Published in final edited form as:

Neuroepidemiology. 2014 ; 42(4): 197–203. doi:10.1159/000360138.

Prevalence of Cognitive Impairment No Dementia in a Rural Area of Northern China

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Abstract

Objective—Few data are available on the prevalence of cognitive impairment no dementia (CIND) in rural China. The aim of this study was to estimate the prevalence of CIND in individuals aged 60 years and older in a large rural community, and to analyze the associated risk factors.

Methods—A two-phase, door-to-door epidemiological study was used for residents aged 60 years and older in Ji County, a rural county near Tianjin in Northern China. In phase 1 of the study, the Mini-Mental State Examination and Clinical Dementia Rating were administered for screening purposes. In phase 2, the subjects who screened positive were further examined by neurologists. A total of 5,744 individuals underwent the home visit interview, where demographic variables and comorbidities were recorded; 5,550 individuals completed the two phases. CIND was diagnosed by the Aging, Demographics and Memory Study on CIND criteria. The odds ratio (OR) for each risk factor was calculated by logistic regression analysis.

Results—The prevalence of CIND among those aged 60 years and older was 23.3%. The prevalence of CIND was lower among those with a higher level of education or social involvement. CIND was more prevalent in females, older individuals, those with a past history of stroke, and those living without a partner. Significant risk factors were found by multivariate analyses: past history of stroke (OR = 1.889; 95% CI: 1.437–2.483); being female (OR = 1.546; 95% CI: 1.305–1.832); and having no partner (divorced, widowed or single; OR = 1.250; 95% CI: 1.042–1.499). In turn, level of education (OR = 0.560; 95% CI: 0.460–0.681) and engagement in social activities (OR = 0.339; 95% CI: 0.258–0.404) were protective factors.

Conclusions—This is the first large-scale community-based epidemiological study assessing the prevalence of cognitive loss in the rural Chinese population. The total prevalence of CIND observed was 23.3%, which was higher than in other studies in Western and Asian countries. Living without a partner, female gender and previous stroke increased the risk of CIND, whereas a higher level of education and engagement in social activities reduced the risk of CIND.

Keywords

Cognitive impairment no dementia; China; Prevalence

Introduction

Parallel to the increasing age of the global population, the prevalence of cognitive impairment is likely to also increase in the coming years. However, the rate of increase across different countries will not be uniform: the numbers in developed countries will increase by 100% between 2001 and 2040, but by more than 300% in Asian and South American countries [1]. The speed of aging of the population in China is projected to be one of the fastest in the world.

The term ‘cognitive impairment’ includes individuals with dementia and those without dementia. The latter is also known as ‘mild cognitive impairment’ or ‘cognitive impairment no dementia’ (CIND). CIND and mild cognitive impairment are very similar concepts that describe syndromes seen in older adults encompassing a broad array of cognitive symptoms that are presumed to be governed by multifactorial causation [2, 3]. In some persons, this condition represents an early or prodromal phase of dementia and as such may offer a window of opportunity for early interventions to forestall or prevent dementia.

CIND includes all individuals suffering from cognitive disturbances not severe enough to satisfy the diagnostic criteria for dementia [2, 3]. It encapsulates the transitional states between cognitive integrity, subjective memory complaints and physiological mental aging prior to the development of dementia. Dementia patients are more likely to enter nursing homes and have an earlier (or higher) mortality rate than cognitively normal elders [4]. Understanding the epidemiology of CIND and dementia is crucial for an adequate planning of public health strategies and rational allocation of resources.

However, it has been difficult to determine the prevalence of CIND in the Chinese population. Of the few and small-scale studies available in China, many show considerable variation depending on their geographical location and the methodology employed [5–8]. The substantially higher risk of cognitive impairment in rural compared with urban populations is a matter of concern to the healthcare system in China as 50% of the population is found in rural areas. Our findings from numerous villages in a rural Northern Chinese county will provide useful epidemiological information and factors associated with CIND. The present study aims to estimate the prevalence of CIND in the rural population aged 60 years and older in Ji County (Tianjin, Northern China).

