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3 **Title page**  
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6 **Title:**  
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9 Relation of depression with health behaviors and social conditions of dependent community-dwelling  
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11 older persons in the Republic of Chile  
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## Abstract

**Background:** Depressive symptoms are a leading cause of disability and emotional suffering, particularly in old age. However, evidence on depression and old age in developing countries remains largely ignored. The aim of this study was to examine the relation between health behavior and social conditions with depression among dependent community-dwelling older persons in the Republic of Chile.

**Methods:** This is a cross-sectional and inferential study, using nationally representative secondary data. Two models used logistic regression on 640 dependent community-dwelling older persons from all over Chile, who personally answered a depression assessment, excluding those taking antidepressants. The Geriatric Depression Scale (GDS-15) was used as outcome. The first model aims at any kind of depression (GDS 5>). The second aims at severe depression (GDS 10>). As exposure, we used the health behavior and social conditions of the older persons. Socio-demographic and physical conditions were used as adjustment.

**Results:** 44.5% of the older persons presented depressive symptoms. Among the, 11% had severe depression. Logistic regression showed that significant detrimental factors for being depressed in both models were: visiting the doctor 5 times or over because of acute diseases, feeling uncomfortable with their living arrangement, and feeling discriminated. On the other hand, every additional day of physical exercise and living alone had a beneficial and detrimental effect only in model one.

**Conclusion:** Analyses on ways to support older persons living alone and the promotion of physical exercise to avoid depression are needed, along with a deeper understanding of the comfort with their living arrangement. Finally, ways to address the discrimination among older persons should be further explored.

## Introduction

Depressive symptoms have been reported to be a leading cause of disability among older persons (Whiteford *et al.*, 2013) and to be the most common reason for emotional suffering (Blazer, 2003) among older persons. In old age, depressive symptoms have been shown to have negative effects on the physical health and functioning of the elderly (Comijs *et al.*, 2015), including the quality of life of those older persons suffering from it (Doraiswamy *et al.*, 2002).

However, evidence, in general, about older persons remains low in developing countries. Scarce evidence has been observed in the Republic of Chile, where it has been argued that there is a fundamental lack of adequate and deep epidemiologic, and country-specific research on old age (Gitlin and Fuentes, 2012). This is particularly worrying for Latin America, where the burden of mental illness is a growing concern (Saldivia *et al.*, 2004). Chile has one of the oldest populations in South America (Palloni *et al.*, 2002), with a population aged 60 and over that reached 14.8% in 2013 (United Nations Department of Economic and Social Affairs, 2014), and is expected to reach 20.11% by 2025 and 28.2% by 2050 (Damianovic, 2008).

Depression among older persons aged 60 and over in Chile has shown to have a prevalence of 23% for females and 12% for males (Wong *et al.*, 2005) and was associated with self-perception of health and efficacy, lower instrumental support, and the presence of conflict (Carrasco *et al.*, 2013). However, both studies were limited to the capital city of Chile, Santiago. Both depression (Vicente *et al.*, 2006) and dependency (Gonzalez, 2009), have shown to be different among regions. Dependency has also shown rural-urban and ethnical differences (Gonzalez, 2009). The present study adjusts for these characteristics.

Another study analyzed the relation between depression and age groups in the city of Antofagasta in the northern part of Chile. This study revealed that depression was established in 4% of a sample ranging

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3 from independent to severely dependent older persons (Tapia *et al.*, 2010). However, the design of this  
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5  
6 study was correlational, but not multivariable, and focalized in a small sample from a different northern  
7  
8 region.

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10 The present study builds on the initial report for the survey data presented by the Chilean government  
11 (Gonzalez, 2009). In that report, it was mentioned that there exists an association between depression  
12  
13 and dependency, adjusted by age, gender and years of education. In this study, we aim to build a more  
14  
15 complex model of interactions focused on the depressive status of dependent older persons, explained  
16  
17 by their health behavior and social conditions, while adjusting for physical conditions and  
18  
19 sociodemographic covariates.  
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23 We hypothesized an association between health behavior and social conditions related to the existence  
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25 of depressive symptoms of dependent older persons living in the community after adjusting for  
26  
27 covariates. This aim of this study is to contribute to building a nation-level body of evidence on the  
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29 association of depressive symptoms in developing countries, offering a nationally representative rural-  
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31 urban view, through the random sampling of dependent older persons across the Republic of Chile.  
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## 41 **Methods**

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43 A secondary analysis of a nationwide survey data was conducted using a multistage random sampling  
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45 method. The survey was entitled *national survey on the dependency of older persons*. The sampling  
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47 framework method of the original survey, on which this work is based on, was taken from the population  
48  
49 and housing census of 2002, and aimed at collecting epidemiological data from persons aged 60 and over.  
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51 Stratification was based on rural and urban settings (by population size), and geographical (to include  
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3 subjects from all the regions in Chile). Units of analysis were presented as follows, in ascending order,  
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5 cities, blocks, and houses. More details on the survey were published elsewhere (Gonzalez, 2009).  
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9 The survey on older persons included 4766 respondents aged 60 and over. Ninety-one percent of  
10 respondents were the older persons themselves, while the remaining 9% were surrogates in case the  
11 older persons had some degree of cognitive impairment. The surrogates were individuals with no  
12 cognitive impairment. The survey was administered by 126 adults aged 18 and over, who had previous  
13 experiences with complex surveys, and preferably with tertiary education. To minimize bias, PDAs  
14 (Personal Digital Assistant) were used to enter the responses. Data collection took place between  
15 November 2009 and January 2010.  
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## 24 **Subjects**

