

# Fall prevalence and its influencing factors on quality of life in elderly: a population-based cross sectional study from China

**Jiaojiao Ren**

Zunyi Medical University - Zhuhai Campus

**Guangyou Li** (✉ [ahlgyou@zmu.edu.cn](mailto:ahlgyou@zmu.edu.cn))

Zunyi Medical University - Zhuhai Campus <https://orcid.org/0000-0002-3519-8964>

**Liju Zhang**

Zunyi Medical University - Zhuhai Campus

**Na Zhang**

Zunyi Medical University - Zhuhai Campus

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## Research

**Keywords:** fall, influencing factors, elderly, quality of life

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1 **Fall prevalence and its influencing factors on quality of life in elderly: a**  
2 **population-based cross sectional study from China**

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4 Jiaojiao Ren, Guangyou Li\*, Liju Zhang and Na Zhang

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6 Department of Preventive Medicine, Zhuhai Campus of Zunyi Medical University,

7 Zhuhai 519041, China

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10 \* Correspondence: Guangyou Li, Department of Preventive Medicine, Zhuhai

11 Campus of Zunyi Medical University, Zhuhai, China, Tel: +86-(0)-756-7623326, Fax:

12 +86-(0)-756-7623380, e-mail: ahlgyou@zmu.edu.cn.

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24 **Abstract**

25 **Background:** Fall poses major health problems to the elderly and may potentially  
26 lead to various levels of injuries. At present, the sample sizes from most of the  
27 epidemiological studies on falls in Chinese elderly are limited and studies on fall risks  
28 are not comprehensive. This study is to understand the prevalence of fall and  
29 investigate the possible risk factors with fall focusing on the aged 60 years and older  
30 in China to shed light on designing interventions targeting this vulnerable population.

31 **Methods:** Data were derived from the China Health and Retirement Longitudinal  
32 Study (CHARLS) based on multistage sampling designs, with participants aged 60  
33 and older. The final sample size is 9692. We performed logistic regression analyses to  
34 examine the relationship between fall and its influencing factors.

35 **Results:** Of the 9692 respondents, 1697 (17.5%) had falls within the last 2 years. Our  
36 findings indicated that the participants with disability, chronic condition, age 75 years  
37 above, poor health status, sleep duration of  $\leq 5$ h and taking antihypertensive  
38 medication were more likely to report falls. A dose response relationship was found  
39 between depression, satisfaction with life and risk of fall.

40 **Conclusions:** After adjusting confounders, our study showed that age, sleep duration,  
41 disability, chronic condition, taking antihypertensive medication, self-assessed health  
42 status, depression and satisfaction with life were found to be significantly associated  
43 with fall in Chinese elderly. Such significant associations emphasize the need for  
44 evidence-based prevention and interventions for fall targeting these factors. Future  
45 prospective longitudinal study is warranted to investigate the causal relationship

46 between falls and the influencing factors.

47 **Keywords:** fall, influencing factors, elderly, quality of life

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## 68 **Background**

69 With the development of modern social civilization, the progress of technology and  
70 the continuous improvement of medical and health level, the average life span of the  
71 population is increasing, China is rapidly entering an aging society. In China, the  
72 aging population has increased rapidly over the past two decades. At the end of 2018,  
73 the population aged 60 years and older accounted for 17.9% [1]. It is estimated that  
74 the population aged 60 years and older will increase to 483 million (33.6%) by 2050  
75 [2]. The acceleration of population aging is an important risk and challenge for  
76 population development in the new era.

77 As a public health problem that endangers the health of the elderly, falls should be  
78 paid enough attention to. Fall refers to sudden, involuntary and unintentional change  
79 of body position, falling on the ground or on a lower plane [3]. When the people  
80 enters the old age stage, the body function begin to decline, which made the old  
81 people become the high-risk group of falls. The annual prevalence of fall among the  
82 Chinese elderly has ranged from 6% to 31% according to WHO global report [4]. The  
83 data of the national injury monitoring system from 2008 to 2013 revealed that 56.6%  
84 falls were contributed to all types of injuries among the population aged 65 years and  
85 older [5]. Falls not only have a huge impact on the physical and mental health of the  
86 elderly, but also cause a heavy economic burden. In the United States, the medical  
87 expenses associated with fall-related health problems account for 0.1% of the total  
88 expenses, even 1.5% in some European countries [6]. In China, an estimated yearly  
89 cost of fall in elderly are more than 5 billion yuan [7]. Therefore, identifying and

90 understanding the risk factors associated with fall among the Chinese elderly is  
91 imperative for designing effective prevention and intervention strategies for falls.

