145.45)	-100.64 (39.09)**	-111.95 (65.49)*
missdays_total.chstatus	Poor-Poor	99.55 (12.27)***	130.13 (10.91)***	109.38 (12.00)***	33.51 (42.47)	132.86 (12.40)***	142.50 (22.46)***
missdays_total.chstatus	Good/Fair-Poor	78.13 (10.02)***	93.61 (8.35)***	82.18 (9.87)***	29.85 (29.01)	100.77 (9.71)***	87.96 (15.53)***
missdays_total.chstatus	Poor-Good/Fair	43.48 (8.82)***	52.31 (7.59)***	36.60 (9.08)***	53.28 (22.65)**	54.17 (8.18)***	59.26 (19.42)***
missdays_total.chstatus	Good/Fair-Good/Fair						
missdays_total.age10		-29.72 (12.05)**	2.37 (5.21)	-31.29 (13.11)**	-2.79 (28.04)	3.34 (5.95)	-1.94 (9.88)
missdays_total.education	Illiterate	7.66 (6.71)	15.18 (7.96)*	5.93 (6.95)	-22.74 (23.76)	13.57 (8.36)	11.21 (21.47)
missdays_total.education	Lower than elementary school	11.84 (7.17)*	-1.20 (6.08)	4.09 (7.80)	31.33 (17.19)*	2.62 (6.58)	-22.65 (14.64)
missdays_total.education	Elementary school	12.80 (6.26)**	6.75 (4.83)	4.73 (6.95)	33.47 (13.53)**	-1.04 (5.49)	28.62 (9.30)***
missdays_total.education	Middle school/ higher						
missdays_total.married	Yes	-25.24 (10.56)**	-12.19 (9.12)	-10.03 (14.26)	-40.70 (18.53)**	-16.60 (9.64)*	13.85 (24.93)
missdays_total.married	No						
missdays_total.lexpense11		-2.70 (3.09)	5.14 (2.32)**	-0.84 (3.41)	-11.23 (7.19)	5.47 (2.76)**	3.61 (3.98)
missdays_total.farm	Non-farmer	-26.62 (6.02)***	-33.70 (4.59)***				
missdays_total.farm	Farmer						
_Sigma.missdays_total		71.08 (2.62)***	73.76 (2.22)***	73.34 (2.84)***	62.44 (6.33)***	76.62 (2.49)***	62.98 (4.66)***
chstatus.Intercept		3.83 (0.98)***	0.24 (0.51)	4.40 (1.06)***	3.26 (2.45)	0.13 (0.56)	0.54 (1.17)
chstatus.age10		-0.36 (0.18)**	0.23 (0.08)***	-0.35 (0.19)*	-0.47 (0.46)	0.24 (0.09)***	0.18 (0.18)
chstatus.education	Illiterate	-0.15 (0.10)	-0.19 (0.12)	-0.18 (0.10)*	0.16 (0.39)	-0.17 (0.13)	-0.47 (0.38)
chstatus.education	Lower than elementary school	-0.06 (0.11)	-0.11 (0.09)	-0.16 (0.12)	0.56 (0.38)	-0.08 (0.10)	-0.28 (0.23)
chstatus.education	Elementary school	0.02 (0.10)	-0.24 (0.07)***	-0.01 (0.11)	-0.08 (0.24)	-0.32 (0.08)***	-0.01 (0.18)
chstatus.education	Middle school/ higher						
chstatus.married	Yes	0.17 (0.17)	0.08 (0.14)	-0.11 (0.22)	0.62 (0.33)*	0.06 (0.14)	0.39 (0.37)
chstatus.married	No						
chstatus.lexpense11		-0.02 (0.05)	0.14 (0.04)***	-0.06 (0.05)	0.12 (0.12)	0.15 (0.04)***	0.13 (0.08)
chstatus.farm	Non-farmer	0.38 (0.09)***	0.20 (0.07)***				
chstatus.farm	Farmer						
chstatus.disabled11	Yes	0.19 (0.20)	-0.04 (0.13)	0.18 (0.20)	0.28 (0.56)	-0.03 (0.13)	0.14 (0.34)
chstatus.disabled11	No						
chstatus.chronic11		-0.04 (0.04)	-0.07 (0.03)**	-0.03 (0.04)	-0.07 (0.11)	-0.04 (0.03)	-0.14 (0.07)**
chstatus.adl11		-0.10 (0.03)***	-0.13 (0.03)***	-0.13 (0.03)***	0.03 (0.11)	-0.12 (0.03)***	-0.21 (0.09)**
chstatus.disabled13	Yes	-0.42 (0.17)**	-0.25 (0.10)**	-0.25 (0.17)	-1.19 (0.47)**	-0.27 (0.11)**	-0.23 (0.27)
chstatus.disabled13	No						
chstatus.chronic13		-0.32 (0.04)***	-0.33 (0.03)***	-0.36 (0.04)***	-0.25 (0.09)***	-0.32 (0.03)***	-0.34 (0.07)***
chstatus.adl13		-0.17 (0.03)***	-0.13 (0.02)***	-0.20 (0.03)***	-0.15 (0.09)*	-0.13 (0.02)***	-0.22 (0.10)**
_Limit2.chstatus		0.57 (0.04)***	0.66 (0.04)***	0.53 (0.05)***	0.76 (0.14)***	0.63 (0.05)***	0.75 (0.10)***
_Limit3.chstatus		0.97 (0.05)***	1.07 (0.05)***	0.97 (0.05)***	1.09 (0.15)***	1.11 (0.05)***	1.00 (0.11)***
_Rho		0.31 (0.07)***	0.35 (0.05)***	0.40 (0.06)***	-0.14 (0.24)	0.37 (0.05)***	0.44 (0.10)***

*** P≤0.1; ** P≤0.05; ***P≤0.01**

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Section and page number (P)
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Abstract (P2)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract (P2–3)
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction (P5-6)
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction (P7)
Methods			
Study design	4	Present key elements of study design early in the paper	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods (P7-8)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Methods (P8-9)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods (P9-10) Appendix 2
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods (P10)
Bias	9	Describe any efforts to address potential sources of bias	Methods (P11)
Study size	10	Explain how the study size was arrived at	Methods (P8-9) Results (P13)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods (P10) Appendix 1
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Methods (P11-13) Appendix 3
		(*b*) Describe any methods used to examine subgroups and interactions	Methods (P12)
		(*c*) Explain how missing data were addressed	Methods (P9)
		(*d*) If applicable, explain how loss to follow-up was addressed	N/A
		(*e*) Describe any sensitivity analyses	Methods (P13)
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Results (P13-14)
		(b) Give reasons for non-participation at each stage	N/A

		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	Report numbers of outcome events or summary measures over time	Tables 1, 2
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Tables 3, 4, 5
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Discussion (P15) Appendix 4
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion (P15-16)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion (P17)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion (P16-20)
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion (P19)
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Funding information (P21)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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The effects of health status on work exit and absenteeism among the older working population in China

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The effects of health status on work exit and absenteeism among the older working population in China

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Abstract

Objectives: To analyze the effects of health status on work exit and absenteeism among the older working population in China.

Design: Secondary analysis of a cohort sample.

Setting and participants: Community samples who engaged in either agricultural or non-agriculture work or both in the 2011 wave of the China Health and Retirement Longitudinal Study (CHARLS) and whose age was 45-55 years for women or 45-60 years for men in the 2013 wave.

Outcome measures: Work exit and number of absent workdays due to health problems in 2013. To address the problems of measurement error of self-rated health status, we used disability condition, number of chronic diseases and functional limitation to construct an index of health. We divided the sample into four groups according to gender and work types (farmers who conducted any agricultural work in 2011 versus non-farmers who conducted non-agricultural work only) and conducted analyses separately.

Results: Farmers (11.0% for women and 4.9% for men) were less likely to exit from work than non-farmers (18.5% and 12.0%, respectively) but took more absent workdays (16.6 days for women and 15.0 days for men) than non-farmers (5.6 and 4.9). Poor health status in 2011 was significantly associated with the work exit in 2013 of female and male farmers but not non-farmers. Older workers (except female non-farmers) with persistently poor health or recent health deterioration over time were significantly more likely to stop working or missed more workdays than those with persistently good health.

Conclusions: Poor two-year lagged health predicts work exit for both male and female farmers, and increases the absent work days in all older working population. Persistently poor health or recent health deterioration over time has detrimental impact on labour market in terms of work exit and absenteeism among all older Chinese workers except for female non-farmers.

Strengths and limitations of this study

- We analyzed the effects of the lagged health status and the evolution of health status over time on work exit and absenteeism among the older working population in China.
- We measured two outcomes: work exit and the number of absent workdays due to health problems among those who remained working.
- To address the problems of measurement error of self-rated health status, we used three detailed health measures to construct an index of health in our analyses.
- We only selected working population in 2011 which might underestimate the effect of health status.

Keywords: Health status; Work exit and absenteeism; Older working population; China

Introduction

China has become one of the fastest ageing countries in the world.[1] The number of people in labour force (aged 18-64 years) is expected to decline by approximately 140 million in 2050 even under the current universal two-child policy.[2] The rapid growth of the older population and shrinking labour force raise many problems in Chinese society. One of the prominent problems is a possible threat to the stability and sustainability of the current social pension system of China. The shrinking labour force will contribute less to the retirement income system and an increasing aged population will be eligible to receive retirement pensions. Therefore the combination of the two trends could significantly impact economic growth adversely and cause the pension fund to become bankrupt.

Currently, China's labour market has shown the following two characteristics. On one hand, the employment rate among older population in the urban area (mainly conducting non-agricultural work) is very low, it only reaches 40% among people between 50 and 59, and this rate decreases further to about 20% for those aged 60-64.[3] This might be due to the official mandatory retirement policies implemented in the urban formal sectors.[4] Specifically, the retirement age for men is 60 years and for women, it is 55 for civil servants and employees for state enterprises, and 50 for others. On the other hand, the employment rate among older population in the rural area (mainly conducting agricultural work) is very high, most people still work between 65 and 69, and by the age of 80, the employment rate is still above 20%.[3] This divergence of employment for the urban and rural areas is mainly due to the fact that the retirement policy, the pension program and unemployment insurance program are limited only to the urban formal sectors in China but not to the rural population. Considering that the older population has become or will become the main component of labour force in China, it is crucial to keep them active and productive in the labour

market to maintain sufficient labour supply and contain the increasing national spending on income support.

Labour market status are affected by many factors, among which the influence of health on labour supply has attracted more and more attention. Specifically, people would have to stop working due to their poor health status or frequently take sick leaves while remaining working. It is important and necessary to study the effect of health status on work exit and absenteeism among the older working people for the following two reasons. First, it helps policy makers better understand the impact of health on labor market activities and therefore they will be able to develop appropriate policies to encourage older working people to not only remain active in the labour market but also remain productive. Second, it helps policy makers better understand the consequence of poor health, which includes not only the higher healthcare expenditures but also the productivity losses attributable to work exit and absenteeism.

