HHS Public Access
Author manuscript
Dement Geriatr Cogn Disord. Author manuscript; available in PMC 2016 August 22.

Published in final edited form as:
Dement Geriatr Cogn Disord. 2015 ; 39(5-6): 294–302. doi:10.1159/000375366.

Prevalence of Dementia and Main Subtypes in Rural Northern China

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Abstract

Background/Aims—The aim of this article was to estimate the prevalence of and to determine the sociodemographic risk factors for dementia, Alzheimer's disease (AD) and vascular dementia (VaD) among individuals residing in rural northern China.

Methods—Between 2011 and 2012, residents aged ≥ 60 years and residing in rural areas of northern China were clinically assessed for symptoms of dementia, AD and VaD. Diagnoses were made using established criteria and standard procedures.

Results—Among 5,578 enrolled study participants aged ≥ 60 years, the prevalence rates of dementia, AD and VaD were 7.7, 5.4 and 1.7%, respectively. Older age (OR = 1.17; 95% CI: 1.14–1.19) and female gender (OR = 2.13; 95% CI: 1.51–3.00) were identified as independent risk factors for AD. In turn, a higher educational level (OR = 0.36; 95% CI: 0.21–0.60) and engagement in social activities (OR = 0.219; 95% CI: 0.163–0.295) were protective factors. Risk factors associated with VaD were older age (OR = 1.11; 95% CI: 1.1– 1.12) and hypertension (OR = 1.83; 95% CI: 1.18–2.86), while a higher educational level (OR = 0.53, 95% CI: 0.44–0.65) and engagement in social activities (OR = 0.34; 95% CI: 0.29–0.41) were protective factors.

Conclusion—High rates of dementia (7.7%) and AD (5.4%) were found in the rural areas of northern China. Older age and female gender were identified as risk factors for AD, while older age and hypertension were risk factors for VaD. A higher educational level and engagement in social activities were identified as protective factors against both AD and VaD.

Keywords

Alzheimer's disease; Dementia; Prevalence; Rural China; Risk factors

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Introduction

As the country with the world's largest population, China will face substantial challenges in adjusting to its ageing population, of which increasing numbers will have some degree of dementia. Thus, investigating the nationwide epidemiology of dementia in rural and urban areas will be of great importance for providing information used in developing appropriate policies and patient care strategies. However, it is especially essential to understand the prevalence of dementia in rural China, because ~ 70% of China's 1.29 billion people live in rural areas, and the majority are primarily engaged in agriculture [1]. A recent meta-analysis estimated that 4.98–5.9% of individuals in China aged >60–65 years have some type of dementia [2, 3] but did not calculate its specific prevalence in rural and urban areas or in regions stratified as northern or southern China. A second recent meta-analysis regarding the prevalence of dementia in different regions of China found geographic differences in the prevalence of dementia across China, with higher rates of Alzheimer's disease (AD) in rural areas compared to urban areas. Moreover, higher prevalence rates of both vascular dementia (VaD) and AD were found in northern as compared to southern China [4].

Few epidemiological data are available on dementia in rural northern China, and the numbers of affected individuals in these areas have been estimated using prevalence data obtained from other regions of China or from cross-sectional studies in which there were large numbers of nonresponders [4, 5]. The higher prevalence of dementia in rural compared to urban areas may result from differences in demographic factors, including education and lifestyle. Moreover, these same factors may account for the large differences in the prevalence and patterns of dementia across northern and southern China. Our current study was conducted to estimate the prevalence of dementia and its main subtypes (AD and VaD) in Chinese individuals residing in rural northern China. We also analyzed the sociodemographic risk factors and comorbidities associated with dementia and its subtypes.

Methods

Study Population

This cross-sectional population-based study was conducted in 56 villages selected from 949 villages in the rural Ji County in northern China. The local medical practitioner in each village (who had worked there for an average of 5.76 ± 3.23 years) was involved in identifying all individuals aged ≥ 60 years based on the date of birth provided on the residence certificate. Inclusion criteria of the study stated that an individual must have legally resided in the county for ≥ 5 years prior to study enrollment. The total number of participants aged ≥ 60 years in these villages was 5,744; however, due to hearing loss (n = 112), refusal (n = 39), death or migration (n = 8) or other issues (n = 7), 5,578 completed both phases of the door-to-door interview. The study protocol was approved by the Committee for Medical Research Ethics at Tianjin Huanhu Hospital and the Tianjin Health Bureau.