92 The occurrence of falls among elderly is not an accident, but a result of the interaction  
93 of multiple factors. The common risk factors of falls among elderly are divided into  
94 internal factors and external factors. Internal factors mainly include: gait, balance  
95 function, sensory system, central nervous system, skeletal muscle system, diseases  
96 (cardiovascular disease, nervous system disease, diabetes), medications and their  
97 adverse reactions, psychological factors and so on [8, 9]. External factors refer to  
98 some objective factors, mainly including environmental factors and social factors, for  
99 example, bad weather conditions, dark roads, obstacles in the environment, the living  
100 standards of the elderly, the health and medical conditions, and social contacts [10,  
101 11].

102 The Chinese elderly are more vulnerable to the certain risk factors attributable to fall,  
103 such as poor sleep, feeling lonely, alcohol consumption and smoking. It has been  
104 reported that most Chinese elderly are prone to sleep inadequacies and poor sleep  
105 quality, which has been shown to be associated with the risk of falls [12, 13]. In  
106 addition, depression and loneliness have also been found to be associated with falls in  
107 elderly population [14, 15]. At present, the sample sizes from most of the  
108 epidemiological studies on falls in Chinese elderly are limited and studies on fall risks  
109 are not comprehensive. Therefore, our study is to understand the prevalence of fall  
110 and investigate the possible risk factors with fall focusing on the aged 60 years and  
111 older in China to shed light on designing interventions targeting this vulnerable

112 population.

## 113 **Methods**

### 114 **Study Sample**

115 Data were taken from the China Health and Retirement Longitudinal Study  
116 (CHARLS), which collected household members aged 45 and above through a  
117 multistage probability proportional to the size of the sample. The national baseline  
118 survey was carried out in 2011, covering 150 county-level units and 450 village level  
119 units.

120 The questionnaire survey was conducted in face-to-face interview. Prior to data  
121 collection, interviewers received short intensive training. Informed consent must be  
122 signed by all respondents. The questionnaire recorded data on the respondents'  
123 demographic characteristics, physical examination, biochemical examination, social  
124 and economic status. In this study, the risk factors of falls were analyzed based on  
125 2011 baseline data and 2015 follow-up data. We extracted data from respondents aged  
126 60 and over. The final sample size is 9692. The Medical Ethics Committee of Peking  
127 University approved the CHARLS study (IRB00001052-11015).

### 128 **Study Variables**

129 The dependent variable in this study is fall. Participants were asked to respond “yes”  
130 or “no” to the question “Have you fallen down in the last two years?”

131 We adjusted independent variables for demographic, biological, psychosocial, and  
132 behavioural factors. Demographic variables included gender, age, level of education  
133 and marital status. Biological variables included co-morbidity related disability,

134 chronic condition, and self-report health status. Psychosocial variables were assessed  
135 with sleep disturbance, depression, loneliness, fear, and satisfaction with life.  
136 Behavioural variables were sleep duration, drinking, smoking, physical activity, social  
137 activities, taking antidiabetic medication, taking antitumor medication, taking  
138 antistroke medication, taking antipsychotic medication and taking antihypertensive  
139 medication.

#### 140 **Statistical Analysis**

141 All data were analyzed using SPSS version 25.0. The independent variables entering  
142 the regression models were determined through univariate analysis; only variables  
143 exhibiting a significant association ( $P < 0.05$ ) with the dependent variables in the  
144 univariate analysis were introduced into the logistic regression models. We performed  
145 logistic regression analyses to examine the relationship between fall and its  
146 influencing factors. All possible interactions were tested among all predictors that  
147 were significant in the final main effects model. The associations between fall and  
148 independent variables in the final model were reported as Odds ratios (ORs) and 95%  
149 confident intervals (CIs).