There is a vast literature that demonstrates poor health has a significant impact on work exit in the developed countries especially among older population. In these economic and epidemiological studies, poor health has been measured by self-rated health (SRH),[5-13] chronic diseases such as depression,[14] rheumatoid arthritis,[15] diabetes,[16] cancer,[17] and functional limitations.[18] Many studies have also shown the impact of one specific disease on the number of absent workdays among people with the disease.[19-25] However, worldwide, there are only a few studies from the developed countries that measure the number of absent workdays in the general population due to a lack of data.[26-30] Most studies to date have focused on either comparing the incremental effects of different chronic diseases on absent workdays or estimating the incremental productivity loss due to

different chronic diseases.[26-31] Overall, there are few studies analyzing the effect of health on work exit or absenteeism in the developing countries,[32] especially among older working population.

In addition, most of the previous studies have examined the static relationship between health and work exit. However, the relationship can be a dynamic process. Studies have shown that not only the current health status but also the previous health status affect decisions concerning work exit.[9, 10] Therefore, the impact of persistently poor health might be different from that of recent health deterioration. To fill the literature gap, this present paper was to examine the effects of health status on work exit and absenteeism among the older working population in China. Specifically, we measured the impact of previous health status and the change of health status over time on work exit and the number of absent workdays due to the health problems among the older people who were previously working. Our hypotheses were: 1) those with poorer previous health status were expected to be more likely to exit from work or missed more workdays; 2) those with persistently poor health were expected to be most likely to exit from work and had the highest number of absent workdays.

METHODS

Data and study population

The data used in the paper were drawn from the first two waves (2011 and 2013) of the China Health and Retirement Longitudinal Study (CHARLS) survey in China. The details of the survey can be found in Zhao *et al*.[33] Generally speaking, CHARLS is designed in the similar way to the US Health and Retirement Study as a broad-purposed social science and health survey of people aged 45 or older and their spouses in China. It is a high-quality survey of nationally representative

sample of Chinese residents. The national baseline survey for CHARLS was conducted between June 2011 and March 2012 and the respondents are followed every 2 years, using a face-to-face computer-assisted personal interview (CAPI). Samples were chosen through multistage probability sampling. In the first stage, 150 county-level units were randomly chosen with a probability proportional-to-size sampling technique from a sampling frame containing all county-level units with the exception of Tibet. The sample was stratified by region and within region by urban districts or rural counties and per capita statistics on gross domestic product. The final sample of 150 counties fell within 28 provinces. After excluding empty or non-resident dwellings, 12,740 households were age-eligible for CHARLS. Final CAPI interviews were conducted on 10,257 households, which included 17,708 individual participants. The response rate of the survey was 80.5%. Of the 19.5% rate of nonresponse, 8.8% was due to refusal to respond, 8.2% to unable to contact sample residents, and 2.0% to other reasons. The survey contains detailed information on individual and household characteristics, such as individual demographics, work activities, health conditions, health services utilization and insurance, physical measurements, and household income, expenditure, and assets.

Our study population was based on the CHARLS participants who engaged in either agricultural or non-agriculture work or both in 2011 and whose age was between 45 and 55 years for women or between 45 and 60 years for men in 2013 (n = 4,683). The age restriction was chosen according to the legal retirement age typically for those who are employed in the urban formal sectors in China. Although retirement age policy does not apply to the rural population, for comparison purpose, we chose the same age bands for participants who engaged in the agricultural job. We further restricted our study sample to those without missing data on labour participation status and

other explanatory variables. As a result, our final sample used for analyzing the effect of health status on work exit was 4,332. Among them, 3,942 individuals were still working in 2013 and eligible for the questions on number of absent workdays due to health problems. After removing sample with missing value on number of absent workdays, 3,846 individuals were used for analyzing the effect of health status on number of absent workdays.

Ethics approval for this study was not required because it was based exclusively on the publicly available data, CHARLS, and no new data were collected for this study. CHARLS was approved by the Ethical Review Committee (IRB) at Peking University, Beijing, China.

Measures

Measurement of work exit and absenteeism

In the present paper, we measured two outcomes: work exit and the number of absent workdays due to health problems in 2013. Work exit status was determined by a series of questions in CHARLS (see the Section 1 of Appendix). An individual was considered as "working" if he or she engaged in agricultural work (including farming, forestry, fishing, and husbandry for his or her own family or others) for more than 10 days in the past year, or worked for at least one hour last week (such as earning a wage, running their own business and unpaid family business work), or was on leave but expected to go back or still received salary. Otherwise, an individual was considered as "not working". Since our study population was the CHARLS participants who were "working" in 2011, "not working" in 2013 was referred to as work exit.

The number of absent workdays due to health problems was measured based on the question, "How many days of work did you miss last year due to health problems?" for those who were still working in 2013, i.e., those who engaged in household agricultural work, being employed, or in non-farm self-employed and unpaid family business.

Measurement of health and other controls

SRH has been used extensively in epidemiological and economic studies not only as a measure of population health but also as a predictor of mortality, morbidity, health care utilization and work exit.[5, 8, 9, 12, 34-37] To be consistent with literature, we used SRH as our main health measure. The SRH (5-point Likert scale) in 2011 and 2013 were categorized into: good (reported good health or better than good health), fair (reported fair health), and poor (reported poor health or worth than poor health), respectively. The change of health status from 2011 to 2013 was defined by four categories: poor in 2011 to poor 2013, good/fair 2011 to poor 2013, poor 2011 to good/fair 2013, good/fair 2011 to good/fair 2013.

Other detailed health measures were used to construct an index of health to address the endogeneity and measurement error issues of the SRH, which was described in the Econometric models section. These measures included disability condition, number of chronic diseases, and functional limitations. Other control variables included age, education (illiterate, lower than elementary school, elementary school graduate, and middle school or higher), marriage status (married vs. not), and monthly household expenditures on food, utilities, household items, clothing, medical care, taxes, *etc*. The detailed definition of the health-related and control variables are presented in the Section 2 of Appendix.

Patient and public involvement

There was no public or patient involvement in the development of research question, the outcome measures, the design or implementation of the study.

Econometric models

There are a number of potential problems with the SRH. First, there might exist reverse causality between health and labour market status.[38, 39] To address this, we measured the impact of health status before work exit on work exit (i.e., the impact of health status in 2011 on work exit in 2013) to avoid the reverse causality. Second, the SRH may also suffer "justification bias", that is, an individual could justify his or her work exit by reporting worse health status than his or her true health status.[40] Third, due to individual heterogeneity, the SRH measure might not be comparable across respondents, which means there may also be measurement error problem.

To address the potential endogeneity and measurement error of the SRH, we followed Bound *et. al.*(1999)[9] and used the latent variable model , which is analogous to using the three detailed health measures (i.e., disability condition, number of chronic diseases, and functional limitations) to construct an index of health.[9, 10, 38] Specifically, we used ordered Probit model for the SRH in 2011 (H_{11}) and the change of SRH from 2011 to 2013. We carried out the full information maximum likelihood estimation method using SAS QLIM procedure.[41] A number of goodness-of-fit measures (including different Pseudo R-squared) for the ordered Probit model for the SRH were conducted to show how well the three detailed measures predict SRH.

Two different model specifications were used: Model I. to examine the effect of lagged health status by including H_{11} in the model; Model II. to examine the effect of change in health status by including the change of SRH from 2011 to 2013 in the model. The specific model specifications were presented in the Section 3 of Appendix. All analyses were weighted using the individual longitudinal weights provided by CHARLS.[42]

Similar method was used for absent workdays. We employed the Tobit model for the number of absent workdays and the ordered Probit models for the SRH in 2011 and the change of SRH. Tobit regression was used for the number of absent workdays due to health problems, as its value was truncated at zero with a large number of observations at the zero point.

Considering the gender difference in health and labour force participation,[5, 9, 12] the recommendation of gender-disaggregated analysis,[43-45] and the difference in population and polices between rural and urban areas mentioned above, we divided our sample into four separate groups according to gender and working types in 2011: female farmers (i.e., any agricultural work), female non-farmers (non-agricultural work only), male farmers, and male non-farmers. In addition, we also conducted a preliminary analysis by pooling all four groups and testing difference with interactions. The model parameters were reported in the Section 4 of Appendix. It is shown that the impacts of health status on work exit marginally differ among the groups. Thus, based on both background knowledge and statistical testing, we conducted four separate group analyses.

Interpreting estimated health coefficients

It is difficult to interpret the magnitude of the estimated health coefficients in Probit model for work exit and Tobit model for the number of absent workdays. To help the interpretation, we presented the expected probability of work exit for each of the four categories of the change of health status from 2011 to 2013.[46, 47] To do this, we first assigned all individuals in our datasets to one of the four categories, and then calculated the expected probability of work exit for each individual using their own levels for the control variables (i.e., age, education, marriage status, and expenditures in 2011) and the assigned category of the change of health status. Last, we reported the mean value of the expected probability of work exit among all individuals. For absent workdays, we calculated the average expected number of absent workday following the same method.

Sensitivity analysis

We conducted all the analyses without using the weights and conducted the analyses by including all older farmers without applying the age restriction.

Results

Table 1 presents our sample characteristics in 2011 by gender and by our four separate working groups: female farmers, female non-farmers, male farmers, and male non-farmers. About 36% of women and 39% of men were non-farmers (weighted proportion), *i.e.*, engaged in non-agricultural work only in 2011. Not surprisingly, non-farmers' education level was much higher than that of farmers and men's education was higher than that of women. In terms of SRH, farmers and women had poorer SRH than non-farmers and men, respectively. Consistently, farmers were more likely to be disabled, and suffered from more chronic diseases and functional limitations than non-farmers, regardless of gender.

Table 2 presents the percentage of work exit and the number of absent workdays in 2013 by gender and work type. Overall, about 90% were still working in 2013. Regarding each gender and work type group, 18.5% of female non-farmers and 12.0% of male non-farmers stopped work in 2013, while the percentages for female and male farmers were 11.0% and 4.9%, respectively. Conditional on keeping working in 2013, for farmers, the number of absent workdays was 16.6 days for women and 15.0 days for men. For non-farmers, the numbers were 5.6 and 4.9 days for women and men, respectively. Table 2 also shows possible associations among work exit/absenteeism, the SRH in 2011, 2013, and the change of SRH from 2011 to 2013. People in poor health status in 2011 or 2013 had the highest percentage of work exit within each gender and work type group except for female non-farmers. The recent health deterioration (good/fair to poor) and persistently poor health (poor to poor) were associated with a higher probability of work exit for both females and males but this relationship was not shown among non-farmers after further breaking the population down by farmers and non-farmers. In terms of absent workdays, people in poor health status in 2011 and 2013, respectively, or in persistently poor health status over time had the largest number of absent workdays across all the groups.

Validation of constructed health measure

Table 3 presents a number of goodness-of-fit measures (including different Pseudo R-squared) for the ordered Probit model for the SRH to show how well the three detailed measures predict SRH. Different Pseudo R^2s were used to indicate how well these health measures explain SRH. According to Louviere et al. [48] (page 54), one should not expect to obtain pseudo R^2 values as high as the R^2 commonly obtained in ordinary least squared (OLS) regression applications. For instance,

values of McFadden's LRI between 0.2-0.4 indicate extremely good model fits, which is approximately equivalence to 0.7-0.9 for R^2 from OLS based on simulations. Therefore, our pseudo R^2 values (McFadden's LRI ranged from 0.09 to 0.18) suggested that the detailed health measures moderately to strongly explained SRHs.