Phase I: Screening Interview

Potential subjects were contacted directly by a house visit, at which time they were informed concerning the objective of the interview and welcomed to participate. After providing signed written informed consent, the home interview was conducted by at least 2 members of a team consisting of 10 medical practitioners. The medical practitioners had been trained to collect information in a uniform manner by 2 neurologists specializing in dementia and AD from the Dementia Center of Tianjin Huanhu Hospital. During the interview, the practitioners collected information on each participant's sociodemographic characteristics, medical history, scores on the Chinese Mini-Mental State Examination (C-MMSE) and also recorded findings from physical and neurological examinations [6]. Reliable informants (the subject's spouse, children, other relatives or close friends, in descending order) provided information if the subject was unable to do so alone. Subjects with a C-MMSE score less than certain cutoff points (18 for illiterate persons, 24 for persons with 1–11 years of education and 27 for persons with ≥ 12 years of education or a Clinical Dementia Rating ≥ 0.5) were deemed eligible for participation in phase II of the study [5–7]. The average duration of this first interview was 60 min.

The comorbidities of the subjects such as a history of diabetes, hypertension, heart disease or stroke were obtained from a local medical practitioner who had cared for the participant for at least the preceding 5 years. A previous history of stroke as defined by the WHO was based on information obtained from the doctor, patient and a reliable informant. The qualifying symptoms of stroke included sudden or rapidly developing signs of focal or global neurological dysfunction which lasted for >24 h and had no apparent nonvascular cause (e.g., cranial trauma, coma attributable to a metabolic disorder, neoplasia, vasculitis, central nervous system infection or peripheral neuropathy) [8]. A smoker was defined as an individual with a history of smoking ≥ 5 cigarettes per day for >2 years. An alcohol drinker was defined as an individual with a history of drinking an alcoholic beverage ≥ 1 time per week for >2 years. Engagement in social activities was defined as attending any social activity >1 time per week.

Phase II: Neurological Consultation

Subjects who were eligible for phase I were further examined to confirm or exclude the presence of dementia. If dementia was present, its subtype was determined. This assessment was performed during a second home interview; however, this time, the interview was conducted by 2 of 6 board-certificated neurologists from the Dementia Center of Tianjin Huanhu Hospital. The 6 neurologists had been trained together to ensure uniform neurological consultation across all participants. A detailed medical history was obtained from all patients in phase II, and each patient received a physical and neurological examination.

Criteria for Dementia and Its Subtypes

Individuals were classified as having dementia if they fulfilled the criteria listed in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) and had experienced dementia symptoms for ≥ 3 months [9, 10]. Assessments were based on data obtained from the interviews, health examinations, previous health and social work records and tests for cognitive function and functional capacity. The National Institute of Neurological and Communicative Disorders-AD and Related Disorders Association criteria were used for the clinical diagnosis of AD [11], and criteria of the National Institute of Neurological Disorders and Stroke – Association Internationale pour la Recherche et I'Enseinement en Neurosciences were used for the clinical diagnosis of VaD [12]. The clinical criteria used for diagnosing AD included an insidious onset and progressive impairment of memory and other cognitive functions. Since there are no specific motor, sensory or coordination deficits associated with early-stage AD, other possible causes of dementia were excluded before diagnosing AD. The clinical criteria used for diagnosing VaD included a history of ischemic or hemorrhagic strokes, cerebral hypoxic-ischemic events or senile leukoencephalopathic lesions. However, because the clinical course of VaD can be static, remitting or progressive, there is a temporal relationship between stroke and dementia onset, and brain imaging findings are required for a definitive diagnosis. Other dementias (ODs) defined by globally accepted criteria include mixed dementia, frontotemporal dementia, dementia with Lewy bodies, Parkinson's disease with dementia, alcoholic dementia, hydrocephalus dementia and posttraumatic dementia. Cognitive impairment no dementia was diagnosed as either (1) mild cognitive or functional impairment that did not meet the criteria for dementia or (2) performance on neuropsychological or functional tests that was below expectations and ≥ 0.5 standard deviations below the published norms on any test [9].