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26 From the initial 4766 older persons aged 60 and over, subjects with no level of dependency were  
27 excluded, for a sample of 1365 respondents. Furthermore, subjects who did not answer the depression  
28 assessment (GDS) by themselves (surrogates) were excluded. Additionally, those taking medicines for  
29 depression were excluded. Subjects on antidepressants may or may not have gone undetected when  
30 interviewed using a non-clinical diagnostic tool. A preliminary analyses showed that among those taking  
31 anti-depressants and diagnosed by the health staff to be depressed, 28.7% were not grouped as being  
32 depressed using the GDS, while the remaining 71.3% presented some kind of depression. To avoid this  
33 uncertainty we decided to exclude them.  
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38 After the exclusion criteria were applied, the final number of older persons was 640. The sample  
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50 flowchart can be seen in figure 1.

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53 [figure 1]  
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3 The operational definition of dependency for this study follows the one used in the original survey.  
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6 Dependency was characterized by the functionality of the person and the amount, type and level of  
7 assistance received from others. The two components of this definition were the functional limitation  
8 and the need for human assistance because of impaired functionality. Following this general definition of  
9 dependent persons, the operational definition includes the following characteristics: bedridden people,  
10 people with any level of dementia, an inability to perform one ADL, inability to perform one IADL, in  
11 constant need of help to perform one ADL and those in constant need of help to perform two IADL.  
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## 23 **Measurements**

24  
25 In this study, the outcome was the geriatric depression scale (GDS) (Yesavage *et al.*, 1982). It has been  
26 tested and used extensively with older populations (Yesavage *et al.*, 1982). The test used in this study  
27 was the short-form GDS which consisted of 15 questions, and was developed in 1986 with a high  
28 correlation ( $r = .84$ ,  $p < .001$ ) with the original 30-item scale (Sheikh, 1986). The cut-off points used in the  
29 present study are taken from Almeida and Almeida (Almeida and Almeida, 1999) where scores over 5  
30 indicated some kind of depression ranging from mild to severe, with a sensitivity and specificity of 85.4  
31 and 73.9 respectively according to ICD-10. Reliability coefficients were 0.81 (CI .73-.87). In the same  
32 study, severe depression were those scores over 10 according to ICD-10 (Almeida and Almeida, 1999).  
33  
34 For the present study, two models are presented. In the first model, we focus on any kind of depression.  
35 Thus, the depressed group are those that scored 6 and over, and were coded as one (1). This low cut-off  
36 point aimed at a high sensitivity. In the second model, using the same explanatory variables for model  
37 consistency, we focused on those considered to be severely depressed. The severely depressed group  
38 were those that scored 11 and over, and were coded as one (1). This high cut-off point aimed at dealing  
39 with false-negatives and positives, and confirming the findings of the broader definition of the first  
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3 model. Older persons themselves were required to answer this test; only those answered by the older  
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6 persons themselves were included in this study.  
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12 For this study two kinds of exposures were set; those related to health behaviors and those related to  
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14 social conditions. As part of health behaviors we included the number of visits to the doctor within the  
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16 past six months were divided into visits due to acute disease or periodic health check-ups. The number  
17  
18 of chronic diseases ranged from zero (0) to five (5). The diseases included were: hypertension, Parkinson,  
19  
20 diabetes, cardiovascular diseases, and respiratory condition. Smoking presented three options: never  
21  
22 smoked, quit smoking, and continued smoking; while alcohol drinking was measured at present only  
23  
24 with a yes (1) and no (0) option. Physical activity was recorded from the question “In the last three  
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26 months, how many times a week have you performed physical activities?” The valid range varied from  
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28 zero (0) to seven (7).  
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36 Regarding social conditions we included living alone was coded as one (1) and zero (0) when they were  
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38 living with other persons. Satisfaction with the living arrangement used the variable “Generally speaking,  
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40 are you uncomfortable living alone/with the persons you live now?” The answer was coded one (1) for  
41  
42 yes and zero (0) for no. Unemployment was assessed with the following question “Did you work last  
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44 week, doing something other than house chores?”, and was coded one (1) for yes and zero (0) for no.  
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48 Discrimination was taken from the question “Have you felt discriminated in the past 12 months? Never  
49  
50 was coded as zero (0) and used as reference, all other kind of discrimination (socioeconomic  
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52 discrimination, female sex, ethnic background, sexual preferences, foreigner, physical appearance,  
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54 health conditions and others) were coded as one (1).  
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6 Additionally, to account for covariates and possible confounders we included both sociodemographic  
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8 characteristics and physical conditions. Sociodemographics included sex, age, urbanization, ethnic  
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10 background, education and marital status of the older persons were included. Also, physical conditions  
11  
12 included the *Katz Index of activities of daily living* (ADL), which measured independence in the care-  
13  
14 recipient's ADLs. The six items were rated dichotomously as zero (no) and one (yes), and we calculated a  
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16 total score (range 0–6). Higher scores indicated more independence in activities of daily living.  
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21 The *Lawton Instrumental Activities of Daily Living* (IADL) Scale measured independence in IADL. The  
22  
23 items were rated dichotomously as zero (no) and one (yes), and we calculated the total score (range 0–8).  
24  
25 Higher scores indicated more independence in instrumental activities of daily living.  
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28 Falls were registered as a dichotomous variable, in accordance with the answer to the question “In the  
29  
30 past 12 months, have you fallen? A fall experience was coded as one (1).  
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34 Cognitive impairment was measured using the Mini Mental State Examination. The mini mental state  
35  
36 examination (MMSE) is the most commonly used instrument for screening cognitive function. This  
37  
38 examination is not suitable for making a clinical diagnosis, but could be used to indicate the presence of  
39  
40 cognitive impairment. This test had a cut-off point equal or less than 12. Cognitive impairment was  
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42 coded as one (1) and no-impairment was coded as zero (0).  
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## 49 **Statistical methods**