Subjects and Methods

Subjects

Ji County is in a rural area of Tianjin, a large city in Northern China, with 949 villages and a total population of 960,000 at the time the survey began. This study randomly selected 56 villages where most villagers are peasants and are cared for by the one practitioner present in their village. To be included in the study, subjects were required to have been living in the area for more than 5 years and to be legally residing in the county in 2011. The total number of participants aged 60 years or older in these villages was 5,744. However, due to hearing loss ($n = 112$), refusal ($n = 67$), death or migration ($n = 8$), or other reasons ($n = 7$), only 5,550 subjects finished the two-phase, door-to-door interview and were included in the study. The local practitioner in each village (working an average of 5.76 ± 3.23 years) was involved in identifying all individuals aged 60 years and older according to the date of birth on the residents' birth certificates. The study was approved by the ethics committee for medical research at Tianjin Huanhu Hospital and the Tianjin Health Bureau.

First Phase: Screening Interview

The sampled subjects were contacted directly by house visit. They were informed of the objective of the interview and welcomed to participate. Written consent was obtained, and the home interview was performed by at least 2 members of a team of 10 local practitioners who had obtained their medical licenses more than 5 years prior to the study. They were selected because of their willingness to participate in the study and ability to complete the at-home visits. Together, the team was trained by 2 neurologists who specialized in dementia and Alzheimer's disease in the Dementia Center at Tianjin Huanhu Hospital. The content of the training consisted of how to collect information and how to evaluate cognitive impairment. In addition to the demographic questionnaire, a personal and medical history, and a brief physical and neurological examination, all of the subjects were asked to complete the Chinese Mini-Mental State Examination [5]. Reliable informants (e.g. spouses, children, other relatives and close friends, in descending order) were asked to complete the Activities of Daily Living and Clinical Dementia Rating questionnaires [9] and to help provide the necessary information if the subjects could not provide the information themselves. Subjects with a Chinese Mini-Mental State Examination score under the cutoff points (i.e. 18 for illiterate persons, 24 for 1–11 years of education, and 27 for 12 years or more of education [6, 10]) and/or a Clinical Dementia Rating judged to be 0.5 or more were deemed eligible for the second stage of the study. The average duration of an interview was 40 min.

Second Phase: Neurological Consultation

Positive subjects were examined to confirm or exclude the presence of dementia or CIND. A home interview was performed again, but this time, 2 of 6 board-certified neurologists from the Dementia Center at Tianjin Huanhu Hospital performed the assessment. The 6 neurologists were trained together to ensure uniform neurological consultation across participants. A detailed medical history, physical examination and neurological examination were undertaken.

Criteria for CIND and Dementia

CIND was diagnosed as: (1) mild cognitive or functional impairment that did not meet the criteria for dementia or (2) performance on neuropsychological or functional measures below expectations and 0.5 standard deviations below published norms on any test [11]. Dementia was diagnosed according to the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition [12].

Statistical Analysis

The raw prevalence of CIND was calculated taking into account the total number of cases of CIND with respect to the total study sample. We calculated both overall and specific prevalence per age group, gender, residential situation, smoking and drinking status, comorbidities, engagement in social activities and educational level.

The continuous variables were expressed as means $\pm$ standard deviations, while frequency distributions were used for the qualitative variables. Logistic regression analysis was used to explore the sociodemographic and clinical factors independently associated with the presence of CIND. The data were analyzed using the SPSS version 16.0 (SPSS Inc., Chicago, Ill., USA).

Results

Out of the initial study sample of 5,744 subjects, 5,550 completed the two-phase interview (participation rate: 96.62%). There were 1,295 subjects diagnosed with CIND, 413 with dementia and 3,842 without cognitive impairment. On average, individuals with CIND were older than those without cognitive impairment (73.32 ± 7.55 vs. 67.89 ± 6.03 years; $p < 0.001$).

Table 1 shows the prevalence of CIND by sociodemographics and comorbidities. The prevalence of CIND was higher in women (26.1%) than in men (19.8%) and those with a history of stroke ($p = 0.018$). A sequential increase in prevalence was seen with older age ($p < 0.001$) and with fewer years of education ($p < 0.001$). The prevalence of CIND was lower among those who smoked ($p = 0.002$), drank ($p < 0.001$) or lived with a partner ($p < 0.001$).

Table 2 reveals that individuals with CIND, compared with individuals without cognitive impairment, are more likely to have less than 5 years of formal education, to live without a partner, to be less engaged in social activities ($p < 0.001$) and to have a past history of stroke ($p < 0.001$). Individuals with CIND were less likely to smoke or drink alcohol ($p < 0.001$) than individuals without cognitive impairment. No significant differences exist for hypertension, diabetes mellitus or heart disease.