Statistical Analysis

The overall prevalence of dementia was calculated taking into account the total number of dementia cases with respect to the total study sample. The overall prevalence of dementia and its specific prevalence per 5-year age group, sex and educational level were calculated. Additionally, the age- and sex-specific prevalence rates of dementia and its various subtypes were also determined. A subject's marital status was classified as either married or widowed/separated (single or divorced). Educational attainment was categorized as having ≤ 5 or >5 years of formal education.

In each analysis, the dependent variable was dementia and its subtypes were AD and VaD. Frequency distributions were used for the analysis of qualitative variables and the numbers of individuals (%). Age-adjusted and sex-adjusted ORs were calculated to identify sociodemographic and clinical factors associated with dementia. Variables with an OR p value <0.05 were included in a multivariate analysis to identify sociodemographic and clinical factors independently associated with dementia, AD and VaD. p values <0.05 were considered statistically significant. All data were analyzed using IBM SPSS Statistics for Windows (Version 20.0; IBM Corp., Armonk, N.Y. USA).

Results

Of the 5,578 study participants aged ≥ 60 years, 429 (7.7%) were diagnosed with some form of dementia. Among these individuals, 34.5% were men and 65.5% were women. The dementia diagnoses included 299 (5.4%) cases of AD, 96 (1.7%) cases of VaD and 34 (0.6%) cases of OD. The mean ages of individuals with normal cognition, VaD and AD were

67.9 ± 6.0, 74.1 ± 8.3 and 76.7 ± 8.2 years, respectively. The study group also included 1,307 (23.4%) individuals with cognitive impairment no dementia and 3,842 individuals with normal cognition.

Table 1 shows the prevalence rates of dementia, AD and VaD according to gender, 5-year age groups and educational level. The overall rate of dementia was higher in females (9.1%) than in males (6.0%). AD was more common in females than in males (6.7 vs. 3.7%, respectively), while VaD was equally common in both genders (1.7 vs. 1.7%). Dementia became progressively more common as individuals aged beyond 70 years and was also more common among participants with fewer years of education. Among the 429 individuals with dementia, AD was the main diagnosis (299 cases; 70%) followed by VaD (96 cases; 22%) and OD (34 cases; 8%).

The age-adjusted ORs for AD and VaD are shown in table 2. Our analysis showed significant positive associations between AD and other factors including female gender, having ≤ 5 years of formal education, being without a partner and having no engagement in social activities. A subsequent multivariate analysis found that independent risk factors for AD were older age (OR = 1.17; 95% CI: 1.14–1.19) and female gender (OR = 2.13; 95% CI: 1.51–3.00). Independent protective factors against AD were having >5 years of formal education (OR = 0.36; 95% CI: 0.21–0.60) and engagement in social activities (OR = 0.219; 95% CI: 0.163– 0.295) (table 3).

VaD was associated with having ≤ 5 years of formal education, no engagement in social activities and the presence of hypertension. No gender differences were identified for VaD in the univariate analysis. The subsequent multivariate analysis identified older age (OR = 1.11; 95% CI: 1.1–1.12) and hypertension (OR = 1.83; 95% CI: 1.18–2.86) as independent risk factors for VaD. Independent protective factors against AD included having >5 years of formal education (OR = 0.53; 95% CI: 0.44–0.65) and engagement in social activities (OR = 0.34; 95% CI: 0.29–0.41) (table 3).

Results of a further evaluation of the association between hypertension and VaD are shown in table 4. Hypertension was twice as prevalent among individuals with VaD as compared to those with normal cognition. Additionally, hypertension accompanied by diabetes mellitus was 3-fold more prevalent among individuals with VaD; however, no significant association was identified between having VaD combined hypertension and heart disease.