#### 150 **Results**

151 Of the 9692 aged 60 and older who responded questions on fall, 1697 (17.5%) had  
152 falls within the last 2 years. Among the 4900 (50.6%) females, 17.7% had falls, which  
153 is slightly higher than 17.4% for males. A large portion of the participants aged  
154 between 60 and 74 years (80.2%). About 39.6% of the participants reported having no  
155 more than elementary school and only 21.7% reported having high school and above

156 qualifications. Majority of the respondents were married (87.1%) and 10.7% were  
157 widowed (Table 1).

158 The characteristics of the current study sample revealed that those who had disability,  
159 chronic condition, and poor health status were more likely to report fall. With regard  
160 to psychosocial factors, those who were either depressed, fearful, restless and lonely  
161 most of the time (5-7 days) per week reported more higher fall rates (30.3%, 29.8%,  
162 25.8% and 28.6%). Similarly, 41.0% of participants who were not at all satisfied with  
163 life had fall compared to 14.6% who were completely satisfied with life. Among the  
164 behavioural factors, the participants who had sleep duration no more than 5 h, about  
165 21.8% had falls, whereas only 13.2% of the participants had falls for those who had  
166 sleep duration of 8 h. Findings revealed the risk of fall is significantly higher for those  
167 who drank alcohol, took antidiabetic medication, and antihypertensive medication  
168 than those who did not have the alcohol use, take antidiabetic or antihypertensive  
169 medication. However, smoking, physical activity, taking medicine to treat stroke,  
170 taking medicine to treat emotional, nervous, or psychiatric problems and social  
171 activities did not show significant association with falls (Table 2).

172 In the final multivariate logistic model, after adjusting for various demographic,  
173 biological, psychosocial and behavioural factors, age, sleep duration, disability,  
174 chronic condition, taking antihypertensive medication, self-assessed health status,  
175 depression and satisfaction with life were found to be significantly associated with  
176 falls. The participants who had sleep duration of  $\leq 5$ h were more likely to report falls  
177 than those who slept 8 h ( $\leq 5$ h: OR=1.132, 95% CI: 1.256-1.954). The participants

178 with disability, chronic condition, age 75 years above, and taking antihypertensive  
179 medication were more likely to report falls (OR=1.868, 95% CI: 1.630-2.141;  
180 OR=1.987, 95% CI: 1.756-2.248; OR=1.987, 95% CI: 1.273-1.681; OR=2.291, 95%  
181 CI: 1.865-2.814). A dose response relationship was found between depression and risk  
182 of falls. Thus, as the time of depression increases, the risk of falls also increases  
183 (depression 1-2 days: OR=1.545, 95% CI: 1.274-1.873; depression 3-4 days:  
184 OR=1.623, 95% CI: 1.318-1.999; depression 5-7 days: OR=1.738, 95% CI:  
185 1.452-2.082). Satisfaction with life also came to the same dose response relationship  
186 (very satisfied: OR=1.832, 95% CI: 1.288-2.607; somewhat satisfied: OR=1.784, 95%  
187 CI: 1.289-2.469; not very satisfied: OR=2.152, 95% CI: 1.545-2.997; not at all  
188 satisfied: OR=2.268, 95% CI: 1.559-3.300). In addition, those who were very poor  
189 health status had higher odds of reporting falls (OR=1.882, 95% CI: 1.318-2.688)  
190 (Table 3).

## 191 **Discussion**

192 With the rapid aging of the global population, falls are increasingly considered to be  
193 the leading cause of physical function impairment. Moreover, the cumulative effect of  
194 falls and resulting injuries among elderly would consume a disproportionate amount  
195 of health care resources in most countries. To effectively address the growing problem  
196 of falls, it is essential to understand the risk factors of falls.

197 The disability and chronic conditions have been found to be significantly associated  
198 with falls among elderly (OR=1.868; OR=1.987). The previous studies found the  
199 increased risk of falls among elderly with impaired vision and hypertension, which

200 highlighted the importance of disability and chronic condition variables in our study  
201 [16, 17]. The earlier published studies also identified that there was strong association  
202 between diabetes mellitus and fall among elderly [18, 19]. The mechanisms could be  
203 diabetes mellitus could affect falls through “peripheral neuropathy, visual impairment  
204 caused by diabetic retinopathy and diabetic foot ulcers”. A recent prospective  
205 controlled study revealed an individual with a stroke had a greater risk of falls when  
206 compared to those without stroke [20].