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52 After using descriptive statistics to describe our data in the univariate stage, we looked for correlations  
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54 among the explanatory variables by using non parametric Spearman's correlation analysis, where only  
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56 two sets of variables revealed light correlations ( $p < .3$ ). Based on the appropriateness of statistical



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3 techniques and data for the bivariate relation among each one of the explanatory variables and the  
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6 primary outcome of depression, we used chi square with phi coefficient for categorical variables and t-  
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8 test for continuous variables.

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10 Explanatory variables that were entered in the binary logistic regression analysis were those that were  
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12 frequently mentioned in the literature to have a relation with the depression of older persons and those  
13  
14 that had a relation strength in the bivariate analyses within an alpha value of .2 of significance (table 3).  
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16 The alpha value of .2 was an arbitrary level selected for explanatory variables that were candidate for the  
17  
18 subsequent multivariate analysis (Mickey and Greenland, 1989). More traditional levels such as .05 may  
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20 fail in identifying variables known to be important (Bursac *et al.*, 2008). Odds Ratios (OR) with 95%  
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22 confidence intervals (CI) were reported. Finally, we conducted an analysis of multicollinearity (variance  
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24 inflation factor of <10). Data was analyzed using SPSS version 21.  
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30 A written consent to analyze this secondary data was obtained from the National Agency for Older  
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32 People in Chile.  
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## 38 **Results**

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41 Nearly 45% of the older persons presented some degree of depression. In addition, 11% presented  
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43 severe depression. A detailed description of sociodemographic characteristics and physical condition of  
44  
45 the older persons is presented in table 1.  
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48  
49 [table 1]

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52 The results of the bivariate analyses of depression, the sociodemographic characteristics, and the  
53  
54 physical condition of the older persons are detailed in table 2. Aiming at a final multivariable model,  
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3 relations within an alpha value of .2 of significance (confidence interval of 80%) were found for the age  
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6 of the older person, urbanization status, and ethnic background. Regarding the relation of depression  
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8 and the physical condition of the older person, we found ADL and IADL scores to be statistically  
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10 significant. Additionally, feeling pain in the last 4 weeks, being admitted to a hospital, number of chronic  
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12 diseases, falls in the past year, and cardiovascular and respiratory conditions were found to be  
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14 statistically significant. Details can be seen in table 2.  
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18 [table 2]  
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21 Regarding our main exposure, we observed that, among health behaviors, visits to the doctor because of  
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23 an acute disease were significant. In addition, physical activity was significant along with smoking habits.  
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25 Finally, among social conditions, we observed that living alone, being uncomfortable with the living  
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27 arrangement, having worked last week, feeling discriminated, having recreational activities and  
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29 volunteering, had a significant relation with depression. Details can be seen in table 3.  
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33 [table 3]  
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### 39 Multivariable analysis

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42 We present two successive regression models. The first for any kind of depression and the second only  
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44 for those severely depressed. The percent of cases for which the dependent variable was correctly  
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46 predicted was 71.5 in model one and 88 in model two, an improvement over the 57.1 and 85.3 percent  
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48 of the null models, respectively. Both models were statistically significant at <0.001 according to the  
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50 omnibus tests of model coefficients. Finally, statistically insignificant *Hosmer and Lemeshow tests* at an  
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52 alpha level of .05 indicate an acceptable goodness of fit for both models.  
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3 The logistic regression model one, for any kind of depression, showed that there were six factors with a  
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5 detrimental effect: much and very much pain, visiting the doctor 5 or more times because of acute  
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7 disease, living alone, being uncomfortable with the living arrangement, and feeling discriminated. The  
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9 same model showed four beneficial effects on depression: age of the older person, higher ADL and IADL  
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11 scores, and the number of times of physical activity during the week for the past three months.  
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14  
15 In the case of model two, using the same explanatory variables, we found that there are six factors with  
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17 a detrimental effect on severe depression: being in moderate pain, much pain and very much pain,  
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19 visiting the doctor 5 or more times because of acute disease, being uncomfortable with the living  
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21 arrangement and feeling discriminated. The same model shows three beneficial effects on severe  
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23 depression: age of the older person, higher IADL scores, visiting the doctor for a checkup once or twice in  
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25 the past 6 months.  
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29 Detailed statistics on health behavior and social conditions can be found in table 4.  
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36 [table 4]  
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42 Beneficial factors  
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45 In detail, for model one, significant beneficial factors against any kind of depression were: every year of  
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47 age (OR: .96, CI: .94~.98); every additional point of ADL score (OR: .80, CI: .65~.98); every additional  
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49 point of IADL score (OR: .93, CI: .87 ~ .99); every additional day of physical exercise during the week in  
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51 the past three months (OR: .82, CI: .69~.98). For model two, significant beneficial factors against being  
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53 severely depressed were: every year of age (OR: .95, CI: .92~.99); every additional point of IADL score  
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3 (OR: .89, CI: .82~.97); and visiting the doctor for a checkup once or twice in the past 6 months (OR: .44,  
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6 CI: .2~.99), when compared to those who did not attend.  
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## 10 11 Detrimental factors