Work exit

Table 4 presents the analytical results of model I for the impact of two-year lagged health only and model II for the impact of the change of health status over time. Other parameter estimates are presented in the Section 5 of Appendix. Results of model I showed that farmers in poor health status in 2011 were more likely to stop work than those in good health in 2011 (model parameter 0.655 ($p \leq 0.05$) for women and model parameter 0.810 ($p \leq 0.01$) for men). Results of model II showed that people who changed health status from poor to poor, good/fair to poor, and poor to good/fair were significantly more likely to exit from work than people with persistently good status except for female non-farmers. For example, among female farmers, the probabilities of work exit were significantly higher for those who changed health status from poor to poor (model parameter 0.752 ($p \leq 0.01$)), good/fair to poor (model parameter 0.763 ($p \leq 0.01$)), and poor to good/fair (model parameter 0.415 ($p \leq 0.05$)) than those with persistently good health status (the reference group). The expected values shown in Tables 5 and 6 are more helpful in understanding the magnitudes of the effects. Across all groups except for female farmers and female non-farmers, people with persistently poor health had the highest probability of work exit, e.g., 0.28 for all males with persistently poor health compared with 0.05 for those with persistently good health. There was then a decreasing trend of probability of work exit among farmers with health status change

from good/fair to poor, poor to good/fair and then good to good. However, this trend did not hold for non-farmers.

Number of absent workdays due to health problems

Among those who were still working in 2013, the overall average number of absent workdays due to health problems was 12 days (SE=0.63). The average number of absent workdays among farmers (16.6 (1.4) for women and 15.0 (1.1) for men), much higher than non-farmers (5.6 (1.3) and 4.9 (0.9), respectively) (Table 2). All older working people with poorer health status had significantly more number of absent workdays due to health problems (Table 4 and Table 5). When analyzing the impact of the change of health status over time, the model parameters (Table 4) and expected values (Table 6) showed a decreasing trend with persistently poor status leading to the largest number of absent workdays, followed by the changes from good/fair to poor, from poor to good/fair, and persistently good/fair. The exception was found in female non-farmers.

Sensitivity analyses

The analysis results without using the weights provided by CHARLS were consistent with the main analysis results considering the weights. In addition, after dropping the age restriction for farmers, we observed similar effects (in terms of magnitude and significance) of the lagged health status and the change of health status over time. The detailed results can be found in the Section 6 of Appendix.

Discussion

The effect of health status on work exit and absent workdays among older working people in China has not been extensively studied. This present paper fills the gap by examining the impact of the two-year lagged health status and the change of health status over time on work exit and absent workdays in a representative older working population sample in China. We found that the effects of health status varied by the two outcomes (i.e., work exit and absent workdays) as well as by both gender and working types (agricultural work vs. non-agricultural work). Two-year lagged health status had significant effects on work exit among female and male farmers but not among non-farmers. In addition, the older workers (except female non-farmers) with poor health in either 2011or both 2011 and 2013 were significantly more likely to exit from work or missed more workdays than those with persistently good health over time. Those with persistently poor health or recent health deterioration incurred the highest probability of work exit and number of absent workdays except for female non-farmers.

Many studies have investigated the relationship between health and labor force participation or work exit among older workers in the developed countries.[5-13] For example, Bound et al. (1999) investigated the dynamic effects of health on labor force behaviour of older workers using US data and found that poor health led many older workers to withdraw from the labor force.[9] In addition, respondents whose health declined relatively recently were more likely to exit from the labour force than those whose health declined earlier.[9] Disney et al. (2006) demonstrated that ill health predicted individual retirement behaviour among workers aged from 50 until state pension age in Britain.[10] van den Berg et al. (2010) showed that poor SRH was strongly associated with exit from paid employment due to retirement, unemployment or disability among older workers in 11 European countries.[7] However, there are very few such studies in the developing countries.

Consistent with findings in literature, our study showed that female or male older workers with poor health (without further distinguishing farmers and non-farmers) were significantly more likely to exit from work. In contrast to Bound *et al.*,[9] we found that female or male older workers with persistently poor health incurred the highest probability of work exit. The discrepancy might be due to different populations, labour force markets and social security systems.

Our study revealed the important differences between farmers and non-farmers as well as between males and females in Table 1 and Table 2. Farmers generally had worse health status than non-farmers. However, the work exit rate was lower in farmers than in non-farmers, which is consistent with previous studies,[3, 4, 49] and conditional on keeping working in 2013, the number of absent workdays for farmers was found to be higher than that of non-farmers. One possible explanation is that since social security schemes have not been fully implemented in rural areas and agricultural income is the main source of income for older farmers, they have to continue their work to late life. The other possible explanation is that poorer health status of farmers compared to non-farmers causes them to take more sick leaves while remaining working. In addition, we found that health status was not a significant factor leading to work exit for female non-farmers, which suggests that work exit of female non-farmers is attributable to factors other than health. The improvement in health status only might not keep female non-farmers at work.

In our population selection, we restricted to women between 45 and 55 years and men between 45 and 60 years in 2013 based on the retirement age policy that is applied to the urban formal sectors in China. However, this policy does not apply to the rural population (i.e. those in agricultural work). We therefore conducted sensitivity analyses by including all older working farmers without

the age restriction. It showed that the effects of health status were similar to our main analysis results by applying the age restriction and relaxing the age restriction did not affect our conclusion on the influence of health status on work exit and the number of absent workdays for farmers.

One of our limitations is that when analyzing the impact on work exit, we did not further distinguish those who were not working in 2013 by their work exit routes, e.g., retirement, disability (due to health reasons), or other reasons due to the small sample size for the subgroups. We found neither health reasons nor retirement was the major reason for the work exit in 2013. Specifically, about 25% of female farmers and 40% of male farmers were not working due to health reasons and these proportions went up to 33% and 41%, respectively, if we dropped the age restriction. Only 2% of female and male farmers were not working due to retirement and the proportions did not change much if we dropped the age restriction (2% of female farmers and 5% of male farmers). The detailed reasons of work exit for different groups can be found in the Section 7 of Appendix. The small proportion of retirement for farmers was partially due to the lack of retirement and pension schemes for rural population in China.[49] On the other hand, about 5% and 27% of female non-farmers and 20% and 8% of male non-farmers stopped working due to health reasons and retirement, respectively. Therefore, the effects of health status on work exit were comparable in the three groups (female farmers, male farmers and male non-farmers) because of their similar work exit routes. Also, the facts that very few female non-farmers stopped working due to health reasons and relatively high proportion of female non-farmers stopped working due to retirement partially confirm our explanation that work exit of female non-farmers is attributable to factors other than health.

In the present study, we only selected working population in 2011. People in poor health in 2011 who continued working in 2013 might have unobserved characteristics that encouraged them to work. For example, they might be in better health status than our health measures suggested or had a strong commitment to their work.[9] Therefore, we may have underestimated the effect of health status. However, we were more interested in examining the effect of health on the decision whether to continue working among the older people who had been already in the labour force. Therefore, our study findings are more relevant to the policies that attempt to retain the existing older working population through improving their health.

The proportion of older workers is expected to increase among the working population in China, which will be further exacerbated by China's recent plan to raise the official retirement age.[50] Our study has important policy implications for China and other developing countries. Female non-farmers currently have earlier legal retirement age than male non-farmers and our findings indicate that female non-farmers might have to stop working due to the legal retirement age requirement instead of health. Therefore, more research is needed to investigate whether the legal retirement age should be extended for female non-farmers. Since exit from labour force is generally not reversible at an older age particularly for non-farmers, the priority should be given to the policies that better improve the overall workers' health status and improve the work circumstances of workers especially with persistently poor health. In addition, having realized the problem of lacking old-age security for the rural elderly, China government launched a nationwide, experimental rural social pension plan in 2009, which is expected to cover 10 percent of rural regions by the end of 2009, about 50 percent by 2012, and 100 percent by 2020.[51] However, our and previous findings using the same data indicated that the new pension plan did not affect the

labor supply of rural elderly, as the majority of the elderly population sampled continued to work into their seventies. Our findings of older farmers taking more sick leaves while remaining in the labour force also suggest an unproductive rural labour force. It may indicate that the new pension plan has not provided enough social security for the elderly in rural China or there is a lack of knowledge and awareness of such pension plan. More research is needed in the future to explore the reasons why rural elderly still keep working under the new pension plan and accurately estimate the effect of the new pension plan on welfare of rural elderly.

In conclusion, poor two-year lagged health predicts work exit for both male and female farmers, and increases the absent work days in all older working population. Persistently poor health or recent health deterioration over time has detrimental impact on labour market in terms of work exit and absenteeism among all older Chinese workers except for female non-farmers.

Contribution Statement

XL and WZ designed the study, developed data analysis plan and equally contributed to this study. HS performed statistical analysis of the data. AHA provided guidance on economic theory and analysis. All authors made significant contributions to the interpretation of results and participated in drafting and revising the manuscript. All authors have approved the final version.

Competing Interests

None.

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Ethics approval

The original CHARLS was approved by the ethics review committee of Peking University.

Data Sharing Statement

All data collected in CHARLS are maintained at the National School of Development of Peking University, Beijing, China, and are publicly available at: http://charls.pku.edu.cn/en.

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Table 1. Demographic and health characteristics in 2011

Variables	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Sample N	1652	2680	1256	396	1874	806
Age, years	48.06 (0.07)	51.07 (0.09)	48.16 (0.06)	47.89 (0.16)	51.28 (0.1)	50.74 (0.16)
Education						
Illiterate	344 (19.45)	158 (5.45)	319 (26.01)	25 (7.69)	135 (7.46)	23 (2.36)
Lower than elementary school	250 (14.12)	337 (12.17)	218 (17.32)	32 (8.38)	273 (14.93)	64 (7.91)
Elementary school	369 (21.27)	574 (20.59)	308 (24.73)	61 (15.07)	448 (24.31)	126 (14.86)
Middle school or higher	689 (45.15)	1611 (61.78)	411 (31.93)	278 (68.86)	1018 (53.3)	593 (74.87)
Married	1587 (95.15)	2573 (95.68)	1214 (96.3)	373 (93.09)	1788 (94.81)	785 (97.03)
Household expenditures monthly	2744.55 (143.88)	2869.26 (163.99)	2120.78 (80.98)	3862.59 (353.58)	2104.85 (86.05)	4048.25 (393.95)
Self-rated health						
Good	424 (26.38)	884 (36.15)	284 (22.94)	140 (32.54)	544 (30.82)	340 (44.38)
Fair	872 (54.22)	1372 (49.29)	665 (52.12)	207 (57.98)	982 (50.28)	390 (47.76)
Poor	356 (19.41)	424 (14.56)	307 (24.95)	49 (9.48)	348 (18.9)	76 (7.86)
Disable	148 (8.12)	315 (11.07)	124 (10.12)	24 (4.55)	251 (13.29)	64 (7.64)
No. of chronic diseases (range 0-14)	0.99 (0.04)	1 (0.03)	1.1 (0.04)	0.81 (0.07)	1.07 (0.03)	0.89 (0.06)
Functional limitations (range 0-18)	0.48 (0.04)	0.33 (0.02)	0.63 (0.05)	0.19 (0.06)	0.44 (0.03)	0.16 (0.03)
Notes: the proportions in parentheses are weighted proportions; the means are weighted means, and standard errors of the mean are in parentheses.						