207 Our study also showed that falls were related with other behavioural and psychosocial  
208 factors. For sleep duration, our study revealed that sleep duration  $\leq 5$ h was  
209 significantly associated with increased risk of falls and this finding was consistent  
210 with other studies [21, 22]. However, compared with previous literature, our study  
211 found longer duration of sleep ( $> 8$  h) was not significantly related to falls in elderly.  
212 The differences could be due to the sample size, sampling methods and the study  
213 locations. Nevertheless, our findings contributed to understand the relationship on the  
214 sleep duration and falls among elderly in China. The antihypertensive medication use  
215 was also significantly associated with fall in the current study (OR=2.291). The  
216 benefit of antihypertensive medication on hypertension has already been  
217 demonstrated, however, there may be unintended harm associated with  
218 antihypertensive medication use in elderly [23, 24]. A recent study reported that the  
219 odds for fall was increased during the 15 days following antihypertensive medication  
220 initiation [25]. The elderly population are vulnerable to adverse side effects of  
221 antihypertensive medication use, including balance and gait impairment, dizziness,

222 and electrolyte disturbances, which may increase the risk of falls [26, 27].  
223 Consequently, clinicians should weigh the benefits of antihypertensive medication use  
224 against their potential for inducing fall among elderly.

225 Concerning psychological factors, findings revealed that depression was significantly  
226 associated with falls in our study population. The association between the elderly  
227 being depressed for 3 days or more and falls in our study reached the same conclusion  
228 with published studies results [28, 29]. Meanwhile, our study noticed that falls was  
229 related with satisfaction with life. It is an overall cognitive evaluation of a person's  
230 life conditions for a certain period of time according to the criteria he or she chooses.  
231 The main influencing factors of life satisfaction for the elderly were health status,  
232 mental health condition, family harmony, marriage condition, chronic diseases, and  
233 medical condition. The negative situation of these factors may contribute to increase  
234 fall rates in elderly. Therefore, the elderly should have a correct understanding of  
235 body changes, take regular physical check-ups and treat diseases as soon as possible.  
236 In addition, they should adopt a positive attitude towards life, take part in more social  
237 activities and achieve psychological adjustment.

238 Several limitations of this study should be acknowledged. Information collected from  
239 participants was based on self-report, so this study cannot rule out the possibility of  
240 recall bias. Besides, this cross-sectional study did not draw causal inference. Further  
241 studies are warranted when longitudinal data become available.

## 242 **Conclusions**

243 Our study showed that age, sleep duration, disability, chronic condition, taking

244 antihypertensive medication, self-assessed health status, depression and satisfaction  
245 with life were found to be significantly associated with falls in Chinese elderly. Such  
246 significant associations emphasize the need for evidence-based prevention and  
247 interventions for falls targeting these factors. Future prospective longitudinal study is  
248 warranted to investigate the causal relationship between falls and the influencing  
249 factors.

250

### 251 **Abbreviations**

252 *CHARLS*: the China Health and Retirement Longitudinal Study; *ORs*: Odds ratios;  
253 *CIs*: confident intervals

254

### 255 **Ethics approval and consent to participate:**

256 All participants in this study provided written, informed consent and the Medical  
257 Ethics Committee of Peking University approved the study (IRB00001052-11015).

258

### 259 **Consent for publication**

260 Not applicable.

261

### 262 **Availability of data and materials:**

263 The datasets used and/or analysed during the current study are available from the  
264 corresponding author on reasonable request.

265

266 **Competing interests**

267 The authors declare that they have no competing interests

268

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273

274 **Authors' contributions**

275 JJR and YGL conceptualized this study. LJZ drafted the methodology and performed

276 the statistical analyses. NZ produced the first draft of the manuscript. JJR provided

277 language help and contributed to the final revision. All authors read and approved the

278 final manuscript.