Discussion

This large population-based cross-sectional study is one of only a few which have investigated the prevalence rates of AD and VaD in the rural areas of northern China. Moreover, this study explored and identified numerous risk factors for dementia; many of which had not been previously examined for their relation to dementia subtypes AD and VaD in the Chinese population. Our data showed that the prevalence rates of dementia, AD and VaD among Chinese individuals aged ≥ 60 years were 7.7, 5.4 and 1.7%, respectively. These prevalence rates were slightly higher than those found in a previous study of individuals aged ≥ 65 years and residing in rural areas of northeast and southwest China. In that study, the prevalence rates of dementia, AD and VaD were 6.06, 4.26 and 1.28%, respectively [4]. The slightly higher prevalence rates in our study most likely reflect the increased risk for AD and VaD among individuals in northern rural China versus individuals residing in urban areas and southern China [7]. Compared to the results from studies conducted in an urban population, our rates of dementia should be substantially higher, considering that a rural location is an established risk factor for dementia in Asian and other countries [5, 13]. Similar to the patterns of dementia observed in a Western study, our results also found that AD and VaD accounted for 70 and 22% of dementia cases, respectively [14].

Our findings suggest that the prevalence rates of dementia and AD in China significantly increase with advancing age. A previous study found that among individuals aged ≥ 80 years and residing in the same rural area of China as selected for our current study, 73.2% had some degree of cognitive impairment [15]. A high rate of dementia was found in the youngest age group (3.4% among individuals aged 60–64 years), which exceeded the rate found in the next higher age group (65–69 years). However, a subsequent analysis found that this difference between the 2 groups was not statistically significant. The subtle difference between these groups may have resulted from differences in participant gender and educational levels as well as the relatively small number of patients studied (<2,000). However, the results also suggest a similar prevalence of dementia among individuals aged 60–69 years. Literature reports suggest that the prevalence rates of AD and VaD double almost every 5 years starting from 65 and 70 years of age, respectively [16, 17]. In our study, both dementia and AD were found more frequently in women than in men within the same age group; however, there was no gender difference regarding VaD, and this finding was similar to those in other studies [7, 18–20]. In our elderly Chinese population, the higher risk for dementia among women might reflect a lifetime accumulation of social disadvantages such as a lack of educational opportunities in early life which may have severely hindered the access to employment and opportunities for personal development. A lower educational level has previously been found to be associated with cognitive decline and the risk for dementia [21]. However, in our study, even after adjusting for educational attainment, female gender continued to be a risk factor for developing AD. Such data suggest that women may have a biological basis for an increased risk for dementia or may experience social disadvantages such as participating in less complex occupational activities, which has also been found to be associated with cognitive decline [22].

While our study found that being widowed or separated was associated with a higher risk for AD, the relationship between marital status and AD became statistically insignificant after adjusting for engagement in social activities and other confounding factors. Similarly, a previous study conducted in Malaysia found that being married or with a partner was negatively associated with dementia compared to being widowed or separated; however, this relationship was not statistically significant (OR = 0.83; 95% CI: 0.62–1.1) [23]. Another study found that subjects with spouses experiencing incident dementia were at a 6-fold greater risk for incident dementia compared to subjects whose spouses were dementia-free [24]. However, these contrasting results need to be investigated in more detail to confirm their respective validities. Similar to others, our study also found that hypertension was associated with VaD but not with AD [23, 25]. A previous study found that a history of hypertension doubled an individual’s risk for VaD. However, a further analysis of those data showed no increased rate of VaD among people with hypertension alone, but a 3-fold increased risk for VaD among people with hypertension accompanied by heart disease [25]. In contrast, our study showed a 2-fold increased risk for VaD among individuals with hypertension alone, but no association between VaD, concomitant hypertension and heart disease. Interestingly, it did show a 3-fold increased risk for VaD among individuals with both hypertension and diabetes mellitus. Our study found that individuals with normal cognitive function were more likely to be smokers compared to individuals with AD or dementia, suggesting that smoking might protect against AD and dementia; however, this relationship between smoking and AD became statistically insignificant after being adjusted for other factors. The association between smoking and AD has been controversial, with some studies suggesting that smoking protects against AD and others identifying smoking as an AD risk factor [26, 27]. Similar to our investigation, the studies which found that smoking protected against AD were case-controlled or cross-sectional studies, while those which found that smoking was a risk factor were prospective studies [28]. As prospective studies are more accurate in predicting causality than cross-sectional studies due to the decreased influence of survival bias, smoking is more likely to be a risk factor for dementia.