Table 2. Work exit and number of absent workdays in 2013 by self-rated health

	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Work exit, N (weighted %)						
Overall	202 (13.65)	188 (7.71)	129 (10.95)	73 (18.50)	85 (4.98)	103 (12.02)
Self-rated health in 2011						
Good	52 (12.49)	50 (5.47)	28 (11.31)	24 (13.98)	18 (3.76)	32 (7.31)
Fair	106 (14.27)	90 (8.48)	67 (10.23)	39 (20.77)	38 (4.36)	52 (15.27)
Poor	44 (13.52)	48 (10.64)	34 (12.11)	10 (20.16)	29 (8.45)	19 (18.93)
Self-rated health in 2013						
Good	46 (13.02)	46 (6.69)	21 (10.10)	25 (16.42)	14 (2.98)	32 (10.96)
Fair	106 (13.47)	85 (6.44)	68 (9.65)	38 (19.95)	33 (3.06)	52 (11.82)
Poor	50 (14.90)	57 (14.11)	40 (14.48)	10 (16.54)	38 (13.71)	19 (16.45)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	130 (13.42)	113 (6.45)	72 (9.46)	58 (18.88)	38 (2.88)	75 (11.10)
Poor – Good/Fair	22 (12.69)	18 (7.29)	17 (11.47)	5 (17.08)	9 (4.42)	9 (19.37)
Good/Fair – Poor	28 (15.49)	27 (13.44)	23 (16.59)	5 (12.54)	18 (12.80)	9 (15.39)
Poor – Poor	22 (14.30)	30 (15.11)	17 (12.66)	5 (24.90)	20 (14.05)	10 (18.46)
Number of absent workdays, weighted mean (SE)						
Overall	12.85 (1.07)	11.23 (0.79)	16.61 (1.40)	5.57 (1.30)	15.04 (1.09)	4.89 (0.94)
Self-rated health in 2011						
Good	7.80 (1.59)	5.98 (0.86)	10.96 (2.07)	3.67 (2.39)	9.73 (1.73)	1.85 (0.49)
Fair	10.94 (1.38)	10.49 (0.97)	14.32 (1.85)	4.88 (1.49)	13.14 (1.21)	5.58 (1.53)
Poor	25.48 (3.17)	27.86 (3.59)	27.04 (3.58)	17.30 (5.81)	29.60 (4.00)	20.59 (7.88)
Self-rated health in 2013						
Good	5.80 (1.43)	4.13 (0.76)	6.24 (1.28)	5.24 (2.81)	6.10 (1.23)	1.70 (0.73)
Fair	9.39 (1.04)	9.60 (1.01)	12.04 (1.32)	4.45 (1.38)	12.63 (2.37)	4.22 (1.24)
Poor	31.77 (3.88)	32.91 (3.49)	36.48 (4.57)	12.40 (4.54)	37.99 (6.90)	19.53 (6.17)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	7.58 (0.86)	6.59 (0.61)	9.98 (1.07)	3.94 (1.33)	9.16 (0.87)	2.97 (0.77)
Poor – Good/Fair	13.87 (2.93)	17.24 (4.25)	13.39 (3.29)	15.63 (6.63)	19.09 (5.89)	8.00 (6.54)
Good/Fair – Poor	26.42 (5.48)	25.88 (3.78)	32.98 (7.10)	9.40 (4.61)	31.75 (4.51)	12.29 (4.91)
Poor – Poor	37.47 (5.49)	43.92 (6.49)	39.49 (5.97)	20.69 (11.49)	46.87 (6.87)	34.21 (15.48)

Notes: the numbers in parentheses are weighted percentages; the means are weighted means, and standard errors of the mean are in parentheses.

Table 3. Goodness-of-fit measures

From the ordered Probit model for 2011 self-rated health status							
Measures	Formula	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Likelihood Ratio (R)	2 * (LogL - LogL0)	338.75	534.86	248.99	69.06	366.72	138.99
Upper Bound of R (U)	- 2 * LogL0	3309.35	5344.34	2571.62	716.53	3835.49	1472.42
Aldrich-Nelson	R / (R+N)	0.17	0.17	0.17	0.15	0.16	0.15
Cragg-Uhler 1	1 - exp(-R/N)	0.19	0.18	0.18	0.16	0.18	0.16
Cragg-Uhler 2	(1-exp(-R/N)) / (1-exp(-U/N))	0.21	0.21	0.21	0.19	0.20	0.19
Estrella	1 - (1-R/U)^(U/N)	0.19	0.19	0.19	0.17	0.19	0.17
Adjusted Estrella	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)	0.19	0.19	0.18	0.14	0.18	0.15
McFadden's LRI	R / U	0.10	0.10	0.10	0.10	0.10	0.09
Veall-Zimmermann	(R * (U+N)) / (U * (R+N))	0.26	0.25	0.25	0.23	0.24	0.23
McKelvey-Zavoina		0.25	0.24	0.25	0.21	0.24	0.20
From the ordered Probit model for the change of self-rated health status from 2011 to 2013							
Measures	Formula	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Likelihood Ratio (R)	2 * (LogL - LogL0)	449.84	645.69	383.94	60.14	455.83	173.20
Upper Bound of R (U)	- 2 * LogL0	3082.98	4333.81	2654.50	508.99	3482.89	937.43
Aldrich-Nelson	R / (R+N)	0.21	0.19	0.23	0.13	0.20	0.18
Cragg-Uhler 1	1 - exp(-R/N)	0.24	0.21	0.26	0.14	0.22	0.19
Cragg-Uhler 2	(1-exp(-R/N)) / (1-exp(-U/N))	0.28	0.27	0.30	0.19	0.26	0.28
Estrella	1 - (1-R/U)^(U/N)	0.25	0.23	0.28	0.15	0.23	0.21
Adjusted Estrella	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)	0.25	0.22	0.27	0.11	0.22	0.19
McFadden's LRI	R / U	0.15	0.15	0.14	0.12	0.13	0.18
Veall-Zimmermann	(R * (U+N)) / (U * (R+N))	0.33	0.31	0.34	0.23	0.30	0.33
McKelvey-Zavoina		0.32	0.29	0.35	0.20	0.28	0.30

Table 4. Model parameters for work exit and absent workdays

Model [a]	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
I - 2011 Health status [b]						
Poor	0.744 (0.259)***	0.577 (0.253)**	0.655 (0.287)**	0.753 (0.546)	0.810 (0.296)***	0.281 (0.447)
Fair	0.446 (0.156)***	0.306 (0.151)**	0.298 (0.182)	0.563 (0.305)*	0.300 (0.192)	0.251 (0.250)
II – Health status change [c]						
Poor-Poor	0.753 (0.202)***	1.142 (0.204)***	0.752 (0.209)***	0.472 (0.633)	1.265 (0.239)***	1.163 (0.411)***
Good/Fair-Poor	0.621 (0.171)***	0.865 (0.161)***	0.763 (0.173)***	-0.135 (0.507)	1.097 (0.194)***	0.681 (0.300)**
Poor-Good/Fair	0.358 (0.156)**	0.471 (0.165)***	0.415 (0.168)**	0.043 (0.386)	0.419 (0.199)**	0.895 (0.331)***
Number of absent workdays						
I - 2011 Health status [b]						
Poor	101.39 (17.00)***	135.61 (13.50)***	105.66 (17.72)***	72.05 (40.43)*	131.60 (16.20)***	153.55 (25.85)***
Fair	46.67 (10.19)***	65.60 (7.99)***	48.16 (10.79)***	24.87 (22.84)	64.12 (9.71)***	69.65 (14.15)***
II – Health status change [c]						
Poor-Poor	99.55 (12.27)***	130.13 (10.91)***	109.38 (12.00)***	33.51 (42.47)	132.86 (12.40)***	142.50 (22.46)***
Good/Fair-Poor	78.13 (10.02)***	93.61 (8.35)***	82.18 (9.87)***	29.85 (29.01)	100.77 (9.71)***	87.96 (15.53)***
Poor-Good/Fair	43.48 (8.82)***	52.31 (7.59)***	36.60 (9.08)***	53.28 (22.65)**	54.17 (8.18)***	59.26 (19.42)***

[a]: Model I includes 2011 health status (two-year lagged); Model II includes the changes of health status from 2011 to 2013.
[b]: The reference group for health status is Good.
[c]: The reference group for the change of health status is Good/Fair in 2011 to Good/Fair in 2013.
* P≤0.1; ** P≤0.05; ***P≤0.01

Table 5. Expected probability of work exit and expected number of absent workdays by 2011 health status

2011 Health status	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
Poor	0.218	0.122	0.192	0.288	0.123	0.145
Fair	0.143	0.077	0.110	0.229	0.048	0.139
Good	0.067	0.043	0.064	0.100	0.025	0.091
Number of absent workdays						
Poor	42.25	54.90	48.34	20.48	57.66	56.51
Fair	16.50	18.72	19.25	6.61	21.42	13.04
Good	5.68	4.42	6.82	3.12	5.67	1.94

Table 6. Expected probability of work exit and expected number of absent workdays by the change of health status over time

Health status change	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
Poor-Poor	0.288	0.279	0.243	0.322	0.229	0.448
Good/Fair-Poor	0.245	0.199	0.246	0.148	0.182	0.273
Poor-Good/Fair	0.173	0.111	0.151	0.191	0.058	0.347
Good/Fair-Good/Fair	0.098	0.048	0.074	0.180	0.024	0.101
Number of absent workdays						
Poor-Poor	55.79	73.22	67.42	11.86	81.04	70.67
Good/Fair-Poor	41.33	46.53	47.61	10.94	56.21	31.56
Poor-Good/Fair	23.13	24.16	22.77	18.57	28.48	17.81
Good/Fair-Good/Fair	9.19	8.10	10.68	4.83	9.86	3.66

Appendix

1. The questions in CHARLS and the criteria used to determine work status:

FA001: Did you engage in agricultural work (including farming, forestry, fishing, and husbandry for your own family or others) for more than 10 days in the past year?

FA002: Did you work for at least one hour last week? We consider any of the following activities to be work: earn a wage, run your own business and unpaid family business work, et al. Work does not include doing your own housework or doing activities without pay, such as voluntary work.

If respondent said 'yes' on either question FA001 or FA002, then she or he was considered as 'working'. If the answers on both questions were 'no', then the respondent needed to answer the following two questions:

FA005: Do you expect to go back to this job at a definite time in the future or within 6 months?

FA006: Do you still receive any salary from this job?

If respondent said 'yes' on either question FA005 or FA006, then she or he was considered as 'working'.

If respondent said 'no' on all four questions, she or he was considered as 'not working'.