279

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377 **Table 1** Demographic characteristics of study participants

Variables	Total (N=9692) n (%)	Fall		P-value
		Yes (N=1697) n (%)	No (N=7995) n (%)	
<b>Gender</b>				
Male	4792 (49.4)	832 (17.4)	3960 (82.6)	.706
Female	4900 (50.6)	865 (17.7)	4035 (82.3)	
<b>Age</b>				
60-74	7771 (80.2)	1325 (17.1)	6446 (82.9)	.017
≥75	1921 (19.8)	372 (19.4)	1549 (80.6)	
<b>Level of education</b>				
No more than primary school	3835 (39.6)	674 (17.6)	3161 (82.4)	.826
Secondary school	3751 (38.7)	658 (17.5)	3093 (82.5)	
High school and above	2106 (21.7)	365 (17.3)	1741 (82.7)	
<b>Marital status</b>				
Married	8439 (87.1)	1479 (17.5)	6960 (82.5)	.759
Divorced	129 (1.3)	27 (20.9)	102 (79.1)	
Widowed	1035 (10.7)	176 (17.0)	859 (83.0)	
Never married	89 (0.9)	15 (16.9)	74 (83.1)	

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394 **Table 2** Association between fall and biological, psychosocial, and behavioural  
 395 factors

Variables	Total (N=9692) n (%)	Fall		P-value
		Yes	No	
		(N=1697) n (%)	(N=7995) n (%)	
<b>Biological factors</b>				
Disability				
Yes	1369 (14.1)	398 (29.1)	971 (70.9)	< .001
No	8323 (85.9)	1299 (15.6)	7024 (84.4)	
Chronic condition				
Yes	5147 (53.1)	960 (18.7)	4187 (81.3)	.002
No	4545 (46.9)	737 (16.2)	3808 (83.8)	
Self-assessed health status				
Very good	594 (6.1)	53 (8.9)	541 (91.1)	< .001
Good	972 (10.0)	131 (13.5)	841 (86.5)	
Fair	5869 (60.6)	1058 (18.0)	4811 (82.0)	
Poor	1626 (16.8)	309 (19.0)	1317 (81.0)	
Very poor	631 (6.5)	146 (23.1)	485 (76.9)	
<b>Psychosocial factors</b>				
Sleep disturbance				
None (< 1 day)	5034 (51.9)	698 (13.9)	4336 (86.1)	< .001
Little (1-2 days)	1375 (14.2)	219 (15.9)	1156 (84.1)	
Occasionally (3-4 days)	1421 (14.7)	299 (21.0)	1122 (79.0)	
Most (5-7 days)	1862 (19.2)	481 (25.8)	1381 (74.2)	
Depression				
None (< 1 day)	5373 (55.4)	771 (14.3)	4602 (85.7)	< .001
Little (1-2 days)	1595 (16.5)	263 (16.5)	1332 (83.5)	
Occasionally (3-4 days)	1663 (17.2)	341 (20.5)	1322 (79.5)	
Most (5-7 days)	1061 (10.9)	322 (30.3)	739 (69.7)	
Loneliness				
None (< 1 day)	7220 (74.5)	1115 (15.4)	6105 (84.6)	< .001
Little (1-2 days)	919 (9.5)	195 (21.2)	724 (78.8)	
Occasionally (3-4 days)	724 (7.5)	150 (20.7)	574 (79.3)	
Most (5-7 days)	829 (8.5)	237 (28.6)	592 (71.4)	
Fear				
None (< 1 day)	7896 (81.5)	1265 (16.0)	6631 (84.0)	< .001
Little (1-2 days)	663 (6.8)	133 (20.1)	530 (79.9)	
Occasionally (3-4 days)	639 (6.6)	152 (23.8)	487 (76.2)	
Most (5-7 days)	494 (5.1)	147 (29.8)	347 (70.2)	