Table 3 shows significant predictive factors found by multivariate analyses: past history of stroke (OR = 1.889; 95% CI: 1.437–2.483; $p < 0.001$), being female (OR = 1.546; 95% CI: 1.305–1.832; $p < 0.001$) and having no partner (defined as divorced, widowed or single; OR = 1.250; 95% CI: 1.042–1.499; $p = 0.016$). Protective factors for CIND were: having an education of more than 5 years (OR = 0.560; 95% CI: 0.460–0.681; $p < 0.001$) and engagement in social activities (OR = 0.339; 95% CI: 0.258–0.404; $p < 0.001$). A negative

and nonsignificant relationship was found between CIND and smoking (OR = 0.948; 95% CI: 0.770–1.167) and drinking (OR = 0.899; 95% CI: 0.705–1.146).

Discussion

Our study was the first large-scale, community-based epidemiological study of a rural population in Northern China. The findings show an overall CIND prevalence of 23.3% in individuals aged 60 years and older in Ji County in 2011. The prevalence was higher with age, female gender, low levels of education, low social engagement, a past history of stroke, and living without a partner. Significant risk factors were found by multivariate analyses, i.e. a past history of stroke and being female, while protective factors were having at least 5 years of education and engagement in social activities.

With limited data available regarding the prevalence of CIND in the Chinese rural population, adequate comparisons are difficult to make. Our estimated prevalence of CIND (23.3%) was higher than in other studies in Western and Asian countries [6, 10, 13, 14], but these previous studies had all included urban and rural populations or only urban populations. There was only one study performed in Beijing that found a slightly higher prevalence of 25.07% (1,048 of 4,180) in a rural population aged 65 years and older [15]. In Spain, two studies yielded a CIND prevalence of 23.3% in a rural zone [14] versus 13.8 and 14.7% in an urban setting [13, 14]. Similarly, in Beijing, Tang et al. [6] reported that CIND was more prevalent in rural than in urban locations (18.8 vs. 6.9%) among people aged 60 years or above. In Portugal, Nunes et al. [10] found cognitive impairment to be more prevalent in rural than in urban populations (16.8 vs. 12.0%). These studies show the rural-to-urban prevalence ratio varies between 2 and 3. Considering this ratio and that the prevalence of CIND in the Chinese population ranges from 5.32 to 17.7% [6–8], our finding of 23.3% falls within the expected range. Future studies should include both rural and urban subjects to better compare prevalence rates and clinical predictors of CIND.

There has been conflicting evidence regarding gender differences in cognitive impairment risk. In a meta-analysis, gender was independently associated with dementia risk in all regions other than North America and Pacific Asia [16]. In our study, the prevalence of CIND was higher in women than in men. This gender difference may be partly attributed to the greater number of men attending schooling before the 1950s in China. This difference was more pronounced in the rural setting than in the urban setting. With low education being a proven risk factor for CIND, this may partly account for women having a higher prevalence of CIND. Another contributing factor may be that Chinese women have a higher life expectancy than men (77.37 vs. 72.38 years in 2010). Despite these two factors, the multivariate analysis found female gender to be an independent risk factor for CIND. Other factors, possibly on a neurophysiological or hormonal level, may pre-dispose women to develop CIND and warrant further research.

A past history of stroke holds the strongest correlation with CIND and is an independent factor for CIND. Similarly, the study by Nunes et al. [10] in urban Portugal found that a previous stroke increased the risk of dementia. A recent review identified the strongest predictor of cognitive decline to be the occurrence of a second stroke [17, 18]. In people

with recurrent stroke, the risk of dementia rose to 30%, regardless of the number and severity of vascular risk factors they had been exposed to before the stroke [17]. However, compared with previous Western studies, the association between stroke and CIND is substantially weaker in the Chinese population. This may be explained by the lack of modern healthcare in rural China, thus resulting in a high mortality rate following the first stroke.