2. Variable definition

Variables	Definition
Age	Continuous variable and measured in years
Education	Four categories: illiterate, lower than elementary school, elementary school graduate, and middle school or higher
Married	Married vs. not
Household expenditures monthly	Monthly household expenditures on food, utilities, household items, clothing, medical care, taxes, etc.
Self-rated Health Status	Three categories: good (reported health status equal to or better than good health), fair (reported health status as fair), and poor (reported health status equal to or worse than poor health)
Disable	Yes vs. no; where yes if having any of the five disabilities: physical disabilities, brain damage/mental retardation, vision problems, hearing problems, speech impediment
No. of chronic diseases (range 0-14)	Chronic diseases considered include 1.hypertension; 2.dyslipidemia; 3.diabetes; 4.cancer; 5.chronic lung disease; 6.liver disease; 7.heart problems; 8.stroke; 9.kidney disease; 10.stomach or other digestive disease; 11.emotional, nervous, or psychiatric problems; 12.memory-related disease; 13.arthritis or rheumatism; and 14.asthma.
Functional limitations (range 0-18)	Functional limitations are assessed in three domains: 7 items measuring physical functions (1.running/jogging about 1 km; 2.getting up from a chair; 3.climbing several flights of stairs; 4.stooping, kneeling or crouching; 5.reaching or extending arms; 6.lifting or carrying over 5 kg; and 7.picking up a small coin), 6 items measuring basic activities of daily living (BADLs) (1.dressing; 2.bathing; 3.eating; 4.getting in/out of bed; 5.using the toilet; and 6.controlling urination and defecation), and 5 items measuring instrumental ADL (IADLs) (1.doing household chores; 2.preparing hot meals; 3.shopping for groceries; 4.managing money; and 5.taking medications) (Hu et al., 2015)[1]. Each item is measured using a 4-likert scale, "1= No, I don't have any difficulty", "2=I have difficulty but can still do it", "3= Yes, I have difficulty and need help" and "4= I can not do it". The functional limitations are scored as a total number of items with answers at scale 3 or 4 for functional limitations and at scale > 1 for BADL and ADL.

[1] Hu L, Lv X, Zhou S, *et al.* Socio-Demographic Determinants, Physical Health Status, and Depression Associated with Functional Limitations Among Older Chinese Adults. Ageing International 2015; 40: 311–326.

3. Econometric model specifications

We used Model I, including 2011 health status in the model, as an example to show our model specifications.

Modeling work exit

We used Probit model for work exit in 2013, and ordered Probit model for health status in 2011. For each individual i, let y_i^w be labour force participation observed in 2013, $\mathbf{x}_i$ be the vector of exogenous factors (i.e., age, education, marriage status, and log transformed expenditures in 2011), $\mathbf{z}_i$ be the vector of detailed health measures (disability condition, number of chronic diseases, the number of total functional limitations) in 2011 and $\boldsymbol{H}_i$ be the SRH in 2011. Then our models were specified as:

$$y_i^{w*} = \boldsymbol{H}_i'\boldsymbol{\beta}_{\boldsymbol{h}}^{\boldsymbol{w}} + \mathbf{x}_i'\boldsymbol{\beta}_{\boldsymbol{x}}^{\boldsymbol{w}} + u_i^w \quad (1)$$

$$y_i^w = \begin{cases} Work, & y_i^{w*} < 0 \\ Not\ work, & y_i^{w*} \geq 0 \end{cases} \quad (2)$$

$$h_i^{w*} = \mathbf{x}_i'\boldsymbol{\beta}_{\boldsymbol{hx}}^{\boldsymbol{w}} + \mathbf{z}_i'\boldsymbol{\beta}_{\boldsymbol{hz}}^{\boldsymbol{w}} + \varepsilon_i^w \quad (3)$$

where y_i^{w*} and h_i^{w*}

$$\boldsymbol{H}_i = \begin{cases} Poor, & if\ h_i^{w*} \leq 0 \\ Fair, & if\ 0 < h_i^{w*} \leq c^w \\ Good, & if\ h_i^{w*} > c^w \end{cases} \quad (4)$$

are the latent variables for y_i^w and H_i, respectively; (u^w, ε^w) is independent of $\boldsymbol{z}$ and distributed as multivariate normal with mean zero and covariance matrix $\begin{pmatrix} 1 & \rho_w \\ \rho_w & 1 \end{pmatrix}$. The full information likelihood based on the joint distribution of $(\boldsymbol{y^w}, \boldsymbol{H})$ given $\mathbf{x}$ and $\mathbf{z}$ was used for estimating all parameters in structure equations (1) – (4) simultaneously, which was described as the full information maximum likelihood (FIML) estimation method in Wooldridge (2002). As pointed

by Woodridge (2002), with these models, the average probability of work exit for given **x**, **z,** and ***H*** can be estimated by

$$P(y^w = \text{not work}) = \boldsymbol{\Phi}(\boldsymbol{H}'\boldsymbol{\beta}_{\boldsymbol{h}}^{\boldsymbol{w}} + x'\boldsymbol{\beta}_{\boldsymbol{x}}^{\boldsymbol{w}}) \quad (5),$$

where $\boldsymbol{\Phi}$ is the cumulative density function of the standard normal distribution.

Modeling for number of absent workdays due to health problems

Same method was used to address the endogeneity of SRH for absent workdays. While we used the Probit model for work exit, we employed the Tobit model for number of absent workdays, and the ordered Probit models for health status in 2011 and 2013. Tobit regression was used for the number of absent workdays due to health problems, as its value was truncated at zero with a large number of observations at the zero point. Similar to the work exit model, the number of absent workday models were specified as

$$y_i^{m*} = \boldsymbol{H}_i'\boldsymbol{\beta}_{\boldsymbol{h}}^{\boldsymbol{m}} + \mathbf{x}_i'\boldsymbol{\beta}_{\boldsymbol{x}}^{\boldsymbol{m}} + u_i^m \quad (6)$$

$$y_i^m = \begin{cases} y_i^{m*}, & y_i^{m*} > 0 \\ 0, & y_i^{m*} \le 0 \end{cases} \quad (7)$$

$$h_i^{m*} = \mathbf{x}_i'\boldsymbol{\beta}_{\boldsymbol{hx}}^{\boldsymbol{m}} + \mathbf{z}_i'\boldsymbol{\beta}_{\boldsymbol{hz}}^{\boldsymbol{m}} + \varepsilon_i^m \quad (8)$$

where y^m

$$H_i = \begin{cases} Poor, & if\ h_i^{m*} \le 0 \\ Fair, & if\ 0 < h_i^{m*} \le c^m \\ Good, & if\ h_i^{m*} > c^m \end{cases}, \quad (9)$$

denotes the number of absent workdays, (u^m, ε^m) is independent of $\boldsymbol{z}$ and distributed as multivariate normal with mean zero and covariance matrix $\begin{pmatrix} \sigma^2 & \rho_m \\ \rho_m & 1 \end{pmatrix}$.

For given **x**, **z,** and ***H***, the expectation of y^mcan be estimated by

$$E(y^m \mid \mathbf{x},H) = P(y^m > 0 \mid \mathbf{x},\boldsymbol{H}) \cdot E(y^m \mid \mathbf{x},H,y > 0) = \boldsymbol{\Phi}\left((\boldsymbol{H'\beta_h^m} + \mathbf{x'\beta_x^m})/\sigma\right)\left(\boldsymbol{H'\beta_h^m} + \mathbf{x'\beta_x^m}\right) + \sigma \boldsymbol{\phi}\left((\boldsymbol{H'\beta_h^m} + \mathbf{x'\beta_x^m})/\sigma\right) \quad (10)$$

where $\boldsymbol{\phi}$ and $\boldsymbol{\Phi}$ are the density function and the cumulative density function of the standard normal distribution, respectively.

4. Test results for interaction terms

Parameter	Level	Estimate	StdErr	tValue	Probt
notwork.hstatus11	1-poor	0.341	0.216	1.575	0.115
notwork.hstatus11	2-fair	0.127	0.155	0.823	0.410
notwork.hstatus11	3-good	0.000			
notwork.male	1-male	-0.641	0.153	-4.176	0.000
notwork.male	2-female	0.000			
notwork.farm	0-nonfarm	0.081	0.157	0.517	0.605
notwork.farm	1-farm	0.000			
notwork.hs_male	0-poor,male	0.391	0.206	1.899	0.058
notwork.hs_male	1-fair,male	0.117	0.182	0.645	0.519
notwork.hs_male	2-Others	0.000			
notwork.hs_farm	0-poor, nonfarm	0.264	0.263	1.004	0.315
notwork.hs_farm	1-fair, nonfarm	0.320	0.185	1.728	0.084
notwork.hs_farm	2-Others	0.000			
notwork.hs_male_farm	0-poor,male, nonfarm	0.166	0.287	0.577	0.564
notwork.hs_male_farm	1-fair,male, nonfarm	0.265	0.148	1.793	0.073
notwork.hs_male_farm	2-good,male, nonfarm	0.221	0.205	1.076	0.282
notwork.hs_male_farm	3-Others	0.000			

5. Model parameters

Parameters (standard error) for work exit, Model I

Parameters	Level	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
notwork.Intercept		-3.953 (1.046)***	-3.552 (0.664)***	-2.724 (1.228)**	-5.527 (2.132)***	-3.802 (0.882)***	-2.583 (1.073)**
notwork.hstatus11	Poor	0.744 (0.259)***	0.577 (0.253)**	0.655 (0.287)**	0.753 (0.546)	0.810 (0.296)***	0.281 (0.447)
notwork.hstatus11	Fair	0.446 (0.156)***	0.306 (0.151)**	0.298 (0.182)	0.563 (0.305)*	0.300 (0.192)	0.251 (0.250)
notwork.hstatus11	Good						
notwork.age10		0.272 (0.195)	0.238 (0.102)**	0.136 (0.226)	0.521 (0.400)	0.129 (0.135)	0.348 (0.166)**
notwork.education	Illiterate	-0.107 (0.115)	-0.054 (0.180)	0.041 (0.126)	-0.400 (0.323)	-0.122 (0.221)	0.243 (0.340)
notwork.education	Lower than elementary school	-0.189 (0.129)	0.178 (0.114)	0.047 (0.143)	-0.708 (0.345)**	0.256 (0.135)*	0.049 (0.213)
notwork.education	Elementary school	-0.128 (0.107)	-0.023 (0.099)	0.031 (0.128)	-0.294 (0.222)	-0.020 (0.126)	-0.077 (0.171)
notwork.education	Middle school/ higher						
notwork.married	Yes	-0.180 (0.172)	-0.312 (0.168)*	-0.342 (0.221)	-0.067 (0.316)	-0.075 (0.221)	-0.604 (0.289)**
notwork.married	No						
notwork.lexpense11		0.173 (0.049)***	0.089 (0.043)**	0.115 (0.061)*	0.240 (0.096)**	0.166 (0.058)***	0.006 (0.071)
notwork.farm	Nor-farmer	0.275 (0.092)***	0.543 (0.084)***				
notwork.farm	Farmer						
hstatus11.Intercept		1.883 (0.767)**	0.419 (0.397)	1.593 (0.864)*	2.850 (1.691)*	0.369 (0.468)	0.848 (0.770)
hstatus11.age10		-0.249 (0.143)*	0.065 (0.062)	-0.095 (0.160)	-0.572 (0.316)*	0.044 (0.072)	0.106 (0.119)
hstatus11.education	Illiterate	-0.265 (0.083)***	-0.089 (0.103)	-0.220 (0.087)**	-0.507 (0.241)**	-0.038 (0.107)	-0.337 (0.276)
hstatus11.education	Lower than elementary school	-0.298 (0.091)***	-0.047 (0.073)	-0.286 (0.099)***	-0.247 (0.233)	-0.118 (0.079)	0.202 (0.168)
hstatus11.education	Elementary school	-0.025 (0.077)	-0.124 (0.058)**	-0.047 (0.087)	0.063 (0.173)	-0.161 (0.065)**	-0.062 (0.119)
hstatus11.education	Middle school/higher						
hstatus11.married	Yes	0.200 (0.134)	0.098 (0.114)	0.164 (0.173)	0.321 (0.248)	0.177 (0.125)	-0.115 (0.248)
hstatus11.married	No						
hstatus11.lexpense11		0.080 (0.036)**	0.099 (0.027)***	0.006 (0.042)	0.209 (0.078)***	0.105 (0.032)***	0.092 (0.050)*
hstatus11.farm	Nor-farmer	0.179 (0.067)***	0.255 (0.050)***				
hstatus11.farm	Farmer						
hstatus11.disabled11	Yes	-0.179 (0.110)	-0.278 (0.075)***	-0.130 (0.114)	-0.512 (0.298)*	-0.243 (0.082)***	-0.412 (0.169)**
hstatus11.disabled11	No						
hstatus11.chronic11		-0.364 (0.028)***	-0.335 (0.020)***	-0.316 (0.031)***	-0.509 (0.066)***	-0.319 (0.024)***	-0.369 (0.039)***
hstatus11.adl11		-0.165 (0.025)***	-0.238 (0.026)***	-0.175 (0.027)***	-0.161 (0.059)***	-0.234 (0.027)***	-0.230 (0.065)***
_Limit2.hstatus11		1.742 (0.049)***	1.642 (0.039)***	1.611 (0.052)***	2.085 (0.120)***	1.577 (0.043)***	1.785 (0.081)***
_Rho		0.254 (0.098)***	0.022 (0.099)	0.287 (0.110)***	0.176 (0.194)	0.182 (0.120)	-0.129 (0.164)