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15 For model one, significant detrimental factors that increased the likelihood of any kind of depression  
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17 were: being in much pain (OR: 2.60; CI: 1.37~4.94) or very much in pain (OR: 2.30; 1.09~4.87), when  
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19 compared to those with no pain; visiting the doctor 5 times or more because of acute diseases (OR: 2.86,  
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21 CI: 1.09~7.51), when compared to those with no visits; living alone (OR: 2.09, CI: 1.12~4.03) as opposed  
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23  
24 to living with others; feeling uncomfortable with their living arrangement (OR: 3.67, CI: 1.12~12.04 ) as  
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26 opposed to feeling comfortable; and feeling discriminated (OR: 2.24, CI: 1.38~3.63) as opposed to not  
27  
28 feeling discriminated.  
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31 For model two, detrimental factors for being severely depressed were: being in moderate pain (OR: 4.02;  
32  
33 CI: 1.15~14.11), much pain (OR: 3.49; CI: 1.09~11.19) or very much in pain (OR: 5.93; 1.72~20.39), when  
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35 compared to those with no pain; visiting the doctor 5 times or more because of acute diseases in the  
36  
37 past six months (OR: 4.02, CI: 1.31~12.33), when compared to those with no visits; feeling uncomfortable  
38  
39 with their living arrangement (OR: 4.54, CI: 1.31~15.68) as opposed to feeling comfortable; and feeling  
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41 discriminated (OR: 3.85, CI: 2.04~7.25) as opposed to not feeling discriminated.  
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## 49 **Discussion**

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52 In our study, depression, ranging from mild to severe, had a prevalence of 44.5% among the community-  
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54 dwelling older persons aged 60 and over. This figure is much higher than that found in similar studies  
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3 among old-age community-residents using the GDS scales. In China which showed a prevalence of 26%  
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6 using the same scale and same cut-off score among older residents in a Chinese rural community (Liu *et*  
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8 *al.*, 1997). In this study Activities of Daily Living (ADL) were included as predictors. Also, in Pakistan the  
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10 prevalence of depression has been reported to reach 22.9 % in an older population aged 65 and over, for  
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12 both dependent and independent community-residents, according to the GDS-15 (Ganatra *et al.*,  
13  
14 2008).In Mexico, older population aged 60 and over, for both dependent and independent community-  
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16 residents, according to the 30-item GDS, depressive symptoms was estimated to be 21.7% (Garcia-Pena  
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18 *et al.*, 2008). This suggests that the prevalence of depression in the Republic of Chile may be high.  
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22 However, it may be considered that ethno-cultural differences may preclude cross-national comparisons  
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24 regarding the prevalence of depressive symptoms (Bromet *et al.*, 2011; Castro-Costa *et al.*, 2007).  
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27 Regarding health behaviors, visiting the doctor because of acute care has been reported in the literature  
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29 to be associated with depression. In our study, visiting the doctors 5 times or more seemed to have a  
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31 detrimental effect in both our models, any kind of depression and severe depression. This may be due to  
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33 the stress of unexpected situations, as in the case of suffering from an acute disease (Kendler and  
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35 Gardner, 2016). Thus, every additional visit increases that stress and emotional burden, especially in a  
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37 population known for its frailty, which may help explain the bigger effect size for those with a more  
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39 severe depression. This may be reinforced by the fact that patients with major depressive disorder have  
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41 been shown to visit primary care centers more frequently (Garcia-Huidobro *et al.*, 2012), and also show a  
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43 high prevalence of major depressive disorder in emergency departments. (Castilla-Puentes *et al.*, 2008)  
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48 On this regard, the results must be carefully considered, keeping in mind a possible reversed causality  
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50 between depression and every additional visit, where every additional visit would increase the  
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52 depression and reversely, this depression may increase the conditions for more visits. On the other hand,  
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54 we found that every additional day of physical exercise decreased the likelihood of being depressed by  
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56 nearly 20%. This beneficial effect has been reported in older populations (Tse *et al.*, 2015), and has  
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3 shown to reflect better physical functioning, higher levels of independence, decreased perception of  
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6 pain, among others.  
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12 Regarding social conditions, living alone, which has been widely documented to be related to depression  
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14 was significant in model one, for any kind of depression, but not for those severely depressed. While it  
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16 may seem counterintuitive, the cross-sectional nature of this study precludes further analyses. It may be  
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18 that those with more severe depression stop living alone, or the effect becomes negligible past a  
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20 threshold of severity, for reasons beyond the scope of these data. On the other hand, feeling  
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22 uncomfortable with their living arrangement (Singh and Misra, 2009) is statistically significant in both  
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24 models, any kind of depression and severe depression, putting emphasis on the self-perception of  
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26 comfort with life choices. Additionally, in the literature, feeling discriminated affected depression  
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28 (Nadimpalli *et al.*, 2015) as well as mental health as a whole (Pascoe and Smart Richman, 2009), as has  
29  
30 been found in both our models. However, to the knowledge of the authors, there are no studies dealing  
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32 with ageism and mental health in Chile to discuss further and remains a road to be explored in future  
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34 research.  
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40 Regarding the association of depression and ADLs, a previous study in Santiago, the capital city of Chile,  
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42 using the *Survey on Health, Well-Being, and Aging in Latin America and the Caribbean (SABE)* (Albala *et*  
43  
44 *al.*, 2005) focusing on older persons in Santiago and 6 other cities in Latin America and the Caribbean, did  
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46 not find a significant association between difficulties to carry out ADLs and depression, although it did  
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48 find this association in all the other 6 cities analyzed: Buenos Aires, Bridgetown, Sao Paulo, Habana,  
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50 Mexico DF and Montevideo. However, our model for severe depression failed to find statistical  
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54 significance between ADL and severe depression.