A lower educational level has been consistently reported as a risk factor for AD and dementia, with the risk decreasing with increasing education. Furthermore, longitudinal studies have also found associations between the educational level and AD and/or the incidence of dementia that were similar to those in our cohort. Such studies include the Rotterdam study [29], the EURODEM study [13], the MoVIES study [30], the Baltimore Longitudinal Study of Aging [31], the Framingham study [32] and the East Boston study [33]. Although it has been suggested that the effect of education might result from a diagnostic bias, as early dementia might be missed in a highly educated person, we do not believe this was a frequent occurrence in our study because the different cutoff points on the MMSE were based on an individual's educational background.

Similar to previous cross-sectional and longitudinal studies, our study found that the risks for both AD and VaD were highly associated with no engagement in social activities [34, 35]. However, we cannot yet make any causal statement concerning the role of social engagement in enhancing or preserving cognitive function. If the effect is indeed causal, its precise mechanism may be mediated by multiple influences. For example, a 2-year prospective study conducted in Hong Kong found that a high level of cognitive activity and a low level of loneliness were associated with better scores on a cognitive performance test [36]. This suggests that engagement in social activities has a dual protective effect by increasing cognitive activity and reducing loneliness. Further longitudinal studies are needed to verify this relationship.

Similar to previous studies, our study also found that alcohol consumption helped protect against AD; however, this relationship between alcohol consumption and AD became statistically insignificant after adjusting for other factors. Another study found that moderate drinkers with no significant cognitive impairment performed better on cognitive ability tests compared to noncognitively impaired individuals who did not consume alcohol [37]. Finally, the results of still another previous study suggested that moderate drinking improved cognitive functions [38]. However, many of these studies were inconclusive, as the data were derived from cross-sectional surveys and self-reported answers to questions. Data concerning an individual's age at first-time alcohol use, the type and amount of alcohol consumed and changes in drinking behavior need to be collected in future studies.

Our current study has one limitation that should be mentioned. Since it was cross-sectional rather than longitudinal, the findings should be interpreted with caution, as some risk factors may have been incorrectly identified and associated with the survival rather than the development of the disease (Neyman bias). Thus, it is possible that a sizable proportion of participants in our sample who reported no hypertension, diabetes or heart disease were in fact undiagnosed and undertreated. However, our study does have its strengths. While a major concern when conducting prevalence studies is nonparticipation, our study had a fairly high participation rate (97.1%). If the nonresponders were predominately participants with dementia, our study probably underestimated the prevalence of dementia.

In conclusion, our results suggest that risk factors for AD include older age and female gender, while a higher educational level and engagement in social activities are protective factors. VaD is positively associated with older age and hypertension and is inversely associated with a higher educational level and engagement in social activities.

Acknowledgments

The project was supported by the Tianjin Science and Technology Support Programs (funding No. 12ZCZDSY02900 and 12ZCZDSY01600), the Science and Technology Project of the Tianjin Municipal Health Bureau (funding No. 11KG117) and the Tianjin Natural Science Foundation (funding No. 13JCYBJC21300). This article has been edited by native English-speaking experts from BioMed Proofreading LLC.

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Table 1

Prevalence rates of dementia, AD and VaD according to sex, age and educational level

	Individuals, n	Dementia		AD		VaD	
		cases, n (%)	95% CI	cases, n (%)	95% CI	cases, n (%)	95% CI
Total	5,578	429 (7.7)	6.99–8.39	299 (5.4)	4.77–5.95	96 (1.7)	1.38–2.06
Gender							
Male	2,482	148 (6.0)	5.03–6.89	93 (3.7)	3.00–4.50	42 (1.7)	1.18–2.20
Female	3,096	281 (9.1)	8.06–10.10	206 (6.7)	5.78–7.53	54 (1.7)	1.28–2.21
Age							
60–64 years	1,683	58 (3.4)	2.57–4.32	35 (2.1)	1.40–2.76	19 (1.1)	0.62–1.63
65–69 years	1,394	39 (2.8)	1.93–3.66	24 (1.7)	1.04–2.41	15 (1.1)	0.53–1.62
70–74 years	983	55 (5.6)	4.16–7.03	40 (4.1)	2.83–5.30	12 (1.2)	0.53–1.91
75–79 years	719	77 (10.7)	8.45–12.97	62 (8.6)	6.57–10.67	13 (1.8)	0.83–2.78
80–84 years	452	112 (24.8)	20.80–28.76	77 (17.0)	13.57–20.50	23 (5.1)	3.06–7.11
85+ years	189	63 (33.3)	26.61–40.05	43 (22.8)	16.77–28.73	10 (5.3)	2.10–8.48
Education							
Illiterate	2,240	286 (12.8)	11.39–14.15	199 (8.9)	7.71–10.06	58 (2.6)	1.93–3.25
≤5 years	2,022	119 (5.9)	4.86–6.91	82 (4.1)	3.20–4.92	34 (1.7)	1.21–2.24
>5 years	1,316	24 (1.8)	1.10–2.55	18 (1.4)	0.74–1.20	4 (0.3)	0.01–0.60