* P≤0.1; ** P≤0.05; ***P≤0.01

Parameters (standard error) for work exit, Model II

Parameters	Level	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
notwork.Intercept		-3.450 (1.045)***	-3.675 (0.648)***	-2.261 (1.231)*	-5.014 (2.135)**	-4.073 (0.896)***	-2.727 (1.028)***
notwork.chstatus	Poor-Poor	0.753 (0.202)***	1.142 (0.204)***	0.752 (0.209)***	0.472 (0.633)	1.265 (0.239)***	1.163 (0.411)***
notwork.chstatus	Good/Fair-Poor	0.621 (0.171)***	0.865 (0.161)***	0.763 (0.173)***	-0.135 (0.507)	1.097 (0.194)***	0.681 (0.300)**
notwork.chstatus	Poor-Good/Fair	0.358 (0.156)**	0.471 (0.165)***	0.415 (0.168)**	0.043 (0.386)	0.419 (0.199)**	0.895 (0.331)***
notwork.chstatus	Good/Fair-Good/Fair						
notwork.age10		0.239 (0.194)	0.251 (0.102)**	0.075 (0.227)	0.582 (0.398)	0.180 (0.139)	0.353 (0.163)**
notwork.education	Illiterate	-0.103 (0.115)	-0.063 (0.178)	0.025 (0.126)	-0.376 (0.325)	-0.157 (0.225)	0.219 (0.328)
notwork.education	Lower than elementary school	-0.149 (0.127)	0.120 (0.114)	0.049 (0.140)	-0.633 (0.347)*	0.275 (0.138)**	-0.034 (0.215)
notwork.education	Elementary school	-0.126 (0.108)	-0.060 (0.099)	0.024 (0.128)	-0.354 (0.225)	-0.079 (0.130)	-0.063 (0.168)
notwork.education	Middle school/ higher						
notwork.married	Yes	-0.166 (0.171)	-0.280 (0.167)*	-0.328 (0.220)	-0.158 (0.322)	-0.073 (0.225)	-0.542 (0.285)*
notwork.married	No						
notwork.lexpense11		0.152 (0.049)***	0.098 (0.043)**	0.102 (0.060)*	0.198 (0.094)**	0.164 (0.060)***	0.022 (0.068)
notwork.farm	Non-farmer	0.317 (0.092)***	0.589 (0.082)***				
notwork.farm	Farmer						
chstatus.Intercept		3.749 (0.894)***	0.439 (0.484)	4.128 (0.964)***	3.957 (2.197)*	0.459 (0.537)	0.416 (1.064)
chstatus.age10		-0.417 (0.166)**	0.219 (0.076)***	-0.398 (0.177)**	-0.597 (0.408)	0.240 (0.083)***	0.151 (0.164)
chstatus.education	Illiterate	-0.141 (0.095)	-0.091 (0.122)	-0.150 (0.097)	-0.086 (0.315)	-0.088 (0.124)	-0.247 (0.353)
chstatus.education	Lower than elementary school	-0.073 (0.104)	-0.160 (0.085)*	-0.104 (0.109)	0.195 (0.305)	-0.140 (0.092)	-0.193 (0.206)
chstatus.education	Elementary school	0.017 (0.091)	-0.243 (0.068)***	-0.013 (0.099)	0.063 (0.230)	-0.286 (0.073)***	-0.146 (0.164)
chstatus.education	Middle school/ higher						
chstatus.married	Yes	0.282 (0.148)*	0.109 (0.130)	0.153 (0.181)	0.483 (0.289)*	0.102 (0.137)	0.244 (0.316)
chstatus.married	No						
chstatus.lexpense11		0.009 (0.043)	0.110 (0.034)***	-0.035 (0.046)	0.123 (0.103)	0.088 (0.038)**	0.189 (0.076)**
chstatus.farm	Non-farmer	0.383 (0.082)***	0.288 (0.064)***				
chstatus.farm	Farmer						
chstatus.disabled11	Yes	0.003 (0.185)	-0.163 (0.119)	-0.062 (0.188)	0.311 (0.537)	-0.167 (0.126)	-0.009 (0.288)
chstatus.disabled11	No						
chstatus.chronic11		-0.028 (0.037)	-0.054 (0.030)*	-0.004 (0.039)	-0.111 (0.095)	-0.015 (0.033)	-0.135 (0.065)**
chstatus.adl11		-0.131 (0.025)***	-0.119 (0.024)***	-0.141 (0.027)***	-0.109 (0.064)*	-0.124 (0.025)***	-0.121 (0.078)
chstatus.disabled13	Yes	-0.276 (0.158)*	-0.198 (0.099)**	-0.117 (0.160)	-1.079 (0.460)**	-0.167 (0.106)	-0.307 (0.231)
chstatus.disabled13	No						
chstatus.chronic13		-0.302 (0.032)***	-0.332 (0.029)***	-0.330 (0.036)***	-0.240 (0.074)***	-0.326 (0.032)***	-0.338 (0.061)***
chstatus.adl13		-0.146 (0.024)***	-0.142 (0.019)***	-0.154 (0.025)***	-0.130 (0.070)*	-0.144 (0.020)***	-0.166 (0.063)***
_Limit2.chstatus		0.578 (0.041)***	0.668 (0.039)***	0.549 (0.042)***	0.686 (0.117)***	0.648 (0.042)***	0.736 (0.090)***
_Limit3.chstatus		0.967 (0.048)***	1.063 (0.044)***	0.974 (0.050)***	0.998 (0.127)***	1.097 (0.049)***	1.004 (0.097)***
_Rho		0.351 (0.082)***	0.256 (0.084)***	0.377 (0.087)***	0.104 (0.245)	0.226 (0.101)**	0.443 (0.160)***

*** P≤0.1; ** P≤0.05; ***P≤0.01**

Parameters (standard error) for absent workdays, Model I

Parameters	Level	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
missdays_total.Intercept		72.93 (66.39)	-108.78 (36.03)***	19.19 (74.27)	55.22 (144.86)	-102.70 (41.58)**	-133.37 (69.78)*
missdays_total.hstatus11	Poor	101.39 (17.00)***	135.61 (13.50)***	105.52 (17.71)***	72.05 (40.43)*	131.60 (16.20)***	153.55 (25.85)***
missdays_total.hstatus11	Fair	46.67 (10.19)***	65.59 (7.99)***	48.21 (10.79)***	24.87 (22.84)	64.12 (9.71)***	69.65 (14.16)***
missdays_total.hstatus11	Good						
missdays_total.age10		-25.53 (12.50)**	-1.34 (5.46)	-20.21 (13.60)	-5.83 (28.81)	-3.45 (6.24)	2.09 (10.44)
missdays_total.education	Illiterate	6.25 (7.05)	18.76 (8.41)**	7.52 (7.36)	-27.34 (23.51)	20.06 (8.78)**	6.92 (22.91)
missdays_total.education	Lower than elementary school	5.45 (7.66)	1.94 (6.37)	-0.02 (8.39)	21.95 (17.48)	4.63 (6.90)	-12.93 (15.28)
missdays_total.education	Elementary school	10.14 (6.50)	11.03 (5.04)**	5.05 (7.27)	28.17 (13.67)**	5.87 (5.71)	26.08 (9.85)***
missdays_total.education	Middle school/ higher						
missdays_total.married	Yes	-25.46 (11.03)**	-12.88 (9.60)	-3.12 (15.00)	-42.20 (18.43)**	-13.81 (10.22)	-5.99 (25.41)
missdays_total.married	No						
missdays_total.lexpense11		-0.44 (3.20)	4.68 (2.43)*	0.37 (3.56)	-9.77 (7.62)	5.55 (2.90)*	2.19 (4.22)
missdays_total.farm	Nor-farmer	-30.57 (6.28)***	-26.56 (4.92)***				
missdays_total.farm	Farmer						
_Sigma.missdays_total		74.26 (2.94)***	79.21 (2.72)***	77.39 (3.34)***	62.89 (6.29)***	81.72 (3.06)***	69.81 (5.87)***
hstatus11.Intercept		2.06 (0.84)**	0.28 (0.42)	2.00 (0.94)**	2.40 (1.89)	0.18 (0.49)	0.77 (0.85)
hstatus11.age10		-0.27 (0.16)*	0.08 (0.06)	-0.11 (0.17)	-0.64 (0.35)*	0.04 (0.07)	0.16 (0.13)
hstatus11.education	Illiterate	-0.32 (0.09)***	-0.11 (0.11)	-0.26 (0.09)***	-0.45 (0.28)	-0.04 (0.11)	-0.47 (0.31)
hstatus11.education	Lower than elementary school	-0.33 (0.10)***	-0.05 (0.08)	-0.29 (0.11)***	-0.32 (0.26)	-0.08 (0.08)	0.08 (0.18)
hstatus11.education	Elementary school	-0.08 (0.08)	-0.13 (0.06)**	-0.03 (0.09)	-0.19 (0.19)	-0.17 (0.07)**	-0.06 (0.13)
hstatus11.education	Middle school/higher						
hstatus11.married	Yes	0.19 (0.15)	0.09 (0.12)	0.05 (0.19)	0.50 (0.28)*	0.18 (0.13)	-0.23 (0.30)
hstatus11.married	No						
hstatus11.lexpense11		0.08 (0.04)**	0.11 (0.03)***	-0.02 (0.05)	0.30 (0.09)***	0.13 (0.03)***	0.09 (0.05)*
hstatus11.farm	Nor-farmer	0.20 (0.07)***	0.29 (0.05)***				
hstatus11.farm	Farmer						
hstatus11.disabled11	Yes	-0.13 (0.12)	-0.21 (0.08)***	-0.04 (0.12)	-0.52 (0.33)	-0.23 (0.08)***	-0.15 (0.18)
hstatus11.disabled11	No						
hstatus11.chronic11		-0.40 (0.03)***	-0.35 (0.02)***	-0.36 (0.03)***	-0.55 (0.08)***	-0.33 (0.02)***	-0.40 (0.04)***
hstatus11.adl11		-0.16 (0.03)***	-0.22 (0.03)***	-0.18 (0.03)***	-0.11 (0.08)	-0.22 (0.03)***	-0.21 (0.07)***
_Limit2.hstatus11		1.75 (0.05)***	1.64 (0.04)***	1.63 (0.06)***	2.09 (0.14)***	1.59 (0.05)***	1.75 (0.09)***
_Rho		0.31 (0.08)***	0.44 (0.05)***	0.38 (0.08)***	0.02 (0.22)	0.43 (0.07)***	0.52 (0.09)***