In accordance with previous studies, higher levels of education independently reduced the risk of cognitive impairment [19, 20]. For individuals with CIND in our study, 87.6% had less than 5 years of formal education, and 53.7% were illiterate. This study, with a baseline level lower than in other studies, showed that just 5 years of education is adequate to reduce the risk of CIND. One study found illiteracy-imposed restriction of the cognitive reserve to be a proven cause of early onset of dementia, with low-educated persons demonstrating less tolerance to the neuropathologic effects of dementia, having inadequate coping skills and presenting sooner [21]. Such differences have initiated investigations into the underlying biological mechanisms. A recent epidemiological study based on 875 autopsies revealed no protective effect of the years of education received in early stages in life in relation to the accumulation of neurodegenerative or vascular pathologies of the brain [22]. Further studies are needed to explore the mechanism by which the first 5 years of education alter the brain in a protective fashion.

Our study also revealed that engagement in social activities was inversely associated with CIND. However, in a cross-sectional study, it is unclear whether engagement in social activities is a preventive factor against cognitive impairment or whether individuals with a greater cognitive capacity are more likely to engage in social activities and are able to compensate once cognitive impairment has begun. The former is more likely, with longitudinal studies reporting that social relations reduce the risk of dementia [23] and promote longevity [24]. Moreover, transgenic mouse models of Alzheimer's disease housed in more stimulating environments than standard laboratory cages showed lower deposition of pathological β -amyloid in their brains [25]. In contrast, genetic twin studies suggest heritability between 60 and 80% in nonfamilial Alzheimer's disease [26]. Yet it is possible that the expression of a genotype may be strongly related to environmental factors. Imaging studies on healthy human volunteers have illustrated the effect of cognitively stimulating interventions on neural substrates [27]. However, ambiguity remains in the literature. Is it possible that this ambiguity is due to the fact that the measures of social interaction are too general and vastly different between studies? Perhaps future studies need to extrapolate the specific characteristics within social engagement that prevent cognitive impairment.

In our study, we found that living without a partner is an independent risk factor for CIND. The prevalence of CIND was much lower among those with a partner. Individuals with cognitive impairment were more likely to live without a partner than those who had no cognitive impairment. There were no similar data available from previous studies.

Our study found no significant association between prevalence of CIND and diabetes mellitus, hypertension or cardiovascular disease. This contrasts with the past findings that both hyperglycemia and hyperinsulinemia, as part of the process leading to type 2 diabetes

mellitus, are associated with cognitive dysfunction and dementia [28] . Similarly, hypertension has previously been associated with a higher incidence of dementia [29] ; however, the trials using antihypertensive medication have been inconclusive [30, 31] . Survival bias may explain the non-association of diabetes mellitus and hypertension with cognitive impairment, as these two factors are risk factors for cardiovascular disease [32] . Analysis of Framingham cohorts [33] showed that participants with hypertension and diabetes mellitus had higher rates of all-cause mortality than healthy individuals. It is likely that in our study and past studies, many of those with diabetes and/or hypertension, particularly men, would have died before the development of cognitive impairment [34] .

This study found drinking and smoking as nonsignificant protective factors for CIND. This study did not quantify the amount of alcohol. Cervilla et al. [35] found that cognitive impairment was not associated with use of alcohol, although there was a nonsignificant trend toward a protective effect against the onset of cognitive impairment for moderate drinkers compared with nondrinkers and heavy drinkers. In a recent meta-analysis, the relative risk of dementia for light-to-moderate drinkers compared with nondrinkers was 0.74 (95% CI = 0.61–0.91). It remains unclear whether the protective effect of moderate alcohol consumption is due to long-term consumption or a specific short-term benefit in late life [36] . Future epidemiological studies need to quantify the alcohol consumed. On the other hand, several recent studies have found that smoking significantly increases the risk of mental decline and dementia. It has been suggested that smoking increases dementia risk through oxidative damage or through atherosclerosis and other cardiovascular pathologies. Moreover, a survival bias may be present as both drinking and smoking increase the risk and death from certain cancers, cerebrovascular or cardiovascular diseases.

Consideration of these findings must take into account the limitations of this study. Phase 2 assessments and the diagnosis of CIND and dementia were not carried out by the same 2 neurologists for all participants, but rather by 2 from a team of 6 neurologists. As such, interobserver reliability may be affected. To minimize this bias and with the aim to ensure a uniform appraisal of interviews, all 6 neurologists met before and after each weekend in the rural villages. Among the strengths of the study, the door-to-door invitation to participate in the study, though necessary in a village with no postage, resulted in personal introduction and a low refusal rate. The study cohort would permit a longitudinal evaluation of CIND, and the long-term results will aid in identifying the characteristics of those with CIND who later develop dementia and the clinical progression of both diseases.