	Satisfaction with life				
	Completely satisfied	829 (8.5)	121 (14.6)	708 (85.4)	< .001
	Very satisfied	3487 (36.0)	553 (15.9)	2934 (84.1)	
	Somewhat satisfied	4486 (46.3)	772 (17.2)	3714 (82.8)	
	Not very satisfied	690 (7.1)	169 (24.5)	521 (75.5)	
	Not at all satisfied	200 (2.1)	82 (41.0)	118 (59.0)	
Behavioural factors					
	Sleep duration				
	≤ 5	2719 (28.1)	593 (21.8)	2126 (78.2)	< .001
	6-7	4125 (42.6)	708 (17.2)	3417 (82.8)	
	8	1988 (20.5)	262 (13.2)	1726 (86.8)	
	9-10	768 (7.9)	116 (15.1)	652 (84.9)	
	≥ 11	92 (0.9)	18 (19.6)	74 (80.4)	
	Drinking				
	Yes	3576 (36.9)	733 (20.5)	2843 (79.5)	.001
	No	6116 (63.1)	964 (15.8)	5152 (84.2)	
	Smoking				
	Yes	849 (8.8)	132 (15.5)	717 (84.5)	.116
	No	8843 (91.2)	1565 (17.7)	7278 (82.3)	
	Physical activity				
	Yes	4788 (49.4)	803 (16.8)	3985 (83.2)	.059
	No	4904 (50.6)	894 (18.2)	4010 (81.8)	
	Social activities				
	Yes	5664 (58.4)	1003 (17.7)	4661 (82.3)	.541
	No	4028 (41.6)	694 (17.2)	3334 (82.8)	
	Antidiabetic medication				
	Yes	505 (5.2)	127 (25.1)	378 (74.9)	< .001
	No	9187 (94.8)	1570 (17.1)	7617 (82.9)	
	Antitumor medication				
	Yes	70 (0.7)	10 (14.3)	60 (85.7)	.476
	No	9622 (99.3)	1687 (17.5)	7935 (82.5)	
	Antistroke medication				
	Yes	152 (1.6)	29 (19.1)	123 (80.9)	.608
	No	9540 (98.4)	1668 (17.5)	7872 (82.5)	
	Antipsychotic medication				
	Yes	99 (1.0)	21 (21.2)	78 (78.8)	.330
	No	9593 (99.0)	1676 (17.5)	7917 (82.5)	
	Antihypertensive medication				
	Yes	2306 (23.8)	437 (19.0)	1869 (81.0)	.037
	No	7386 (76.2)	1260 (17.1)	6126 (82.9)	

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398 **Table 3** Results of multivariate logistic regression between fall and its associated  
 399 factors

Variable	$\beta$	Wald	P value	OR	95% CI
Age	0.380	28.686	< .001	1.463	1.273-1.681
Disability	0.625	80.580	< .001	1.868	1.630-2.141
Chronic condition	0.687	118.910	< .001	1.987	1.756-2.248
Self-assessed health status		22.805	< .001		
Very good (ref)					
Good	-0.065	0.257	.612	0.937	0.730-1.204
Fair	0.001	0.000	.994	1.001	0.808-1.240
Poor	0.210	2.134	.144	1.234	0.931-1.635
Very poor	0.632	12.109	.001	1.882	1.318-2.688
Depression		37.587	< .001		
None (< 1 day) (ref)					
Little (1-2 days)	0.435	19.617	< .001	1.545	1.274-1.873
Occasionally (3-4 days)	0.484	20.763	< .001	1.623	1.318-1.999
Most (5-7 days)	0.553	36.147	< .001	1.738	1.452-2.082
Satisfaction with life		25.945	< .001		
Completely satisfied (ref)					
Very satisfied	0.606	11.334	.001	1.832	1.288-2.607
Somewhat satisfied	0.579	12.177	< .001	1.784	1.289-2.469
Not very satisfied	0.766	20.567	< .001	2.152	1.545-2.997
Not at all satisfied	0.819	18.311	< .001	2.268	1.559-3.300
Sleep duration		13.945	.007		
$\leq 5$	0.124	0.199	.012	1.132	1.256-1.954
6-7	0.163	0.348	.555	1.177	0.685-2.022
8 (ref)					
9-10	0.422	2.259	.133	1.525	0.880-2.644
$\geq 11$	0.283	0.941	.332	1.326	0.749-2.348
Antihypertensive medication	0.829	0.105	< .001	2.291	1.865-2.814

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