*** P≤0.1; ** P≤0.05; ***P≤0.01**

Parameters (standard error) for absent workdays, Model II

Parameters	Level	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
missdays_total.Intercept		130.62 (64.54)**	-96.15 (33.94)***	112.25 (71.52)	62.70 (145.45)	-100.64 (39.09)**	-111.95 (65.49)*
missdays_total.chstatus	Poor-Poor	99.55 (12.27)***	130.13 (10.91)***	109.38 (12.00)***	33.51 (42.47)	132.86 (12.40)***	142.50 (22.46)***
missdays_total.chstatus	Good/Fair-Poor	78.13 (10.02)***	93.61 (8.35)***	82.18 (9.87)***	29.85 (29.01)	100.77 (9.71)***	87.96 (15.53)***
missdays_total.chstatus	Poor-Good/Fair	43.48 (8.82)***	52.31 (7.59)***	36.60 (9.08)***	53.28 (22.65)**	54.17 (8.18)***	59.26 (19.42)***
missdays_total.chstatus	Good/Fair-Good/Fair						
missdays_total.age10		-29.72 (12.05)**	2.37 (5.21)	-31.29 (13.11)**	-2.79 (28.04)	3.34 (5.95)	-1.94 (9.88)
missdays_total.education	Illiterate	7.66 (6.71)	15.18 (7.96)*	5.93 (6.95)	-22.74 (23.76)	13.57 (8.36)	11.21 (21.47)
missdays_total.education	Lower than elementary school	11.84 (7.17)*	-1.20 (6.08)	4.09 (7.80)	31.33 (17.19)*	2.62 (6.58)	-22.65 (14.64)
missdays_total.education	Elementary school	12.80 (6.26)**	6.75 (4.83)	4.73 (6.95)	33.47 (13.53)**	-1.04 (5.49)	28.62 (9.30)***
missdays_total.education	Middle school/ higher						
missdays_total.married	Yes	-25.24 (10.56)**	-12.19 (9.12)	-10.03 (14.26)	-40.70 (18.53)**	-16.60 (9.64)*	13.85 (24.93)
missdays_total.married	No						
missdays_total.lexpense11		-2.70 (3.09)	5.14 (2.32)**	-0.84 (3.41)	-11.23 (7.19)	5.47 (2.76)**	3.61 (3.98)
missdays_total.farm	Non-farmer	-26.62 (6.02)***	-33.70 (4.59)***				
missdays_total.farm	Farmer						
_Sigma.missdays_total		71.08 (2.62)***	73.76 (2.22)***	73.34 (2.84)***	62.44 (6.33)***	76.62 (2.49)***	62.98 (4.66)***
chstatus.Intercept		3.83 (0.98)***	0.24 (0.51)	4.40 (1.06)***	3.26 (2.45)	0.13 (0.56)	0.54 (1.17)
chstatus.age10		-0.36 (0.18)**	0.23 (0.08)***	-0.35 (0.19)*	-0.47 (0.46)	0.24 (0.09)***	0.18 (0.18)
chstatus.education	Illiterate	-0.15 (0.10)	-0.19 (0.12)	-0.18 (0.10)*	0.16 (0.39)	-0.17 (0.13)	-0.47 (0.38)
chstatus.education	Lower than elementary school	-0.06 (0.11)	-0.11 (0.09)	-0.16 (0.12)	0.56 (0.38)	-0.08 (0.10)	-0.28 (0.23)
chstatus.education	Elementary school	0.02 (0.10)	-0.24 (0.07)***	-0.01 (0.11)	-0.08 (0.24)	-0.32 (0.08)***	-0.01 (0.18)
chstatus.education	Middle school/ higher						
chstatus.married	Yes	0.17 (0.17)	0.08 (0.14)	-0.11 (0.22)	0.62 (0.33)*	0.06 (0.14)	0.39 (0.37)
chstatus.married	No						
chstatus.lexpense11		-0.02 (0.05)	0.14 (0.04)***	-0.06 (0.05)	0.12 (0.12)	0.15 (0.04)***	0.13 (0.08)
chstatus.farm	Non-farmer	0.38 (0.09)***	0.20 (0.07)***				
chstatus.farm	Farmer						
chstatus.disabled11	Yes	0.19 (0.20)	-0.04 (0.13)	0.18 (0.20)	0.28 (0.56)	-0.03 (0.13)	0.14 (0.34)
chstatus.disabled11	No						
chstatus.chronic11		-0.04 (0.04)	-0.07 (0.03)**	-0.03 (0.04)	-0.07 (0.11)	-0.04 (0.03)	-0.14 (0.07)**
chstatus.adl11		-0.10 (0.03)***	-0.13 (0.03)***	-0.13 (0.03)***	0.03 (0.11)	-0.12 (0.03)***	-0.21 (0.09)**
chstatus.disabled13	Yes	-0.42 (0.17)**	-0.25 (0.10)**	-0.25 (0.17)	-1.19 (0.47)**	-0.27 (0.11)**	-0.23 (0.27)
chstatus.disabled13	No						
chstatus.chronic13		-0.32 (0.04)***	-0.33 (0.03)***	-0.36 (0.04)***	-0.25 (0.09)***	-0.32 (0.03)***	-0.34 (0.07)***
chstatus.adl13		-0.17 (0.03)***	-0.13 (0.02)***	-0.20 (0.03)***	-0.15 (0.09)*	-0.13 (0.02)***	-0.22 (0.10)**
_Limit2.chstatus		0.57 (0.04)***	0.66 (0.04)***	0.53 (0.05)***	0.76 (0.14)***	0.63 (0.05)***	0.75 (0.10)***
_Limit3.chstatus		0.97 (0.05)***	1.07 (0.05)***	0.97 (0.05)***	1.09 (0.15)***	1.11 (0.05)***	1.00 (0.11)***
_Rho		0.31 (0.07)***	0.35 (0.05)***	0.40 (0.06)***	-0.14 (0.24)	0.37 (0.05)***	0.44 (0.10)***

*** P≤0.1; ** P≤0.05; ***P≤0.01**

6. Sensitivity analyses

Analysis results without considering weights

Table 1. Demographic and health characteristics in 2011, mean (Standard Deviation) or N (%) (No weight)

Variables	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male Farmers (5)	Male non-farmers (6)
Sample N	1652	2680	1256	396	1874	806
Age, years	48.12 (2.06)	51.25 (3.77)	48.21 (2.07)	47.86 (1.99)	51.39 (3.81)	50.93 (3.67)
Education						
Illiterate	344 (20.82)	158 (5.90)	319 (25.40)	25 (6.31)	135 (7.20)	23 (2.85)
Lower than elementary school	250 (15.13)	337 (12.57)	218 (17.36)	32 (8.08)	273 (14.57)	64 (7.94)
Elementary school	369 (22.34)	574 (21.42)	308 (24.52)	61 (15.40)	448 (23.91)	126 (15.63)
Middle school or higher	689 (41.71)	1611 (60.11)	411 (32.72)	278 (70.20)	1018 (54.32)	593 (73.57)
Married	1587 (96.07)	2573 (96.01)	1214 (96.66)	373 (94.19)	1788 (95.41)	785 (97.39)
Household expenditures monthly	2403.42 (3072.13)	2472.03 (3887.91)	2041.30 (2555.22)	3551.97 (4118.78)	2005.07 (2631.23)	3557.75 (5701.61)
Health Status						
Good	424 (25.67)	884 (32.99)	284 (22.61)	140 (35.35)	544 (29.03)	340 (42.18)
Fair	872 (52.78)	1372 (51.19)	665 (52.95)	207 (52.27)	982 (52.40)	390 (48.39)
Poor	356 (21.55)	424 (15.82)	307 (24.44)	49 (12.37)	348 (18.57)	76 (9.43)
Disable	148 (8.96)	315 (11.75)	124 (9.87)	24 (6.06)	251 (13.39)	64 (7.94)
No. of chronic diseases (range 0-14)	1.06 (1.23)	1.03 (1.20)	1.12 (1.27)	0.84 (1.06)	1.07 (1.21)	0.93 (1.16)
Functional limitations (range 0-18)	0.53 (1.42)	0.36 (1.12)	0.63 (1.50)	0.24 (1.09)	0.44 (1.23)	0.19 (0.78)

Table 2. Work exit (N (%) of not working) and number of absent workdays (Mean (SE)) in 2013 by self-rated health (No weight)