Conclusions

To our knowledge, this is the first large, community-based epidemiological study assessing the prevalence of cognitive loss in a rural Chinese population. The raw prevalence of CIND observed among those aged 60 years and older was 23.3%. The prevalence of CIND was higher among those who lived without a partner, were female or had a previous stroke, whereas a higher educational level and engagement in social activities reduced the risk.

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Table 1

Prevalence of CIND by sociodemographics and comorbidities

	Number	CIND, n	Prevalence, %	p
Total	5,550	1,295	23.3	
Gender				0.000 (30.98)
Male	2,467	489	19.8	
Female	3,083	806	26.1	
Age				0.000 (1,016)
60–65 years	1,677	201	12.0	
66–69 years	1,390	240	17.3	
70–74 years	978	264	27.0	
75–79 years	871	296	34.0	
80–84 years	447	209	46.8	
85–89 years	151	70	46.4	
90+ years	36	15	41.7	
Education				0.000 (391.2)
0 years	2,217	695	31.3	
1–5 years	2,017	439	21.8	
6–8 years	981	137	14.0	
9+ years	335	24	7.2	
Smoking				0.002 (9.913)
Yes	1,366	276	20.2	
No	4,184	1,019	24.4	
Drinking				0.000 (19.377)
Yes	948	169	17.8	
No	4,602	1,126	24.5	
Lives with a partner				0.000 (110.0)
Yes	4,505	922	20.5	
No	1,045	373	35.7	
Engagement in social activities				0.000 (145.6)
Yes	4,637	941	20.3	
No	913	354	38.8	
<i>Comorbidities</i>				
Hypertension				0.855 (0.033)
Yes	2,118	497	23.5	
No	3,432	798	23.3	
Diabetes mellitus				0.172 (1.865)
Yes	390	80	20.5	
No	5,160	1,215	23.5	
Past history of stroke				0.018 (5.594)
Yes	382	108	28.3	
No	5,168	1,187	23.0	

	Number	CIND, n	Prevalence, %	p
Heart disease				0.462 (0.542)
Yes	425	93	21.9	
No	5,125	1,202	23.5	

Values in parentheses denote χ^2 values.

Table 2

Comparison of the group without cognitive impairment with the CIND group by sociodemographics and comorbidities

	No-CI, n	CIND, n	p
Total	3,842 (69.2%)	1,295 (23.3%)	
Education			0.000 (148.4)
0–5 years	2,712 (70.6%)	1,134 (87.6%)	
>5 years	1,130 (29.4%)	161 (12.4%)	
Smoking	1,006 (26.2%)	276 (21.3%)	0.000 (12.289)
Drinking	734 (19.1%)	169 (13.1%)	0.000 (24.505)
No partner	515 (13.4%)	373 (28.8%)	0.000 (160.6)
Engagement in social activities	3,432 (89.3%)	941 (72.7%)	0.000 (212.4)
Comorbidities			
Hypertension	1,448 (37.7%)	497 (38.4%)	0.658 (0.196)
Diabetes mellitus	280 (7.3%)	80 (6.2%)	0.176 (1.832)
Past history of stroke	196 (5.1%)	108 (8.3%)	0.000 (18.242)
Heart disease	289 (7.5%)	93 (7.2%)	0.686 (0.163)

Values in parentheses denote χ^2 values unless specified otherwise. No-CI = No cognitive impairment (CIND or dementia). p value: statistically significant differences between the 2 groups.

Table 3

Variables significantly associated with total CIND versus no cognitive impairment

	B	OR	p
Gender – female	0.436	1.546 (1.305–1.832)	0.000
Past history of stroke	0.636	1.889 (1.437–2.483)	0.000
No partner	0.223	1.250 (1.042–1.499)	0.016
Smoking	–0.053	0.948 (0.770–1.167)	0.616
Drinking	–0.106	0.899 (0.705–1.146)	0.390
Engagement in social activities	–1.082	0.339 (0.258–0.404)	0.000
Education (>5 years)	–0.580	0.560 (0.460–0.681)	0.000

Values in parentheses denote 95% CI.