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3 Regarding IADLs, the same survey did not find a significant relation with depression, although it did find  
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5 this association in all the other 6 cities analyzed mentioned above.

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8 This lack of significance only for the Chilean sample may seem counter intuitive, as the literature shows  
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10 several examples of significance between depressive symptoms and difficulties dealing with functional  
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12 independence (Connolly *et al.*, 2016). However, we can also find that the presence of high depressive  
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14 symptoms may not substantially diminish physical performance (Matthews *et al.*, 2011), making clear  
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16 the cross-sectional limitation of this study. It may be argued that the present data is nationally  
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18 representative, while the SABE survey only focused on the mainly urban capital city. It could be possible  
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20 that the differences in these two settings could account for the lack of significance.  
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24 While depression has been previously associated to poor health conditions (Philco *et al.*, 2012), more  
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26 attention should be focused on how ADLs and IADLs do relate to physical exercises in a longitudinal way.  
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28 Independently, physical exercises have been shown to be an important protective factor against  
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30 depression by enhancing social connections, and biological markers that increase the feeling of wellbeing  
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32 through physical changes that take place when doing physical activities. The present study revealed the  
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34 presence of a “dose effect” between physical exercises and depression. However, the effect seems to  
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36 disappear for those severely depressed, supporting the idea of encouraging physical activity to avoid  
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38 depression or before depressive conditions get severe.  
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44 Mental disorders, including depressive symptoms, have been linked to smoking habits and alcohol  
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46 consumption among the general adult population in Chile (Araya *et al.*, 2007; Dois and Cazenave, 2009),  
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48 but that association has not been made among older persons. In our study, there was no significant  
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50 relation between smoking and alcohol drinking and depression. This may be due to the fact that older  
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52 populations in Chile have a lower lifetime prevalence of alcohol and nicotine dependence compared to  
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54 younger adult populations (Kohn *et al.*, 2008).  
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3 Discrimination has been shown to have a harmful effect on the mental health of general Chilean  
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6 population in Chile (Capezza *et al.*, 2012). While in Chile there are no specific studies on discrimination  
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8 suffered by older persons, our results open the possibility of paying more attention to these harmful acts,  
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10 keeping in mind that a depressive status may induce the perception of being discriminated.

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13 Unemployment in Chile has been associated to poorer mental health in working age adults (Jefferis *et al.*,  
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15 2011). However, while this relation has not been explored in older adults, we can argue that the same  
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17 mechanism intervenes to account for social interactions that prevent depressive symptoms.

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21 The present study, while being nationally representative, has some limitations that should be considered  
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23 when interpreting the results. One of these limitations is the cross-sectional design of the study. Both  
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25 exposure and outcome were measured at the same time, hindering the possibility of establishing  
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27 causation. While we were cautious when interpreting the results, while keeping in mind the effect size,  
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29 consistency, plausibility and temporality, there remained some concerns regarding reverse causality  
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31 among depression and health behaviors. Additionally, the present data did not include information on  
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33  
34 the economic status of the subjects, which precludes suggesting policies oriented to economic  
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36 interventions. Arguably, older persons living alone, being uncomfortable with their living arrangement,  
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38 and being discriminated by their socioeconomic status may be influenced by economic characteristics,  
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40 however, lack of information on the subject presents a limitation in our study.

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44 We concluded that with the decreasing number of marriages, decreased fertility rate, increased  
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46 longevity and absence of a long term care system, analyses on ways to support older persons living alone  
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48 to avoid depression are needed. Policies reaching out to those elderly living alone should be of particular  
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50 interest, along with increasing the community awareness of those living alone, and the participation of  
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52 those who ostracize themselves in later stages of life.  
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Another aspect is the necessity to have a deeper understanding of the comfort of older persons with their living arrangement. Comfort with a living arrangement is a subjective feeling, mediated by multiple factors. Studies to analyze these mediating factors may help understand how to improve the life of those feeling uncomfortable, particularly in the absence of formal care.

Additionally, ways to prevent discrimination among older persons should be encouraged. However, it is also important to understand how this discrimination takes places and to what extent it is caused by perception or behaviors that may be classified as ageism.