% values represent % prevalence rates of dementia.

Table 2

Univariate analysis of variables significantly associated with AD and VaD

	Normal cognition (ref.), n (%)	AD, n (%)	Age-adjusted OR (95%CI)	p value	VaD, n (%)	Age-adjusted OR (95%CI)	p value
Gender							
Male	1,838 (47.8)	93 (31.1)			42 (43.8)		
Female	2,004 (52.2)	206 (68.9)	2.75 (2.09–3.63)	<0.001	54 (56.3)	1.46 (0.96–2.22)	0.074
Education							
>5 years	1,130 (29.4)	18 (6.0)			4 (4.2)		
0–5 years	2,712 (70.6)	281 (94.0)	3.79 (2.31–6.22)	<0.001	92 (95.8)	6.82 (2.48–18.72)	<0.001
Smoking	1,006 (26.2)	58 (19.4)	0.62 (0.46–0.86)	0.003	18 (18.8)	0.60 (0.36–1.01)	0.055
Alcohol consumption	734 (19.1)	28 (9.4)	0.44 (0.29–0.67)	<0.001	11 (11.5)	0.53 (0.28–1.01)	0.052
Widowed/separated	492 (12.8)	111 (37.1)	1.65 (1.21–2.23)	0.001	25 (26.0)	1.12 (0.67–1.88)	0.675
No social activities	410 (10.7)	119 (39.8)	4.20 (3.16–5.58)	<0.001	22 (22.9)	2.42 (1.44–4.07)	0.001
Comorbidities							
Hypertension	1,449 (37.7)	119 (39.8)	1.14 (0.88–1.48)	0.339	52 (54.2)	1.93 (1.28–2.92)	0.002
Diabetes mellitus	280 (7.3)	22 (7.4)	1.47 (0.90–2.39)	0.12	8 (8.3%)	1.48 (0.70–3.14)	0.30
Heart disease	289 (7.5)	25 (8.4)	0.78 (0.50–1.27)	0.34	9 (9.4)	0.99 (0.49–2.02)	0.98

Table 3

Multivariate analysis of variables significantly associated with AD or VaD

	B	OR (95% CI)	p value
AD			
Age (years)	0.153	1.17 (1.14–1.19)	<0.001
Female gender	0.756	2.13 (1.51–3.00)	<0.001
Education (>5 years)	−1.03	0.36 (0.21–0.60)	<0.001
Current smoker	0.101	1.11 (0.73–1.68)	0.637
Alcohol consumption	−0.454	0.635 (0.37–1.089)	0.099
Widowed/separated	0.310	1.364 (0.988–1.88)	0.059
Engages in social activities	−1.52	0.219 (0.163–0.295)	<0.001
VaD			
Age	0.103	1.11 (1.1–1.12)	<0.001
Education (>5 years)	−0.632	0.53 (0.44–0.65)	<0.001
Engages in social activities	−1.07	0.34 (0.29–0.41)	<0.001
Hypertension	0.608	1.83 (1.18–2.86)	0.007

Table 4

Age-adjusted ORs for the association of hypertension alone and hypertension accompanied by cardiovascular risk factors with VaD

	Normal cognition	VaD	Age-adjusted OR (95% CI)	p value
No hypertension	2,393	44	1.0 (ref.)	
Hypertension	1,449	52	1.93 (1.28–2.92)	0.002
Hypertension only	1,159	39	1.83 (1.18–2.86)	0.007
Hypertension and diabetes	165	8	3.35 (1.51–7.43)	0.003
Hypertension and heart disease	159	6	1.62 (0.67–3.94)	0.288