	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
Overall	202 (12.23)	188 (7.01)	129 (10.27)	73 (18.43)	85 (11.54)	103 (12.78)
Self-rated health in 2011						
Good	52 (12.26)	50 (5.66)	28 (9.86)	24 (17.14)	18 (10.31)	32 (9.41)
Fair	106 (12.16)	90 (6.56)	67 (10.08)	39 (18.84)	38 (10.87)	52 (13.33)
Poor	44 (12.36)	48 (11.32)	34 (11.07)	10 (20.41)	29 (18.33)	19 (25.00)
Self-rated health in 2013						
Good	46 (12.17)	46 (5.87)	21 (8.30)	25 (20.00)	14 (12.81)	32 (11.23)
Fair	106 (11.61)	85 (5.77)	68 (9.76)	38 (17.59)	33 (10.18)	52 (11.93)
Poor	50 (13.85)	57 (13.48)	40 (13.07)	10 (18.18)	38 (11.24)	19 (22.35)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	130 (11.61)	113 (5.61)	72 (8.93)	58 (18.47)	38 (12.85)	75 (11.05)
Poor – Good/Fair	22 (12.87)	18 (7.38)	17 (11.81)	5 (18.52)	9 (9.46)	9 (21.43)
Good/Fair – Poor	28 (15.91)	27 (11.11)	23 (16.08)	5 (15.15)	18 (9.38)	9 (17.65)
Poor – Poor	22 (11.89)	30 (16.67)	17 (10.43)	5 (22.73)	20 (13.70)	10 (29.41)
Number of absent workdays						
Overall	14.18 (1.02)	12.02 (0.75)	16.19 (1.24)	7.21 (1.46)	14.66 (0.98)	5.26 (0.90)
Self-rated health in 2011						
Good	8.05 (1.47)	6.94 (1.01)	10.00 (1.96)	3.75 (1.82)	10.04 (1.57)	1.68 (0.38)
Fair	12.18 (1.23)	10.66 (0.85)	13.82 (1.48)	6.40 (1.86)	12.51 (1.08)	5.44 (1.13)
Poor	26.76 (3.18)	28.08 (3.25)	27.52 (3.49)	21.41 (7.09)	28.85 (3.54)	23.85 (8.32)
Self-rated health in 2013						
Good	6.63 (1.35)	4.74 (0.95)	7.31 (1.69)	5.03 (2.15)	6.39 (1.39)	1.62 (0.68)
Fair	10.64 (1.07)	9.51 (0.73)	11.77 (1.26)	6.70 (1.91)	11.54 (0.94)	4.18 (0.89)
Poor	32.14 (3.50)	36.69 (3.63)	35.11 (3.95)	14.38 (5.60)	39.18 (4.12)	25.84 (7.21)
Change of self-rated health 2011 – 2013						
Good/Fair – Good/Fair	8.63 (0.85)	7.00 (0.56)	9.93 (1.05)	4.93 (1.37)	8.90 (0.77)	2.92 (0.56)
Poor – Good/Fair	14.90 (3.16)	14.97 (2.73)	14.08 (3.43)	19.50 (8.33)	16.22 (3.04)	7.28 (5.66)
Good/Fair – Poor	25.67 (4.48)	28.71 (3.87)	29.57 (5.35)	8.93 (4.91)	32.22 (4.62)	14.02 (4.99)
Poor – Poor	38.30 (5.31)	48.42 (6.82)	39.87 (5.72)	24.20 (12.87)	48.71 (7.44)	46.91 (17.37)

Table 3. Model parameters for work exit and absent workdays (No weight)

Model [a]	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
I - 2011 Health status [b]						
Poor	0.817 (0.249)***	0.834 (0.252)***	0.817 (0.290)***	0.734 (0.470)	0.835 (0.318)***	0.837 (0.395)**
Fair	0.439 (0.154)***	0.310 (0.157)**	0.430 (0.183)**	0.411 (0.283)	0.294 (0.206)	0.297 (0.233)
II – Health status change [c]						
Poor-Poor	0.765 (0.199)***	1.338 (0.188)***	0.806 (0.215)***	0.290 (0.549)	1.285 (0.229)***	1.564 (0.320)***
Good/Fair-Poor	0.732 (0.164)***	0.951 (0.166)***	0.840 (0.174)***	-0.034 (0.465)	0.967 (0.197)***	1.052 (0.289)***
Poor-Good/Fair	0.462 (0.151)***	0.595 (0.160)***	0.523 (0.168)***	0.033 (0.353)	0.433 (0.199)**	1.130 (0.285)***
Number of absent workdays						
I - 2011 Health status [b]						
Poor	114.76 (16.75)***	149.06 (14.45)***	119.13 (18.66)***	77.31 (35.92)**	148.62 (17.19)***	158.01 (27.55)***
Fair	52.62 (10.17)***	70.31 (8.49)***	54.63 (11.34)***	29.71 (21.53)	69.92 (10.14)***	70.00 (15.36)***
II – Health status change [c]						
Poor-Poor	106.13 (11.96)***	138.59 (10.80)***	110.14 (12.61)***	49.85 (38.52)	138.18 (12.27)***	156.50 (23.29)***
Good/Fair-Poor	74.42 (9.92)***	100.98 (8.51)***	76.97 (10.42)***	30.00 (30.18)	102.99 (9.61)***	100.02 (18.55)***
Poor-Good/Fair	46.76 (8.82)***	54.55 (7.63)***	39.32 (9.56)***	62.34 (22.23)***	55.55 (8.35)***	60.16 (20.07)***

[a]: Model I includes 2011 health status (two-year lagged); Model II includes the changes of health status from 2011 to 2013.
[b]: The reference group for health status is Good.
[c]: The reference group for the change of health status is Good/Fair in 2011 to Good/Fair in 2013.
* P≤0.1; ** P≤0.05; ***P≤0.01

Table 4. Expected probability of work exit and expected number of absent workdays by 2011 health status (No weight)

2011 Health Status	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
Poor	0.235	0.168	0.202	0.324	0.119	0.291
Fair	0.138	0.073	0.111	0.218	0.043	0.140
Good	0.065	0.041	0.050	0.118	0.022	0.085
Number of absent workdays						
Poor	47.02	59.78	52.04	24.18	64.75	54.58
Fair	17.01	18.95	19.13	8.22	21.64	12.04
Good	5.26	4.26	5.98	3.49	5.26	1.90

Table 5. Expected probability of work exit and expected number of absent workdays by the change of health status over time (No weight)

HS Change	Female (1)	Male (2)	Female farmers (3)	Female non-farmers (4)	Male farmers (5)	Male non-farmers (6)
Probability of work exit						
Poor-Poor	0.279	0.332	0.247	0.265	0.238	0.594
Good/Fair-Poor	0.268	0.213	0.257	0.171	0.153	0.395
Poor-Good/Fair	0.189	0.130	0.167	0.189	0.060	0.425
Good/Fair-Good/Fair	0.091	0.046	0.068	0.180	0.024	0.097
Number of absent workdays						
Poor-Poor	59.84	77.93	66.80	19.26	83.98	78.65
Good/Fair-Poor	38.79	49.97	43.52	12.43	56.69	36.74
Poor-Good/Fair	24.65	24.57	23.76	24.73	28.63	17.39
Good/Fair-Good/Fair	9.49	8.08	10.77	5.67	9.78	3.71

Analysis results without age restriction for farmers

Table 1. Demographic and health characteristics in 2011 (No age restriction)

Variables	Female farmers (3)	Female farmers without restriction (3)	Male Farmers (5)	Male farmers without restriction (5)
Sample N	1256	3625	1874	3839
Age, years	48.16 (0.06)	56.35 (0.16)	51.28 (0.1)	58.09 (0.17)
Education				
Illiterate	319 (26.01)	1640 (45.93)	135 (7.46)	520 (13.21)
Lower than elementary school	218 (17.32)	719 (19.36)	273 (14.93)	784 (21.00)
Elementary school	308 (24.73)	666 (18.45)	448 (24.31)	1148 (30.31)
Middle school or higher	411 (31.93)	600 (16.26)	1018 (53.3)	1387 (35.48)
Married	1214 (96.3)	3309 (90.58)	1788 (94.81)	3555 (92.10)
Household expenditures monthly	2120.78 (80.98)	1805.23 (43.29)	2104.85 (86.05)	1850.99 (51.04)
Self-rated health				
Good	284 (22.94)	727 (20.46)	544 (30.82)	977 (26.97)
Fair	665 (52.12)	1833 (50.54)	982 (50.28)	1991 (50.76)
Poor	307 (24.95)	1065 (29.01)	348 (18.9)	871 (22.26)
Disable	124 (10.12)	532 (14.20)	251 (13.29)	700 (17.51)
No. of chronic diseases (range 0-14)	1.1 (0.04)	1.30 (0.02)	1.07 (0.03)	1.22 (0.02)
Functional limitations (range 0-18)	0.63 (0.05)	1.00 (0.04)	0.44 (0.03)	0.65 (0.03)
Notes: the proportions in parentheses are weighted proportions; the means are weighted means, and standard errors of the mean are in parentheses.				

Table 2. Model parameters for work exit and absent workdays (No age restriction)

Model [a]	Female farmers (3)	Female farmers without restriction (3)	Male farmers (5)	Male farmers without restriction (5)
Probability of work exit				
I - 2011 Health status [b]				
Poor	0.655 (0.287)**	0.597 (0.159)***	0.810 (0.296)***	0.898 (0.159)***
Fair	0.298 (0.182)	0.274 (0.102)***	0.300 (0.192)	0.526 (0.102)***
II – Health status change [c]				
Poor-Poor	0.752 (0.209)***	0.954 (0.113)***	1.265 (0.239)***	1.087 (0.125)***
Good/Fair-Poor	0.763 (0.173)***	0.760 (0.096)***	1.097 (0.194)***	1.088 (0.104)***
Poor-Good/Fair	0.415 (0.168)**	0.321 (0.091)***	0.419 (0.199)**	0.341 (0.102)***
Number of absent workdays				
I - 2011 Health status [b]				
Poor	105.52 (17.71)***	135.72 (11.81)***	131.60 (16.20)***	118.97 (10.91)***
Fair	48.21 (10.79)***	64.21 (7.38)***	64.12 (9.71)***	52.93 (6.68)***
II – Health status change [c]				
Poor-Poor	109.38 (12.00)***	137.15 (8.45)***	132.86 (12.40)***	130.68 (8.86)***
Good/Fair-Poor	82.18 (9.87)***	96.67 (7.11)***	100.77 (9.71)***	104.75 (7.38)***
Poor-Good/Fair	36.60 (9.08)***	53.80 (6.05)***	54.17 (8.18)***	58.72 (6.01)***

[a]: Model I includes 2011 health status (two-year lagged); Model II includes the changes of health status from 2011 to 2013.
[b]: The reference group for health status is Good.
[c]: The reference group for the change of health status is Good/Fair in 2011 to Good/Fair in 2013.
* P≤0.1; ** P≤0.05; ***P≤0.01

7. Reasons of not working, N (weighted %)

Age Restriction*	Reasons	Female farmers	Female non-farmers	Male farmers	Male non-farmers
Restricted	Health	30 (24.53)	6 (4.89)	32 (39.71)	18 (19.60)
Restricted	Retired	1 (1.91)	20 (26.80)	2 (2.25)	9 (7.60)
Restricted	Others	97 (73.56)	44 (68.32)	50 (58.04)	75 (72.81)
Unrestricted	Health	175 (33.26)		175 (40.81)	
Unrestricted	Retired	7 (1.56)		17 (5.14)	
Unrestricted	Others	347 (65.18)		193 (54.05)	

*** Restricted – age between 45 and 55 years for women or between 45 and 60 years for men**

Unrestricted - including all older farmers without applying the age restriction

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Section and page number (P)
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Abstract (P2)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract (P2–3)
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction (P5-6)
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction (P7)
Methods			
Study design	4	Present key elements of study design early in the paper	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods (P7-8)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	Methods (P8-9)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods (P9-10) Appendix 2
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods (P10)
Bias	9	Describe any efforts to address potential sources of bias	Methods (P11)
Study size	10	Explain how the study size was arrived at	Methods (P8-9) Results (P13)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods (P10) Appendix 1
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Methods (P11-13) Appendix 3
		(*b*) Describe any methods used to examine subgroups and interactions	Methods (P12)
		(*c*) Explain how missing data were addressed	Methods (P9)
		(*d*) If applicable, explain how loss to follow-up was addressed	N/A
		(*e*) Describe any sensitivity analyses	Methods (P13)
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Results (P13-14)
		(b) Give reasons for non-participation at each stage	N/A

		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	Report numbers of outcome events or summary measures over time	Tables 1, 2
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Tables 3, 4, 5
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Discussion (P15) Appendix 4
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion (P15-16)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion (P17)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion (P16-20)
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion (P19)
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Funding information (P21)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.