Nevertheless, it must be noted that these conclusions on social conditions in the present study do not include economic characteristics, which may have a strong effect on the way depression is perceived given the present results. Further studies should address this information.

### **Conflict of interest**

No conflict of interest was reported in this study. In addition, this study was partially supported by the Grant-in-Aid for Scientific Research of the Japan Ministry of Health, Labour and Welfare [H24-Chikyukibo-ippan-001] and the 2015 Grant-in-Aid for JSPS Fellows [H27-Tokubetsu-Kenkyuin-Shorei-hi]. Supporters had no role in this study.

### **Roles of authors**

Dr. Sandoval designed the study, formulated the research question, analyzed the data and wrote the paper. Both Dr. Tamiya and Dr. Lloyd-Sherlock contributed in formulating the

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3 research question, designing the study, and interpreting the results. Dr. Haruko Noguchi helped  
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5  
6 write the paper and interpret the results.  
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3 **Figure legends**  
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6 Figure 1. Flowchart of the sample by exclusion criteria  
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8  
9 Description: This figure explains visually the process followed from the original population to the final  
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11 sample.  
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14 **Table legends**  
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18 Table 1. Univariate analysis  
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21 Description: it presents the characteristics of the subjects regarding the main outcome and exposures,  
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23 along with adjusting covariates.  
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29 Table 2. Bivariate analysis of depression and covariates  
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32 Description: it presents a bivariate analysis of the main outcome, divided into the depressed and not  
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34 depressed groups, and the adjusting covariates.  
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40 Table 3. Bivariate analysis of depression and independent variables  
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43 Description: it presents a bivariate analysis of the main outcome, divided into the depressed and not  
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45 depressed groups, and the exposures, health behaviours and social conditions.  
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51 Table 4. Logistic model for depression and related factors  
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54 Description: it presents a multivariable model of the factors associated to the depressed status of  
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56 subjects.  
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Figure 1. Flowchart of the sample by exclusion criteria

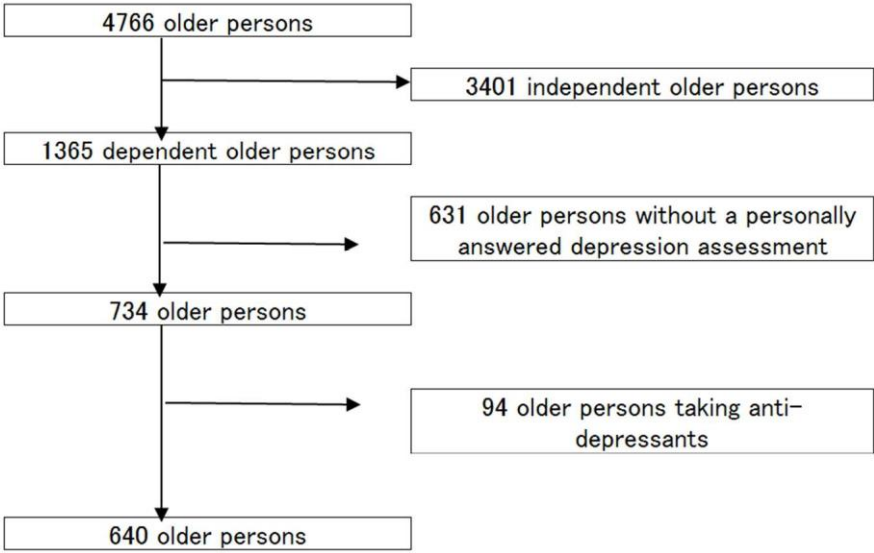


Figure 1. Flowchart of the sample by exclusion criteria

Table 1. Univariate analysis of depression and independent variables

		Total	
		n	%
<b>Depressive symptoms</b>			
GDS Score (possible range 0-15)	mean [SD]	5.8	3.9
GDS for all kinds of depression vs no-depression		355	56
Not depressed (0-5)		285	45
Depression -mild to severe- (6+)			
GDS for severe depression vs all others		570	89
All thers -no depression to moderate- (0-11)		70	11
Severe depression (12+)			
<b>Sociodemographic characteristics</b>			
<b>Gender</b>			
Male		243	38.0
Female		397	62.0
<b>Age</b>			
Number of years	mean [SD]	76	[ 8.7]
<b>Setting</b>			
Rural		259	40.5
Urban		381	59.5
<b>Ethnicity</b>			
No ethnic background		583	91.1
Ethnic background		57	8.9
<b>Education</b>			
Number of years of education	mean [SD]	4.3	[ 3.4]
<b>Marital status</b>			
Married		296	46.3
Divorced		39	6.1
Widow/Widower		255	39.8
Single		50	7.8
<b>Physical conditions</b>			
<b>Physical Functionality Scores</b>			
ADL score	mean [SD]	4.2	[ 1.1]
IADL score	mean [SD]	17.9	[ 3.8]
<b>Cognitively impaired by the Mini Mental Test</b>			
No		568	88.8
Yes		71	11.1
<b>Pain in the last four weeks</b>			
No pain		103	16.1
Very little		61	9.5
A little		105	16.4
Moderate		102	15.9
Much		175	27.3
Very Much		94	14.7
<b>Admitted to a hospital in the past year</b>			
No		540	84.4
Yes		99	15.5
<b>Chronic Disease</b>			
number of chronic diseases	mean [SD]	1.4	[ 1.0]
<b>Hypertension</b>			
No		190	29.7
Yes		440	68.8
<b>Parkinson</b>			
No		610	95.3
Yes		23	3.6
<b>Diabetes</b>			
No		467	73.0
Yes		166	25.9
<b>Cardiovascular condition</b>			
No		486	75.9
Yes		146	22.8
<b>Respiratory condition</b>			
No		493	77.0
Yes		137	21.4
<b>Polypharmacy</b>			
No		378	59.1
Yes		262	40.9
<b>Falls in the past year</b>			
Number of falls	mean [SD]	1.2	[ 3.2]

Table 2. Bivariate analysis of depression and adjusting covariates

		Not depressed		Depressed		Total	p-value	
		n	%	n	%			
<b>Sociodemographic characteristics</b>								
Gender								
	Male	140	57.6	103	42.4	243	.393	
	Female	215	54.2	182	45.8	397		
Age								
	Number of years	mean (SD)	76.97	8.5	74.82	8.8	634	.002
Setting								
	Rural	154	59.5	105	40.5	259	.094	
	Urban	201	52.8	180	47.2	381		
Ethnicity								
	No ethnic background	318	54.5	256	45.5	583	.133	
	Ethnic background	37	64.9	20	35.1	57		
Education								
	Number of years of	mean (SD)	4.35	3.44	4.33	3.40	613	.942
Marital status								
	Married	164	55.4	132	44.6	296	.921	
	Divorced	21	53.8	18	46.2	39		
	Widow/Widower	140	54.9	115	45.1	255		
	Single	30	55.5	285	44.5	50		
<b>Physical conditions</b>								
Physical Functionality Scores								
	ADL score	mean (SD)	4.38	0.941	3.93	1.2	640	<.001
	IADL score	mean (SD)	18.32	3.677	17.28	3.88	640	<.001
Cognitively impaired by the Mini Mental Test								
	No	313	55.1	255	44.9	568	.517	
	Yes	42	59.2	29	40.8	71		
Pain in the last weeks								
	No pain	76	73.8	27	26.2	103	<.001	
	Very little	45	73.8	16	26.2	61		
	A little	67	63.8	38	36.2	105		
	Moderate	61	59.8	41	40.2	102		
	Much	73	41.7	102	58.3	175		
	Very Much	33	35.1	61	64.9	94		
Admitted to a hospital in the past year								
	No	311	57.6	229	42.4	540	.016	
	Yes	44	44.4	55	55.6	99		
Chronic Disease								
	Number of chronic diseases	mean (SD)	1.34	0.935	1.54	1.07	638	.010
Hypertension								
	No	112	58.9	78	41.1	190	.283	
	Yes	239	54.3	201	45.7	440		
Parkinson								
	No	342	56.1	268	43.9	610	.435	
	Yes	11	47.8	12	52.2	23		
Diabetes								
	No	266	57	201	43	467	.311	
	Yes	87	52.4	79	47.6	166		
Cardiovascular condition								
	No	278	57.2	208	42.8	486	.165	
	Yes	74	50.7	72	49.3	146		
Respiratory condition								
	No	289	58.6	204	41.4	493	.013	
	Yes	64	46.7	73	53.3	137		
Polypharmacy								
	No	214	56.6	164	43.4	378	.484	
	Yes	141	53.8	121	46.2	262		
Falls in the past year								
	Number of falls	mean (SD)	0.87	1.747	1.5	4.41	635	.026

chi square with phi coefficient for categorical variables

t -test for continuous variables



Table 3. Bivariate analysis of depression and independent variables

	Not depressed		Depressed		Total	p-value	
	n	%	n	%			
<b>Health behaviour</b>							
Number of visits to the doctor because of a health checkup							
0 times	96.0	54.2	81.0	45.8	177.0	.948	
1-2 times	111.0	55.2	90.0	44.8	201.0		
3-4 times	67.0	57.8	49.0	42.2	116.0		
5 or more times	81.0	55.5	65.0	44.5	146.0		
Number of visits to the doctor because of a disease							
0 times	256.0	60.1	170.0	39.9	426.0	.002	
1-2 times	66.0	50.0	66.0	50.0	132.0		
3-4 times	23.0	46.9	26.0	53.1	49.0		
5 or more times	10.0	30.3	23.0	69.7	33.0		
Physical activity per week in the past three months							
Number of days	mean (SD)	.5	1.5	.3	1.2	617.0	.146
Tobacco smoking							
Never smoked	243.0	59.4	166.0	40.6	409.0	.038	
Quitted smoking	84.0	48.3	90.0	51.7	174.0		
Continues smoking	22.0	51.2	21.0	48.8	43.0		
Present alcohol drinking							
No	272.0	54.6	226.0	45.4	498.0	.418	
Yes	83.0	58.5	59.0	41.5	142.0		
<b>Social conditions</b>							
House Ownership							
No	33	56.9	25	43.1	58	.955	
Yes	278	56.5	214	43.5	492		
Did you work in agriculture							
Did not work in agriculture	181	54.4	152	45.6	333	.858	
Worked in agriculture	60	56.6	46	43.4	106		
Never worked	113	56.5	87	43.5	200		
White collar work							
Worked as white collar	7	63.6	4	36.4	11	.782	
Work as a blue color	234	54.7	194	45.3	428		
Never worked	113	56.5	87	43.5	200		
Living alone							
No	317	56.8	241	43.2	558	.075	
Yes	38	46.3	44	53.7	82		

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Change of living place in the past 5 years						
No	30	51.7	28	48.3	58	.547
Yes	325	55.8	257	44.2	582	
Are you uncomfortable with your living arrangement						
No	345	57.3	257	42.7	602	<.001
Yes	6	24	19	76	25	
Health Insured						
No	17	65.4	9	34.6	26	.288
Yes	320	54.8	264	45.2	584	
Pensioned						
No	112	58.9	78	41.1	190	.283
Yes	239	54.3	201	45.7	440	
Did you work last week?						
No	326	54.5	272	45.5	598	.067
Yes	29	69	13	31	42	
Have you felt discriminated?						
No	304	62	186	38	490	<.001
Yes	51	34	99	66	150	
Do you have any recreational activity						
No	227	53.4	198	46.6	425	.109
Yes	128	60.1	85	39.9	213	
Do you participate in an organization?						
No	267	54.5	223	45.5	490	.276
Yes	87	59.6	59	40.4	146	
Do you volunteer?						
No	324	56.5	249	43.5	573	.176
Yes	30	47.6	33	52.4	63	
Do you receive help from an organization?						
No	318	56	250	44	568	.460
Yes	37	51.4	35	48.6	72	
Do you provide care to someone else?						
No	322	55.5	258	44.5	580	.939
Yes	33	55	285	44.5	60	

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chi square with phi coefficient for categorical variables  
t-test for continuous variables

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Table 4: Logistic model for depression and related factors, n=597 for both models

	Model 1: Any kind of depression (GDS 5->)							Model 2: Severely depressed (GDS 10->)								
	B	S.E.	Wald	df	p-value	Odds Ratio	95% C.I.	B	S.E.	Wald	df	p-value	Odds Ratio	95% C.I.		
							Lower	Upper							Lower	Upper
<b>Healthbehaviour</b>																
Number of visits to the doctors for a checkup (ref 0 times)			2.727	3	.436					5.824	3	.120				
1-2 times	.114	.273	.173	1	.677	1.120	.656	1.912	-.812	.414	3.857	1	.050	.444	.197	.998
3-4 times	-.193	.322	.360	1	.548	.824	.438	1.550	-.068	.427	.026	1	.873	.934	.405	2.156
5 or more times	-.318	.315	1.015	1	.314	.728	.392	1.350	-.742	.461	2.595	1	.107	.476	.193	1.174
Number of visits to the doctor because of an acute disease (ref 0 times)			6.259	3	.100					7.765	3	.051				
1-2 times	.311	.252	1.528	1	.216	1.365	.833	2.236	.223	.363	.376	1	.540	1.250	.613	2.548
3-4 times	.511	.382	1.790	1	.181	1.668	.788	3.527	.867	.481	3.257	1	.071	2.380	.928	6.105
5 or more	1.052	.492	4.565	1	.033	2.862	1.091	7.511	1.392	.571	5.934	1	.015	4.023	1.313	12.330
Chronic disease																
Number of chronic diseases	-.004	.110	.001	1	.972	.996	.803	1.235	.096	.151	.404	1	.525	1.100	.819	1.478
Smoking habit (ref Never smoked)			3.444	2	.179					.713	2	.700				
Quitted Smoking	.437	.241	3.291	1	.070	1.548	.965	2.483	.018	.351	.003	1	.958	1.019	.512	2.028
Continues smoking	-.007	.396	.000	1	.986	.993	.457	2.157	.398	.480	.688	1	.407	1.488	.581	3.811
Physical exercise																
Days doing physical activities in the past three months	-.196	.088	4.938	1	.026	.822	.692	.977	-.255	.179	2.014	1	.156	.775	.545	1.102
<b>Social conditions</b>																
Living alone (ref=with others)	.739	.334	4.884	1	.027	2.094	1.087	4.034	.279	.473	.347	1	.556	1.322	.523	3.343
Uncomfortable with your living arrangement (ref=no)	1.301	.606	4.607	1	.032	3.671	1.120	12.039	1.513	.632	5.723	1	.017	4.539	1.314	15.678
Living alone*Uncomfortable with your living arrangement	.107	1.410	.006	1	.939	1.113	.070	17.652	-2.193	1.444	2.308	1	.129	.112	.007	1.889
Did you work last week? (ref=no)	-.662	.422	2.462	1	.117	.516	.226	1.179	-1.275	.735	3.008	1	.083	.279	.066	1.180
Have you felt discriminated? (ref=no)	.807	.246	10.759	1	.001	2.240	1.384	3.628	1.348	.323	17.388	1	.000	3.849	2.043	7.251
Have you participated in volunteering activities (ref No)	.202	.329	.376	1	.540	1.223	.642	2.331	-.552	.520	1.129	1	.288	.576	.208	1.594
Constant	4.229	1.339	9.976	1	.002	68.621			2.604	1.834	2.017	1	.156	13.518		

Notes: both models are adjusted by sex, age, urbanization, ethnic background, education in years, marital status, falls in the past years, ADL and IADL scores, pain in the past 4 weeks, hospital admission, and cognitive impairment.